OPEN SCIENCE INDIA REPORT

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CONTENTS

FOREWORD

As a young institution established in 2008, National Law University Delhi (NLU Delhi) has always tried to cultivate an institutional atmosphere enabling high quality research with sound social relevance. When the Centre for Innovation, Intellectual Property and Competition (CIIPC) started its journey in 2016, I was excited to witness its growth, especially in areas of meaningful interdisciplinary and empirical research. In that respect, I believe that the project on open science has made a sincere attempt to analyse complex underlying concepts and behavioural aspects, and contribute to significant contemporary debates in this area from a Global South perspective.

The open science movement has attained great significance, especially in an era of big data and artificial intelligence (AI). Many of the decision-making roles traditionally played by humans are getting rapidly transferred to machines. However, contrary to the popular perception that machines are neutral, without the fullest possible access to diverse data, outputs of such technologies are likely to suffer from various biases. In other words, machines may just reflect and in some cases amplify the biases inherent in the data fed to them. Therefore, the scale and scope of possible detriment caused by lack of openness, accessibility, and diversity are likely to be vastly different and much greater than in past decades. It is also important to note in this context that issues of socio-economic exclusion that have existed for ages have not been sufficiently addressed- and in some cases, have become further entrenched in practice. Moreover, experiences unique to countries from the Global South have not been discussed with sufficient prominence in global discussions surrounding open science.

Given the immense social relevance of the open science project in this context, NLU Delhi has tried to facilitate the efforts made by the entire team at CIIPC as far as possible. Our students have actively participated in diverse aspects of the project, and I am happy that apart from honing their research skills and giving them knowledge about latest developments in diverse open movements and intellectual property laws across the globe, this project has exposed them to the importance of neglected aspects such as knowledge sharing, research ethics, and alternative evaluation metrics.

In its own capacity, NLU Delhi has tried to make knowledge more accessible by encouraging faculty participation in developing free online courses on the 'SWAYAM' platform initiated by the Ministry of Human Resource Development (MHRD) and the All India Council for Technical Education (AICTE). Through the University Legal Aid Cell, our students also make consistent efforts to make legal knowledge and assistance more accessible to the local community. However, I must stress on the importance of further discussion and action by institutions and all other stakeholders in the research ecosystem, to make open science a reality.

It is in this context that NLU Delhi and CIIPC are releasing this report, with the hope that the readers are motivated to think seriously about important issues surrounding scientific research and open science; and are stirred into further research and discussions, and pertinent action in personal and collective capacities. In the past two years, CIIPC has made impressive strides in research and communication on important aspects of science, innovation, intellectual property rights, and competition law, and I believe that it will reach further heights in the times to come.

Prof. (Dr) Ranbir Singh
Vice-Chancellor
National Law University Delhi

ACKNOWLEDGMENTS

Collaboration and mutual learning are two hallmarks of open science. In many dimensions, our study on open science in India, and this report which summarises the major findings from the study, is a good illustration of how collaboration and mutual learning among people working in very different spheres are important in research. While it is nearly impossible to mention here all those who have contributed to this study, it is important to acknowledge a few of them.

First of all, I must thank all the students at National Law University, Delhi (NLU Delhi) who were part of this project at its different phases, including literature review, survey design, data collection, and the editing of this report. Most of them worked for countless hours after their classes on a voluntary basis, without any monetary remuneration. The primary motivation that drove them towards this project was the desire for seeing a change in the Indian society with regard to the way knowledge is shared and created. Many interns from other institutions also contributed to this project with similar motivation and spirit. While one may see most of their names in the contributors page, we might have missed many names, in view of the large number of students involved at different phases of the project. My hearty thanks to all of them for being the core strength of this project.

An interdisciplinary work like this would not have been possible in a law school in the absence of a supportive research eco-system. I must thank in particular Prof. Ranbir Singh (Vice-Chancellor, NLU Delhi), for his vision and efforts in making research a priority at NLU Delhi. Many of the excellent research outputs NLU Delhi has produced in a very short span of time illustrate the extent of support and guidance researchers at this institution have received from Prof. Singh. I must also thank our Registrar, Prof. G. S. Bajpai, for his whole-hearted support for this project and his constant encouragement for empirical research. All my colleagues at NLU Delhi, particularly Mr Yogesh Pai, Co-Director of the Centre for Innovation, IP and Competition (CIIPC), deserve to be thanked for their constant support for this project.

While all my current/ former colleagues at CIIPC need to be thanked for their continued support, three of them deserve special mention here. I must thank Ms. Rishika Rangarajan, who was a Research Fellow at CIIPC during the initial phases of this project, for all the support she has given for the project through extensive literature reviews, survey designing, and data collection. Mr Satheesh Menon is an economist by training, and his insights played a substantial role in not just improving the questionnaire used for the survey and the data analyses, but also in refining the overall methodological framework of the study. Ms Shreyashi Ray deserves special appreciation for taking care of each and every minute detail of the project and this report at all stages. She played an important role in the overall coordination for the project, particularly in ensuring that tasks are completed on time, and with utmost attention. Her passion for working towards social justice has had tremendous influence not just in many parts of this report, but on everyone who worked on this project, including me.

If this report is aesthetically pleasing, all credits should go to Ms Rajshree Saraf, our designer. She was selected through a national competition which was open to students and recent graduates from across the country. She is one of those unique artists in whose work one can see a fine blend of artistic skills and critical thinking. Her thoughtful feedback at different stages ensured that the text improved substantially, in terms of readability.

This study has also benefitted immensely from the diverse interviews we conducted as part of this study. I would like to thank in particular Prof. Aditya Bhattacharjea (Professor, Department of Economics. Delhi School of Economics, University of Delhi), Mr Amit Sengupta (Public Health Specialist, Delhi Science Forum), Prof. Anil K. Gupta (Founder, Honey Bee Network), Dr Anindya Chatterjee (Regional Director, Asia, International Development Research Centre), Prof. Aravind Kasthuri (Department of Community Health, St John's Medical College), Prof. C.N.R. Rao (Former Chairman, Science Advisory Council to the Prime Minister of India), Prof. Gajendra Pal Singh Raghava (Head, Bioinformatics Centre at the Institute of Microbial Technology, Indian Institute of Technology Delhi), Mr Sree Harica (Research Associate, Samata and mines, minerals & PEOPLE), Prof. Jayant Murthy (Professor, Indian Institute of Astrophysics), Prof. Jaykumar Menon (ISID Professor of Practice, Mcgill University, Canada; Director, Open Source Pharma Foundation), Dr Kalyan Chakravarthy Kankanala (Founder, BananaIP Counsels, Bengaluru), Mr KR Murali Mohan (Head, Big Data Initiative, Department of Science and Technology, Government of India), Prof. Madhav Gadgil (Founder, Centre for Ecological Sciences, Indian Institute of Science, Bengaluru), Mr Moses Chowdary Gorrepati (EnAble India), Dr Neelam Kumar (Former scientist, National Institute of Science, Technology and Development Studies, Delhi), Ms Nirmita Narasimhan (Policy Director, Centre for Internet and Society), Dr Om Parkash Bhuraita (Himachal Gyan Vigyan Samiti; Director, State

Needless to say, while we have tried our best to make this report as comprehensive and error-free as possible, it may still have many limitations and may even contain some errors. Any such error or limitation should not be attributed to any of the names mentioned here. Your critical feedback is important to improve this work- only through such feedback can we truly practise open science. I therefore encourage all readers to share their feedback by email, and welcome you to this report.

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EXECUTIVE SUMMARY

There is increasing realisation across the world that science is going through a severe crisis. The cyclical stages of science - production and consumption - are riddled with many interconnected issues relating to accessibility, transparency, reliability, quality, inclusiveness, and social relevance. Existing incentive structures and publication models foster research that is primarily driven by the motivation to publish research outputs in 'reputed' journals; without sufficient regard to the quality, relevance, and reach of science. As a result, there is inordinate focus on the number of publications in such journals, sensational findings, and validation from a closed, formal scientific community, that too primarily from the Global North.

Many of the current approaches also create a deficit of trust, sharing, and collaboration among and by scientists. Disclosure of detailed data (including negative results and errors) and conflicts of interest, studies focusing on replication of findings and socially relevant issues, collaboration, and sharing thus receive insufficient attention. Many of the journals in which research is published are paywalled in a way that the content can be accessed only by financially privileged institutions and individuals. Accessibility is also hampered due to lack of facilities enabling mobility and access to resources for persons with disabilities. Other socio-economic barriers such as gender, caste, geography, language, etc. further hinder meaningful participation in knowledge creation. Owing to these diverse factors, coupled with the disdain of the formal scientific community towards traditional or informal systems of science/ knowledge, a significant distance has been created between science and society. Moreover, dissemination of knowledge has also been hampered due to insufficient usage of formats and media which increase accessibility and usability of research outputs.

Various movements such as open access, open data, and open source software, as well as people's/ citizen science movements, have sought to address different facets of the crisis in science. However, most of the initiatives within 'open' movements focus primarily on the consumption stage of science. In contrast, open science is a global movement which includes not only the mentioned movements, but also focuses on the creation of an inclusive ecosystem for the production of science - and an inclusive definition of the term 'science' itself. However, it needs to be specifically mentioned here that the term 'open science' does not have a universally accepted definition; many people have defined the term in numerous different ways. Based on an extensive review of diverse definitions of 'open science', we have tried to come up with a more inclusive definition. We define 'open science' as- "scientific inquiries wherein the characteristics of accessibility, transparency, usability, and non- or minimal existence of IP restrictions, are evident and exist throughout all stages of research. It is also characterised by openness to inclusiveness, collaboration, constant and continuous transfer of knowledge between producers and users of knowledge, and prioritisation of research and innovation based on social needs."

While 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 severe crisis in almost all the aspects discussed above, and it is unfortunate that appropriate action has not been taken for addressing the crisis in science in India in a holistic manner. It is in this context that the Centre for Innovation, IP and Competition (CIIPC), decided to initiate a project for identifying the optimal legal and policy measures

for a strong and sustainable open science movement in India. In order to formulate legal and policy recommendations that would help foster open science in India in a sustainable manner, we intentionally took a bottom-up approach that focuses on arguably the most important stakeholder - researcher. In this context it was important for us to assess and analyse the attitudes and practices of researchers regarding sharing of research outputs, transparency, collaborations, and replication. For this, we conducted a survey among researchers working in institutions located in India, across multiple disciplines. We also analysed the existing and past policies, diverse 'open' initiatives, and citizen science/ people's science movement in India. Some of the important data on the nature of compliance and current implementation of different open policies of the Government were collected through applications filed under the Right to Information Act, 2005. Further, we conducted interviews with diverse stakeholders in the area for a more comprehensive understanding of the diverse issues and challenges for the open science movement in India. This report summarises the major findings from our study.

The first chapter of this report provides a broad description of the crisis in science and contextualises the need for open science. The second chapter gives an overview of the existing initiatives in India within the broader open science umbrella and their limitations. The third chapter gives an account of the findings of the empirical survey that we conducted among researchers in India. On the basis of the contents of the first three chapters, the fourth chapter provides some legal and policy recommendations- with details of the relevant steps that can be taken by different stakeholders- which we believe are crucial for open science.

Our research indicates that although some efforts have been made in India in areas like open access, open data, open educational resources, and citizen science; systemic, holistic, and synchronised shifts required for open science are still lacking. Moreover, the existing initiatives and policies suffer from inadequacies and limitations with respect to scope, content, and implementation. For example, the Department of Biotechnology (DBT) and Department of Science and Technology (DST) Open Access Policy mandates the setting up of institutional repositories and the sharing of research outputs in open access modes for research supported by DBT/ DST; but makes its mandates subject to the law and funding agency/ institutional policies. Relying primarily on data collected through applications filed under Right to Information Act, 2005 we found that information about these mandates are not communicated to many of the relevant researchers/ institutions, and monitoring/ compliance procedures are not followed or enforced. Similarly, the existing policies on government data impose inordinate

restrictions on access and use of such data, which are not subject to any transparency requirements. Usage and access restrictions have been observed in various open educational resources platforms as well. Apart from specified restrictions, findability issues and problems of uncertainty, irregularity, and non-continuity have been observed in many of these initiatives.

The findings of the survey conducted among researchers working in India also paint a bleak picture of the status quo. For example, although a majority stated that open science is important for research (89.74%) and agreed that the outputs of publicly funded research should be accessible (91.96%); only a minority seems to be sharing publications (35.07%) or data (8.41%) through open access repositories. In fact, among the respondents who stated that they have relied upon openly available publications on the internet for their research, only 36.74% share through open access repositories, while the percentage in the case of data is 31.78%. This contrast becomes even more stark when one notes that 42.47% of the respondents stated that the prospect of 'contribution to society/ addressing social needs' influenced their decision to become a scientist or a researcher.

As this study indicates, it is important to understand that such attitudes and practices arise in a context where existing incentives and mechanisms- including evaluation systems, publication models, and institutional/ funding agency policies- may not be assigning much value to knowledge sharing. When asked about their perception as to the benefits of sharing publications or data, highest percentage of survey respondents said that they received no benefits (publications- 42.8%, data- 60.84%). While unwillingness and inability to fund article processing charges (charges demanded by publishers to publish articles in open access modes) were stated as the most important factors discouraging respondents to make their articles openly accessible (42.75% and 28.26% respectively); 44.19% stated that they would be willing to make their data openly accessible only when all research and publications based on those data are completed. Similarly, transparency disclosure practices of respondents and other researchers in their respective institutions indicate grossly insufficient focus on the same. Among the respondents, only 37.77% regularly publish negative results, and only 29.74% of them believe that other researchers working in their institution routinely share the same.

Two of the factors studied to gauge the level of inclusiveness relating to persons with disabilities were - intra-institutional facilities enabling inclusion of persons with disabilities within the institution, and measures implemented for enabling access by such persons to research outputs produced in the institution. Our data indicates that

although many institutions have started providing ramp (71.76%) and wheelchair (55.48%) facilities, provision of Braille textbooks (11.3%) and audiobooks (18.27%) is rarer. Moreover, a large majority of respondents (76.82%) were unaware of institutional measures to ensure that research outputs produced in the institution are accessible to people with disabilities, which indicates insufficient orientation towards important inclusion issues. Another dimension of inclusiveness specifically studied by the survey was linguistic accessibility and comprehensibility. Our data indicate that 30.63% of the respondents have never shared any simplified versions of their research findings, while 29.19% do so only rarely. Similarly, a vast majority of the respondents (78.85%) have never shared translated versions of their research in regional languages. These findings present a state of affairs that deserves concern and concerted efforts to effect better inclusion.

The reproducibility crisis is reflected in our survey findings as well. 49.07% of the respondents agree that the failure to reproduce scientific studies is a major problem in their field. Most of them stated that selective reporting of scientific results is a relevant factor contributing to this problem (86.11%). Insufficient peer review (83.92%), low or poor statistical analysis of original findings (82.04%), and insufficient oversight/ monitoring by principal investigator (80.86%), were selected as the other prominent contributing factors.

As mentioned previously, these attitudes and practices are part of a larger context where openness is not adequately prioritised by guiding policies. Most respondents reported absence of or ignorance regarding funding agency or institutional mandates for disclosure of research methodology, research tools, negative results, errors in research, errors in data, and other limitations. This indicates that these policies are either non-existent or inadequately monitored by the respective institutions or funding agencies. Further, when asked if they were aware of any specific policies by the institution/ funding agency/ government with regard to open access to publications or data, only 43.65% respondents answered, which may indicate non-existence of open access policies. 42.14% respondents stated that they do not know if their funding agency takes measures to monitor policy compliance, while 10.71% said that no such measures are taken.

Interestingly, most of the respondents stated that they are satisfied with these existing rules. 44.89% of the respondents have never made an attempt to change the institutional rules or practices regarding what research is taken up, 40.61% have not made such attempt regarding the way in which research is conducted, and 44.13% have not tried to change rules or practices regarding dissemination of research outputs. While it may not be reasonable to expect all individuals to lobby for

changes, it is worrying to see that as many as 21.76% have never felt the need to change rules/ practices regarding selection of research, while 21.16% and 21.37% have never felt this need regarding conduct and dissemination of research respectively.

In this context, where science is suffering from a crisis but perceptions towards various facets of openness range from apathy to disdain, measures must be taken by all stakeholders in the knowledge creation ecosystem to challenge and change the status quo. The first and foremost step in this regard would be to create awareness regarding the need for open science, and the ways in which all stakeholders can work in their capacity to effect the same. Making openness a priority in science and education policies is also crucial. This must include mandates for open access to publicly funded research, and focus on creating shared resources- be it in terms of online resources; or libraries, laboratories, and collaborative spaces.

We also need to revisit our intellectual property laws and the IPR policies. Instead of perceiving IPR as the sole tool for fostering innovation and creativity, we must look at IPR as just one of the avenues towards the same. Therefore, if any provisions in IP laws hinder innovation or creativity by inordinately hindering access to knowledge, or restrict the public's right to access knowledge or infrastructure funded by themselves, suitable exemptions and exceptions must be introduced. In the context of Copyright law in India, the study recommends replacing the fair dealing exception with the broader fair use exception. The study also recommends including a specific exception for text and data mining. Moreover, specific clarification regarding authors' right over preprints is important in a context in which restrictions on the same are imposed by publishers or perceived by authors.

The unfair access and usage restrictions in the existing open data policies of the government must also be removed. This, of course, should be complemented with suitably robust policies on privacy and data protection. Moreover, since open science focuses on larger inclusion of producers and consumers of science within the research ecosystem, broader reforms are important at all stages of education and law/ policy to ensure that socio-economic barriers on lines of gender, caste, disability, etc. are alleviated.

In order to increase accessibility, robust open access and open data policies and practices are important. Other steps include development and adoption of open source software, making designs of hardware open, creating and regularly updating institutional and disciplinary repositories, and sharing research outputs under open licences so that usage restrictions are clear to the users and the research can be

meaningfully accessed and used. Moreover, library networks and open laboratories should be created to foster equitable access to resources. Facilities that foster accessibility for persons with disabilities, such as audiobooks, flexible leave policies, screen-reading software, etc. should be funded and made available. Further, language of scientific communication should be freed from unnecessarily complex jargon; and researchers should be encouraged to share simplified and translated versions of their research to maximise the reach of their work. The formats in which research outputs are made available must also be machine-readable, interoperable, and accompanied by adequate metadata, to ensure usability and searchability.

Focus needs to be diverted from sensational or "attractive" findings to transparent and socially relevant research. Transparency mandates should be enforced to reduce chances of bias or fraud in the results, and enhance scope for public scrutiny of research. Replication studies also deserve more attention. Open and meaningful public consultation, suitable forms of peer review, intra- and interdisciplinary collaboration, and sharing of intermediate processes or findings through open labnotes, are crucial for improving quality of research and transparency as well as ensuring diversity of perspectives in scientific research.

The existing elitist disdain of the 'mainstream' scientific community towards grassroots science and informal knowledge must also be addressed. Meaningful interaction and engagement of diverse knowledge systems, and fair credit sharing, are important in this regard.

Further, compliance with institutional/ funding agency/ government policies regarding open access, transparency, shared infrastructure, collaboration, etc, should be suitably monitored by the relevant bodies, and appropriate sanctions must be implemented.

Criteria used by policymakers, institutions, and funding agencies to evaluate researchers' performance must be amended to include sharing practices, social relevance of research, and compliance with open access/ open data/ transparency policies. This is because, unfortunately, most institutions currently focus only on number of publications/ patents/ academic conferences, etc. and journal-based metrics such as impact factor. Apart from modifying evaluation criteria, the power enjoyed by commercial publishers who impose charges on authors as well as users of research without commensurate value-addition (apart from the reputation associated with their name) should also be addressed by re-thinking publication models. In this regard, we suggest that professional societies and institutions can be self-sufficient as publishers, and administrative and other transaction

costs may be borne by funding agencies if necessary.

As a cautionary note, we must also add that in order to achieve the goals of open science meaningfully in the Global South, we may also have to look at the infrastructure-related challenges prevalent in the Global South. Many of the Global North assumptions regarding convenience, speed, and negligible cost of the internet for sharing and collaborating may not be applicable in this context. Therefore, adequate focus on print media, physical infrastructures and interactions, and television/ radio communication is also necessary in the Global South context.

Through this report, we hope to bring attention to the existing problems in science, urge the readers to think critically about the same, and hopefully motivate them to effect change in their own capacity - towards more 'open' science.

01

Open Science:
A Response to the Crisis in Science?

I

'Meat eaters are more selfish and less social than vegetarians!'

'Untidy environments increase people's racist tendencies!'

WHAT DO YOU THINK OF THESE STATEMENTS?

What if this was claimed by a renowned scientist based on research data? Would it make a difference if this scientist was a dean of the social and behavioral sciences faculty at a reputed university?

AUTHORED MORE THAN

fifty

AND FABRICATED DATA IN AT LEAST

thirty

RESEARCH PUBLICATIONS

Diederik Stapel, former professor of social psychology at Tilburg University, has authored more than 50 research publications. Many of his research findings attracted mainstream media coverage, and were relied upon by various groups to advocate their causes. He also supervised doctoral and postdoctoral research of many scholars who relied upon his data for their research.

The success of all his experiments elicited amazement from his colleagues which slowly grew into suspicion due to his reluctance to reveal raw data. Eventually, a complaint by two of his students led to an investigation in 2011, which revealed that the data used in at least 30 of his publications were fabricated. Interestingly, Stapel had even made up the existence of a person in charge of data collection for some of his research!

"People think of scientists as monks in a monastery looking out for the truth. People have lost faith in the church, but they haven't lost faith in science. My behavior shows that science is not holy."

Diederik Stapel

II

When people look at us, the visually impaired, they either think of us as poets or in the arts field or as unemployed. But I don't want that.

Anoop had always been determined to free himself from stereotypical social expectations regarding persons with disabilities. Since the time he decided to become a lawyer, he has devoted long hours and immense efforts towards fulfilling his dream. However, there were many obstacles he had to overcome just to get into law school. For example, in the logical reasoning part of the law entrance exams, one is taught to draw Venn diagrams for syllogisms. For answering such questions, a person with visual challenges is limited to imagining these diagrams. In Anoop's words, "If a question comes which has 6-7 statements, you have to hold your imagination till the last sentence is read out to you; it is very difficult." Inadequacy of time to finish the paper and test centres with limited accessibility options were also significant challenges to him on the examination day.

Anoop successfully overcame those challenges and is currently pursuing his B.A., LL.B. course at National Law University, Delhi. But does he have equal access to knowledge resources? While his law school has taken several steps to increase access for students with visual impairment, some significant challenges remain unaddressed. For example, although he is now able to access international databases like Westlaw, some of the prominent Indian legal databases are still not available in accessible formats. Similarly, while the scanner procured by the university library has increased his access to books, does he have access to all the library books? Would this affect his ability to consume and produce research? How does such exclusion impact science?

III

RISING AWARENESS ABOUT THE LINKAGE OF SUGAR TO HEART DISEASE

1967

"Saturated fat and cholesterol - the dietary culprits of heart disease"

- The New England Journal of Medicine (NEJM)

Research funded by the
Sugar Research Foundation (SRF)

In 1967, the New England Journal of Medicine (NEJM) published a paper on the key causes of heart disease, written by some eminent scientists at Harvard. This paper, which influenced public health approaches to nutrition for years, highlighted that saturated fat and cholesterol were the dietary culprits of heart disease. But years later, it was revealed that those scientists were funded by the then Sugar Research Foundation (SRF), whose membership comprised primarily of sugar manufacturers. SRF had set the objective for the research, and was intimately involved in the review process before publication. It has now been realised that this research was in response to rising awareness about the linkage of sugar to heart disease, which is why the scientists glossed over this linkage and highlighted other factors instead.

At the time of publication of the paper, NEJM did not impose any requirements to include conflict of interest statements in the publication. Would the readers of NEJM and health experts have trusted the findings, had they been aware of the involvement of SRF in the funding process?

IV

Reproducibility of results is generally considered as a fundamental aspect of science. The general perception is that most scientific theories are testable by anyone. Is this reflected in reality?

Interestingly, in 2016, an anonymous survey conducted by *Nature* revealed that over 70% of researchers could not reproduce experiments by other scientists. These researchers were from various fields such as Chemistry, Engineering, and Medicine. Why is this happening? What explains the high rate of failures in this regard? Is it because of inefficiency of the scientists or manipulations in data/ methods? Could this be due to selective reporting of experiments?

Over 70% of researchers could not reproduce experiments by other scientists

Is there something common in the above examples?

These examples are multifarious symptoms of a major crisis in science. It is even more concerning when one realises that neither are the incidents isolated, nor do they capture the entire gamut of the crisis.

WHAT IS SCIENCE?

SCIENCE ANTHROPOLOGY,
ARCHAEOLOGY, ARTIFICIAL
INTELLIGENCE, ASTRONOMY,
BIOLOGY, BIOETHICS,
BIOINFORMATICS,
BIOMEDICAL ENGINEERING,
BIOSTATISTICS, BOTANY,
CHEMISTRY, COGNITIVE
SCIENCE, COMPLEX
Science is the systematic
LINGUISTICS, COMPUTER
enterprise of gathering
knowledge about the
CULTURAL STUDIES,
universe and organizing and
ECONOMICS, ENGINEERING
ENVIRONMENTAL
condensing that
STUDIES, ETHNIC
knowledge into testable
PSYCHOLOGY, FORENSICS
laws and theories
HISTORY, INTERNATIONAL
LAW, LIBRARY SCIENCE,
LINGUISTICS, LOGIC,
MATHEMATICS, MEDICINE,
NEURAL ENGINEERING,
POLITICAL SCIENCE, PHYSICS,
PSYCHOLOGY, SOCIOLOGY,
SCIENCE STUDIES, SCIENTIFIC
MODELLING, SEMIOTICS,
SOCIOBIOLOGY, STATISTICS,
SYSTEMS SCIENCE,
THEORETICAL BIOLOGY

Most of us are likely to answer the above question by mentioning some specific disciplines- Physics, Chemistry, Biology, Mathematics, *etc.*- that have been *traditionally* associated with science. However, some point out the incompleteness of this understanding, and its failure to clarify the fundamental values or principles of science.[1]

The American Physical Society has suggested one of the most comprehensive definitions of science:

"Science is the systematic enterprise of gathering knowledge about the universe and organizing and condensing that knowledge into testable laws and theories.

The success and credibility of science are anchored in the willingness of scientists to:

a. Expose their ideas and results to independent testing and replication by others. This requires the open exchange of data, procedures and materials.

b. Abandon or modify previously accepted conclusions when confronted with more complete or reliable experimental or observational evidence."[2]

This definition is inclusive of fields other than those which are traditionally associated with science. Moreover, it highlights values of openness and mutual learning as crucial to the practice of science.

In other words, scientists should share their research freely without restrictions, and be ready to accept contradictory views and beliefs if presented with appropriate evidence.

For the purpose of this report, we have used the word 'science' as per this definition. If we make a reference to the fields traditionally associated with science, we will explicitly make that distinction.

CRISIS IN SCIENCE

The current crisis in science is a result of multiple factors which get manifested in two stages:

- PRODUCTION OF SCIENCE
- CONSUMPTION OF SCIENCE

These stages of science are co-dependent, and in many cases difficult to differentiate.

However, for ease of understanding, we will be categorising the different aspects of the crisis as they occur in production and consumption of science. While most of these problems are global in nature, for the purpose of this report, we will be discussing them in the Indian/ Global South context, wherever possible.

CRISIS IN THE PRODUCTION STAGE

I. Publish *and* Perish

Like most other parts of the globe, the research culture in India faces a widespread problem - research is publication-driven, and not driven by desire for scientific/ social progress. This is born out of immense pressure faced by researchers to publish consistently to progress in their careers.

Globally, the desire among researchers to publish only in prestigious journals, reduces the incentive to conduct research in areas not covered by these journals. The same problem exists in varying degrees in the Global South. An additional problem in the Indian context is the focus on the number of publications rather than their quality. There is insufficient encouragement to engage in quality research, both in educational and occupational spheres. This problem is exemplified by the Academic Performance Indicators

(API) developed by the University Grants Commission (UGC) in India for assessing career advancement applications of academicians. As a consequence, researchers primarily engage in research that can be completed within a short time period. This, coupled with the insufficiency of ethical checks in the system, promotes problems like careless data analyses and high rates of plagiarism.[3]

Even in cases where the quality of research is given due importance by an institution, external funding agencies can play a role in framing the research agenda. This was observed in the case of the NEJM paper discussed earlier. Many public institutions in India such as the Council of Scientific and Industrial Research (CSIR) have been facing serious shortage of funds. As a result, research funding by such institutions has reduced considerably. In June 2017, the chief of CSIR sent a letter to the CSIR laboratories indicating that the researchers would need to look elsewhere for funding their research. Predictably, researchers will now have to depend on private funding agencies whose commercial interests may influence research. Have institutions, funding agencies, and researchers taken sufficient measures to address potential conflicts of interest?

The answer is a clear "no".

We must also add that for better science, we need more replication studies. These studies are important to confirm the accuracy of research findings, and to test whether the results of the research are consistent irrespective of the conditions.

In the current research ecosystem, such studies receive low priority as they do not necessarily bring out eye-catching

For better science, we need more replication studies to confirm the accuracy and consistency of research findings

outcomes.[5] It is extremely difficult to find any research institution or funding agency in India that actively promotes replication studies. Replication studies also don't receive any weightage in the academic performance indicators. If there are no incentives for researchers to engage in replication studies, how do we know whether the results published through numerous journals can be replicated?

Till the time we address these fundamental issues in the research ecosystem, science will perish, and not be enriched, through publications.

REPLICATION STUDIES
REPLICATION STUDIES
REPLICATION STUDIES
REPLICATION STUDIES

Reproduction of research refers to the analysis of raw data from a previous experiment to verify whether the same results as concluded by the original researcher(s) can be obtained by others. Replication studies require repetition of the same experiment and collection of data in a similar manner. Replication of research can also be done to test if the same results can be obtained in a different but similar set of conditions.[4]

II. Lack of Transparency

Lack of transparency is one of the major challenges in the production stage of science. This manifests itself in many ways including non-disclosure of details like source of funding, methodology/ data, and negative results.

Very few researchers reveal the source of funding, or affiliations/ connections and other factors, which may lead to conflict of interest and affect their research. Recently, Campaign For Accountability (CfA) alleged that many US-based researchers did not disclose the funding received by them from Google on publications/ submissions which support Google's business and policy interests.[6] Ironically, CfA has also refused to disclose its funders. Some of the consequences of non-disclosure of such information have been illustrated by the NEJM example which has been discussed earlier.

Similarly, methodology employed for research and data underlying research findings, remain undisclosed in many cases. Stapel's case, as discussed earlier, is clearly indicative of the same. The fame that "perfect" or sensational research findings bring to a scientist can be difficult to resist in the absence of foreseeable consequences. Needless to say, this has far-reaching consequences on not just the quality of science produced by the researcher in question, but also on any work done on the basis of such findings. This could be in the form of further scientific research, public debates, or policy making. In Stapel's case, the validity of the educational qualifications attained by the scholars who relied upon the datasets he had fabricated, was brought into question!

Data shows that the Indian pharmaceutical company Ranbaxy hasn't published any of the eligible trial data during that time period, while 52.1% of trial data is missing in the case of University of Washington.[8]

If there are strong requirements with regard to transparency in methodology/ data, the likelihood of such incidents can be reduced.

Another issue is the lack of incentives for sharing negative results, i.e. results which are contrary to the research hypothesis, and errors or other limitations of the research. A recent study conducted by 'Evidence-Based Medicine Data Lab' in the US, shows that most major companies and research institutions don't publish all eligible clinical trial data (all trials registered on ClinicalTrials. gov).[7] One of the reasons could be the reluctance to share negative results or errors. According to the data between January 2006 and April 2017, publication of trial data varies between 0 and 100 percent.

Moreover, lack of transparency with regard to methodology/ data hinders reproducibility and replicability. The extent of the problem is demonstrated by the fact that most of the research findings published in prestigious journals too are not reproducible.[9]

As one may recall from the discussion on the definition of 'science', secrecy and opacity are against the basic principles of science.[10] They decrease the scope for public scrutiny of the claims made by researchers, and restrict critique on the soundness of research methodology adopted. The current research atmosphere does not provide any incentive, in the form of mandates or general awareness, to adopt transparent approaches.
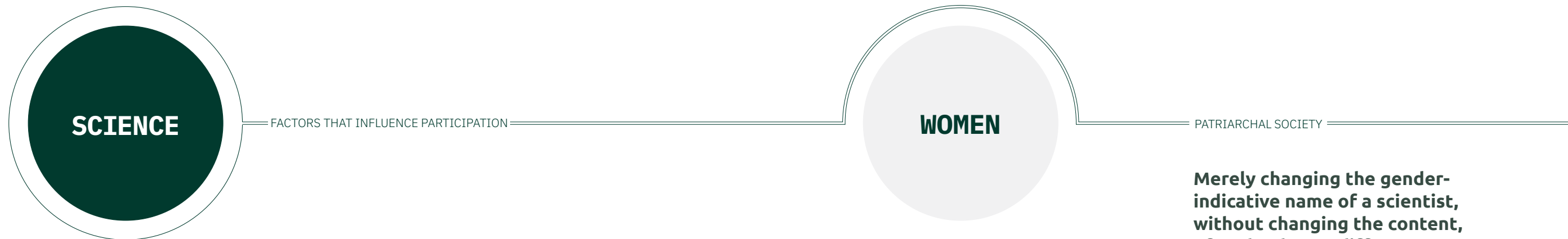
SCIENCE —— FACTORS THAT INFLUENCE PARTICIPATION —— **WOMEN** —— PATRIARCHAL SOCIETY

Merely changing the gender-indicative name of a scientist, without changing the content, often leads to a difference in perception regarding the quality of research

III. Lack of Inclusiveness

Different factors influence participation in the production of science. In the Indian context, some of the important socio-economic factors that affect participation are gender, urban- rural divide, language, caste, disability, and economic status.

However, for the purpose of this section we will be focusing on gender, disability, and economic status.

i. GENDER

The participation of women in science is far below optimal levels. Globally, a mere 29% of the personnel working in traditional science and technology are women.[11] According to latest National Science Foundation (NSF) data, representation of women among employed researchers and scientists in the field of engineering in the United States of America is less than 20 per cent.[12] While no official/ verifiable data is available with regard to the situation in India, anecdotal evidences suggest that the situation in India is far worse.

Although the female literacy rate and enrolment figures of females at different educational levels have improved in India, various social factors have impeded improvement in women's participation in science.[13]

In a patriarchal society, these factors are manifested both inside the household and at the workplace or place of education.[14] Since childhood, society tends to have different expectations of males and females. In some social situations, women are explicitly restricted from relocating for the purpose of education/ work, studying/ working after marriage, studying beyond a certain age or qualification, studying science, or studying/ working at all. However, even where such direct restrictions do not exist, conceptions of "appropriateness" of fields

MEN

TECHNOLOGY

INACCESSIBLE ASSISTIVE

DISABLED

according to gender norms discourage many women from pursuing certain career options. This was exemplified by remarks made by Dr Lawrence Summers, former president and current professor at Harvard University, at a conference in 2005.[15] He said that the shortage of women in senior posts in traditional sciences and engineering was due to their reluctance to work long hours because of childcare responsibilities. He also said that boys outperform girls in traditional sciences and mathematics owing to biological differences and not social conditioning. If directors of leading institutions make remarks such as these, one can imagine how harmful perceptions based on gender are shaped and perpetuated. In fact, the marked difference in the percentage of women in psychology (over 70%) and engineering (less than 20%) seen in data from the National Science Foundation, USA, may be reflecting the effect of such perceptions.[16]

While most workplaces in the formal sector do not impose explicit entry barriers for women, impediments arise in latent ways. The lack of confidence in the capability of women as science professionals leads to bias not only in how they are perceived, but also in selection and evaluation processes, funding, promotion,

< 20 %

Women In Engineering

> 70 %

Women In Psychology
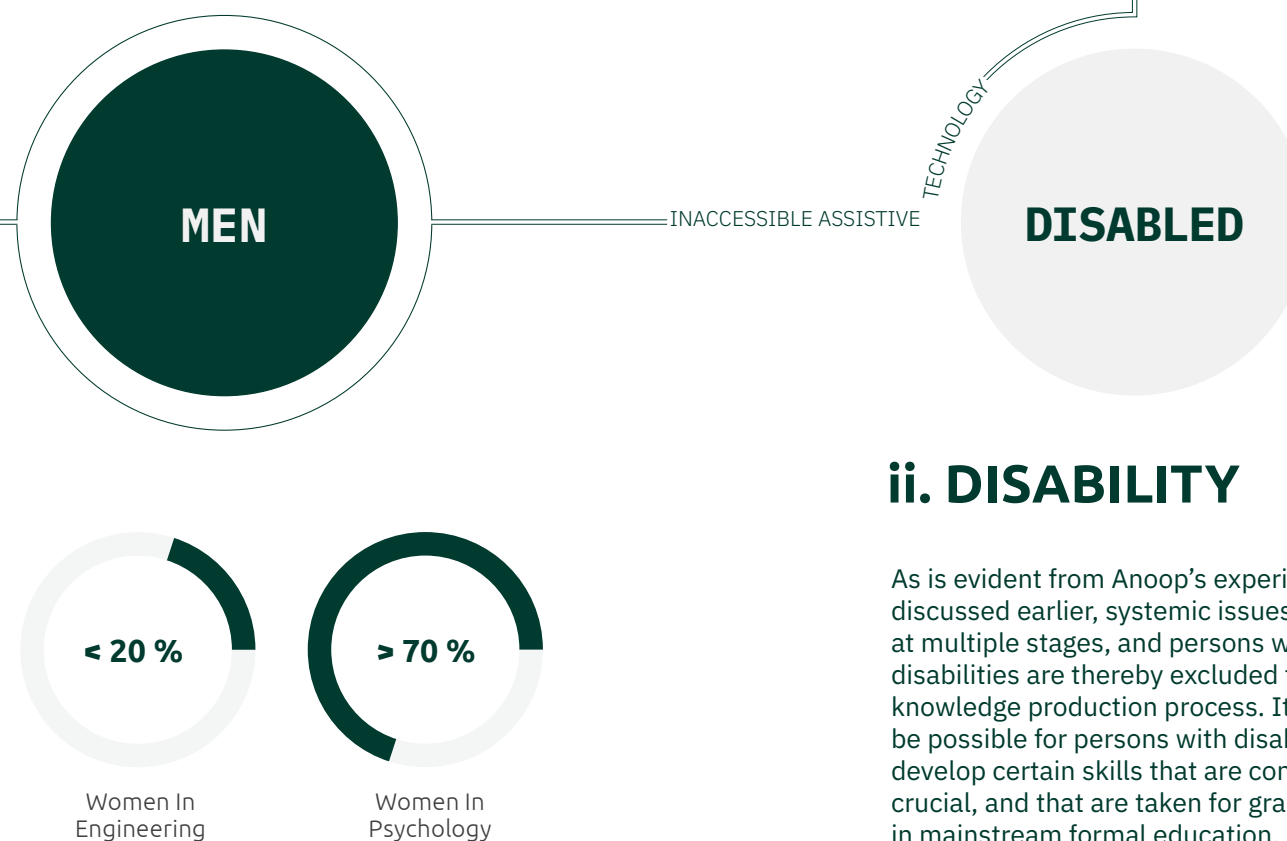
and remuneration.[17] Some people claim that it is merely quality, not gender, that affects such judgments. The problem is that gender norms operate at so many levels in a patriarchal society, that it is difficult to realise when our judgment gets affected by them regardless of intention. It is also challenging to trace prejudices back to specific sources, or prove their existence conclusively. However, some studies have empirically shown that merely changing the gender-indicative name of a scientist, without changing the content, often leads to a difference in perception regarding the quality of research.[18]

ii. DISABILITY

As is evident from Anoop's experiences discussed earlier, systemic issues exist at multiple stages, and persons with disabilities are thereby excluded from the knowledge production process. It may not be possible for persons with disabilities to develop certain skills that are considered crucial, and that are taken for granted, in mainstream formal education. For example, a person with visual disability may not be able to learn how to read, write, or spell, in the absence of assistive technologies.[19] Given that most formal and mainstream knowledge systems are centered around such skills, and that even existing assistive technologies are often inaccessible, such systemic issues add up at every stage. Unless a person with disability has certain socio-economic privileges, they are restricted from being able to afford supportive technologies or access institutions equipped with the same. As a result, a vast majority of persons with disabilities faces exclusion from the production of science and related social spaces. During one of our interviews, Moses Chowdary Gorrepati

highlighted this systemic gap which ultimately leads science to be neither inclusive nor disabled-friendly.[20]

While some assistive technologies are inaccessible due to prohibitive costs involved in procuring them, even when sufficient resources are available, lack of awareness or intent restricts their adoption in institutions. Apart from technologies, an enabling ecosystem which allows for flexible policies relating to work hours, leave, etc. may be important for certain kinds of disabilities. However, these aspects often do not receive due attention, and the awareness is even lower when it comes to invisible disabilities like fibromyalgia. Low numbers of persons with disabilities in various institutions, in turn, contribute to the lack of awareness regarding ways in which such institutions can be made inclusive for such persons.[21] The incentive to effect such inclusion also decreases when institutions start relying on a faulty argument that systemic changes are not important if their direct beneficiaries are low in number.[22] This, in effect, makes it difficult for such persons to access these institutions, causing the cycle to perpetuate.

An overarching issue is the failure, even by prestigious institutions, to see people with disabilities as active participants in the process of knowledge production. The survey data provided in Chapter 3 of the report clearly show that most institutions do not provide for audio-books or braille textbooks, which are crucial for such participation. Like in the case of women, social perceptions, expectations, and hurdles at every level, lead to the eventual exclusion of disabled people from the production of science. Is that a desirable result?

iii. POVERTY

Economic factors also lead to exclusion at every stage of one's life. Access to educational institutions and resources required for being involved in the production of science heavily depends on one's financial capacity. In India, many institutions have serious entry barriers for students who cannot afford exorbitant fees. This hinders numerous people from obtaining the requisite training that they desire and need for being formally integrated in the production of science.

In a developing country like India, which is riddled with inequality issues, resources which are crucial to production of science (such as books, databases, software, laboratories, etc.) are scarce. Unless incentives and mechanisms are introduced to share such resources or the outputs obtained upon exploiting such resources (such as raw experiment data), many people will continue to be excluded from the production of science.

iv. LANGUAGE

In a multilingual country like India, where most people are not well versed in English, restricting communication of science to the English language results in exclusion of millions of Indians from the knowledge creation process. As one may notice from the data provided in Chapter 3, most researchers in India do not share a translated version of their research findings in regional languages.
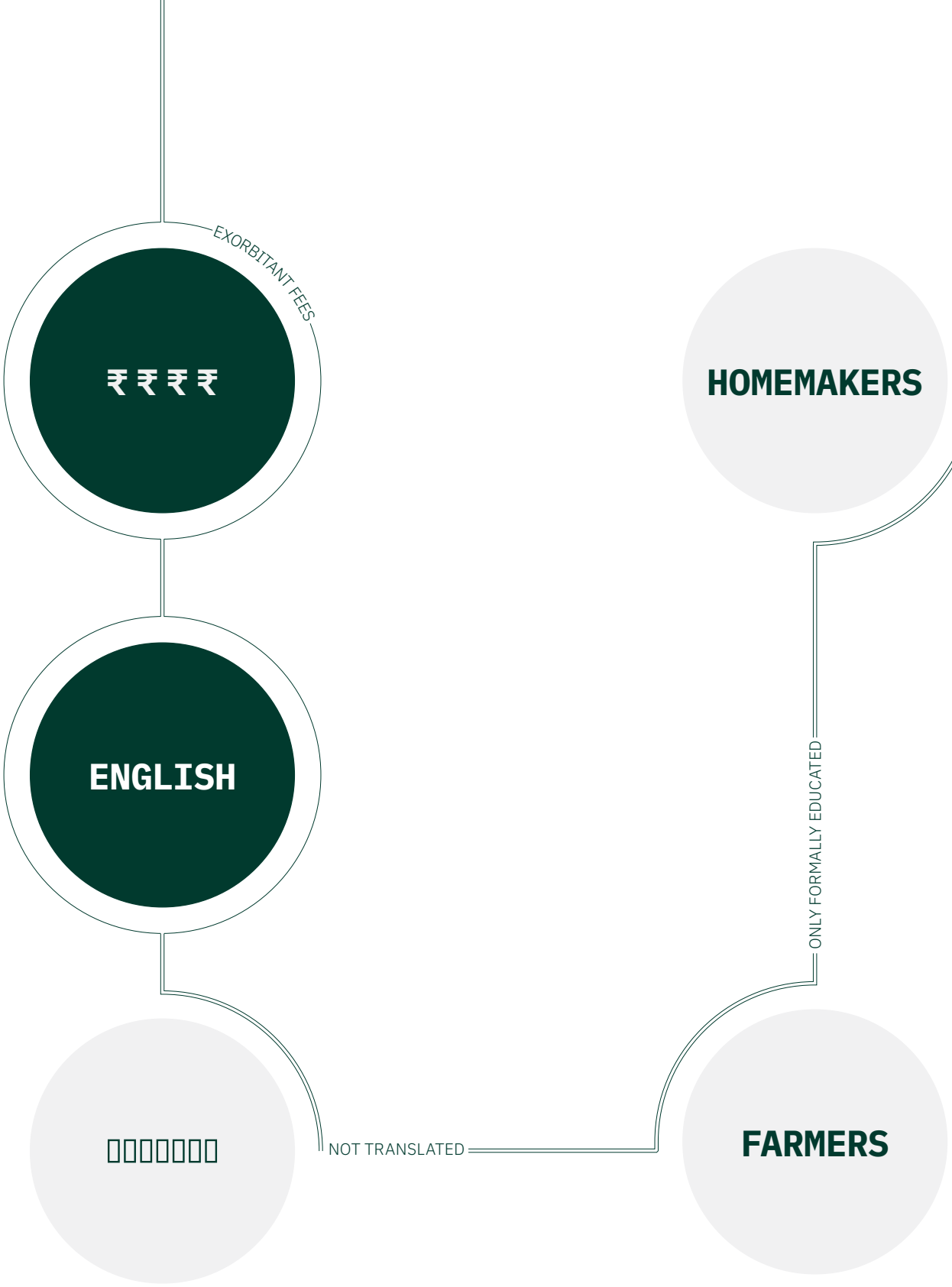
EXORBITANT FEES

₹ ₹ ₹ ₹

ENGLISH

ONLY FORMALLY EDUCATED

□□□□□□□ —— NOT TRANSLATED ——

HOMEMAKERS

FARMERS

Exclusion of certain voices from mainstream science can also lead to the neglect of issues faced by certain communities due to social, economic, or geographical reasons unique to them

v. INFORMAL SCIENCE

The current practice of science excludes local or traditional knowledge and experiences from the mainstream narrative. The word 'science' is still primarily associated with its formal practice, which draws heavily from western influences. But what about informal knowledge and grassroots innovations? Shouldn't traditional cures to diseases, local knowledge about disaster management, practical experiences of farmers and homemakers, etc. also be a part of science? Interestingly, although these forms of knowledge do not often gain the same kind of respect that formal science does, the latter is many a times influenced by the former. Pharmaceutical products are an example in this regard and as illustrated by many studies, traditional knowledge can play an extremely important role in new drug discoveries.[23] Unfortunately,
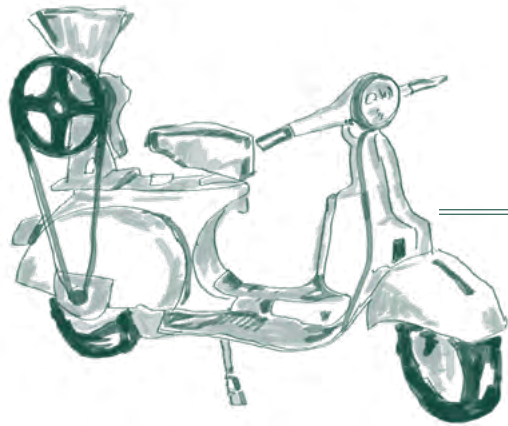
Sheikh Jahangir Sheikh Usman, based in Maharasthra, India, had to forgo formal school education due to financial constraints, much like many poor people in the country. However, that did not stop him from becoming an innovator. With the help of his observation skills and scientific temper, he has devised solutions to multiple local problems. Deriving power from the engine of his two-wheeler vehicle, he has developed machines for grinding grains, washing clothes, and spray-painting, which are mounted on the vehicle. These machines have not only been developed with minimal resources and have low running and maintenance costs, they also specifically cater to the needs of the society which he hails from. For example, in his community, people have access to small quantities of food grains for their personal consumption, but traditional flour mills are designed to grind only huge quantities of grains. Therefore, his innovation, which can grind small amounts of grain at low cost without having to rely on electricity, is an example of practice of science that is socially relevant. His efforts were recognised at the 4th National Grassroots Innovation Awards in 2007 by National Innovation Foundation - India (NIF).[24]

in most cases, this influence does not arise from respectful engagement with the knowledge providers. This includes taking of prior informed consent, proper attribution, and benefit sharing. Exclusion of certain voices from mainstream science can also lead to the neglect of issues faced by certain communities due to social, economic, or geographical reasons unique to them.

Jahangir's example demonstrates that when we perceive only formally educated, lab-coat clad persons working in institutional laboratories as scientists, we leave out from our discourse numerous people from marginalised communities who also practise science. Although Jahangir's efforts were recognised and formally awarded by NIF, it may be safe to say that we fail to recognise and attribute the contribution of many such scientists because of the narrow manner in which we think about 'science' and 'scientists'.

It is important to remember that these diverse dimensions of inclusiveness do not operate in isolation but in various combinations, and lead to different kinds and extents of exclusion. For example, a man from an economically deficient background is likely to have a different experience of exclusion as compared to a woman from a similar background.

MAN, ₹

WOMAN, ₹

IV. Lack of Collaboration
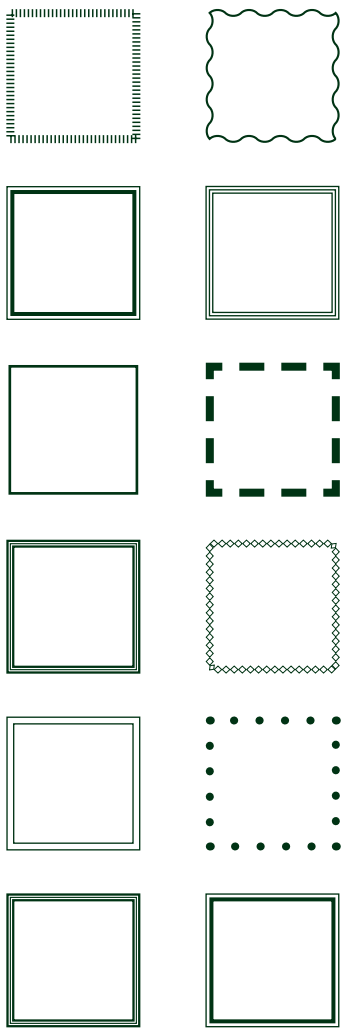
Collaborative research leads to more efficient utilisation of scarce resources, particularly in the Global South, where scarcity of resources is more pronounced. It can also lead to inclusion of a larger variety of perspectives in research, especially if the collaboration includes people from different disciplines or socio-economic backgrounds.

Moreover, it can lead to decrease in room for error due to a larger number of people, with diverse perspectives and experiences, verifying the research.

Modern communication technologies have brought numerous opportunities to share knowledge and collaborate in science at negligible marginal costs. However, these opportunities remain largely underutilised due to various factors. Existing academic practices give differential credit to collaborative works. For example, API formulated by UGC in India provides lesser score for authors of collaborative works.[25] How does this affect incentives for collaboration?

It must also be mentioned that the lack of transparency, inclusiveness, and collaboration, are inter-connected factors in certain cases.

Academic Performance Index (API)
imbalanced incentive structure

The University Grants Commission (UGC) of India is responsible for providing funds to institutes of higher education; as well as coordinating, determining, and maintaining their standards. It has an 'Academic Performance Index' (API) through which it evaluates the performance of academics. API scores have substantial bearing in the career prospects of academics, since they are considered during the latter's selection and promotion to various posts. The way in which API scores are calculated illustrates multiple issues in the current incentive structures in Indian academia.

There is inordinate focus on the number of publications without any regard for quality, which incentivises researchers to focus their research in areas that require less time and seem more attractive to prospective publishers. Scientists hence tend to neglect replication/ reproduction studies and basic scientific research that is not oriented towards immediate, short-term outputs. Additionally, in order to increase the number and frequency of publications, results which garner more attention also become focal points of studies. In the absence of sound transparency conditions and peer review, this tends to lead to unreliable science.

Higher scores are allotted to international publications and publications in journals with higher impact factor. Firstly, neither of these criteria is sound indicator of quality, especially since the word 'international' in the name of a journal is often taken at face value while calculating API scores. The excessive reliance on impact factor as an indicator of quality should also be avoided. Impact factor is calculated on the basis of average citations received by recent publications in a journal, and may not indicate the quality or impact of science published in such a journal. Sole focus on impact factor can also lead to a self-fulfilling cycle of citations, if readers consider citing only those papers that are published in journals with high impact factor. Secondly, in this incentive structure, science catering to local communities, that is produced or published in local languages and is relevant to local social issues, receives less attention.

It may be important to note here that the UGC considers only those papers that are published in journals included in its approved list. This list was created in response to the rising number of predatory journals in India. Predatory journals, among other problematic behaviour, charge money for publishing articles, but without a commensurate peer-review or editing process. However, the UGC list too has been criticised for having included many predatory journals.[26]

Another important aspect in the API is the higher score allotted for persons with single-authored publications, while co-authors get much lower scores in comparison. This implies that an academic engaging in collaborative projects gets a lower score than one working in their individual capacity. Intra and inter-disciplinary collaboration, the resulting exchange and development of diverse ideas, and the possibility of mutual quality-checks, are thereby discouraged.

Disregard of quality in the API is also demonstrated by the scoring system pertaining to research projects. A project that receives a larger grant gets higher scores, irrespective of the quality or relevance of the project. This can also impact the kind of projects that academics feel incentivised to focus on.

Finally, the kind of research outputs and dissemination/ outreach activities that are rewarded by the API system, to the exclusion of others, is a cause for concern. Apart from research papers in approved journals, books/ book chapters, patents/ technology transfers, and major policy documents of government bodies, no other kind of research output is considered. Whether patents/ technology transfers are a holistic indicator of innovation or scientific advancement, is itself heavily contested. Moreover, in terms of other ways of dissemination of knowledge, only lectures and presentations at conferences/ seminars/ workshops are considered. Field-based activities are considered only if they are 'student-related'. The aspects that are currently included may be important to consider while evaluating an academic's performance. However, the complete exclusion of other important practices - like open sharing of publications/ data, measures taken for transparency, community-based research, and dissemination in alternative or inclusive ways - has created an imbalanced incentive structure.

It may not be possible for one evaluation index to encompass all these aspects, especially the more qualitative ones, in its grading system. However, in the context of the heavy - and, in many cases, sole - reliance, by mandate or otherwise, on the API scores to evaluate an academic' performance, all these issues gain substantial significance.

Hence it is important to find ways to address these issues and change the existing incentives in the academic environment in India, by modifying the API system or devising other supplementary evaluation mechanisms.

CRISIS IN THE CONSUMPTION STAGE

65 OF THE WORLD'S 100 MOST CITED ARTICLES ARE BEHIND PAYWALLS

I. Lack of ~~Availability~~ Accessibility

An important challenge on the consumption side of science is the lack of accessibility, which has more than one dimension. Though availability and accessibility are often used interchangeably, it is important to note that not all available text/ data is necessarily accessible.
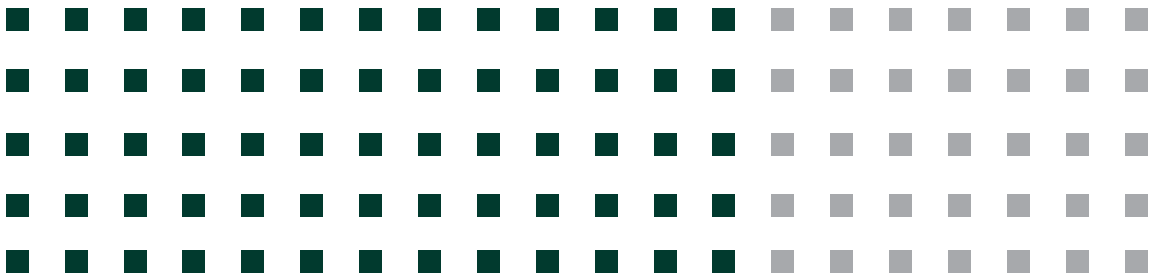
i. FINANCIAL ASPECTS

Many of the research outputs, including those generated from public funded research, are behind paywalls.

For example, a recent study shows that 65 of the world's 100 most cited articles are behind paywalls.[27] This effectively means that only those people or institutions who/which have the means to pay for these outputs can access them. Even the most liberally funded universities like Harvard are finding it difficult to subscribe to many major journals due to hikes in their subscription fees.[28] Predictably, the situation is much worse for most researchers and libraries in the Global South.[29]

The problem of inaccessibility is exacerbated by socio-economic inequalities, which leads to unequal access to valuable knowledge, both in Global North and Global South. There have been claims that almost half of the world's published scientific papers are read only by their authors, editors and reviewers, and a mere 10 percent are cited in other publications.[30] Could the excessive paywalls be one of the factors leading to this situation?

ii. USABILITY

Another dimension to the problem of accessibility is the 'usability' of data or text which is made available. Proper utilisation of any data or text requires the data to be machine readable. This assumes significance in the context of the opportunities provided by text and data mining (TDM).

TDM requires at least a temporary reproduction of the content to be analysed and the content must be available in machine-readable and interoperable formats. However, on most occasions, data or text is released in non-machine readable formats, which creates difficulties especially when extraction of large data sets or volumes of text is necessary.

It is also important to note that a strict copyright regime exacerbates the problem. Copyright law prohibits reproduction of any work without permission of the copyright holder. Unless the copyright holder gives up the right or the law makes an exception, or the copyright expires, such work cannot be reproduced for purposes such as TDM.
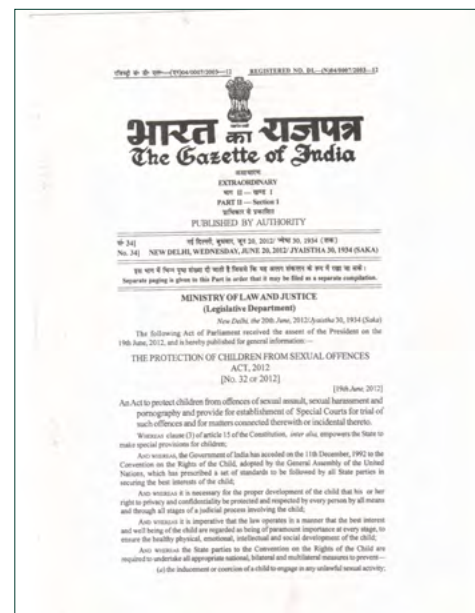
Legal research in India clearly exemplifies this problem. Most of the legislation in India are released only in PDF which are not OCR enabled. Even most of the judgements released by various courts are only in PDF. It is important to mention here that PDF allows limited utilisation of a particular text. This practice is also ironic in a legal system where ignorance of the law cannot be used as a defence by anyone accused of breaking the law.

TDM / the use of digital techniques to analyse large amounts of text and data for patterns, trends, and other useful information. It simplifies and quickens analytical processes which are lengthy and strenuous to conduct manually.

iii. DISABILITY

The copyright law assumes significance in another important dimension of accessibility- accessibility of research outputs for people with disabilities. We recognise that invisible disabilities such as mental health disorders, cognitive dysfunctions, and learning differences also warrant more research for identifying accessible formats for people with such disabilities. However, for the purpose of this report, we will be focusing on the need to make research outputs accessible to people with visible disabilities.

The Marrakesh Treaty to Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired, or Otherwise Print Disabled, 2013, is a positive step in this context, and requires contracting parties to have limitation or exception in their domestic copyright law. Authorised entities are empowered to make accessible format copies on a non-profit basis, which can be distributed by non-commercial lending or by electronic communication.[31] The authorised entities must have lawful access to the work, introduce only those changes necessary to make the work accessible, and supply copies only for use by the intended beneficiaries of the exception.[32]

However, most countries do not have disability-related exceptions within their copyright laws.[33] Although India is one of the contracting parties to the Marrakesh Treaty and has ratified it (*i.e.*, the provisions are enforceable in India), there is still a long way to go before accessibility can be truly and holistically ensured for people with disabilities, as has been discussed in earlier parts of this chapter and will be discussed in the last chapter of the report.

It is important to note that many producers of knowledge are unaware of the importance of dissemination of research outputs in accessible formats; and on platforms that allow options for modifying text sizes and colour contrasts, and providing captions and audio where applicable.

Crisis in science: consumption stage

II. Lack of Interaction Between Researchers
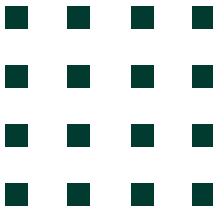
and Society

Currently, scientific communication caters only to a narrow section of the public - mainly to people from high/upper-middle class, English-speaking communities, and those who are formally involved in the relevant discipline. This will become more evident when one sees the data from our survey, discussed in Chapter 3, which clearly shows that very few researchers share their findings in a simplified version and in regional languages.

Catering to the society at large, irrespective of socio-economic background, is important in making science more accessible, and reducing its distance from the community.

CRISIS IN PRODUCTION
CRISIS IN CONSUMPTION

RELATIONSHIP BETWEEN CRISIS IN PRODUCTION AND CRISIS IN CONSUMPTION

The crisis at the production and the consumption stage should be viewed as part of a vicious cycle, with each influencing the other.[34] For example, absence of inclusive participation and collaboration reduces diversity of perspectives and leads to exclusion of socially relevant issues, thus reducing quality of research.[35] Similarly, restrictions on accessibility of research outputs hinder production of science by people from certain socio-economic backgrounds, thus adversely affecting the social relevance and quality of science produced.

NEED FOR DEMOCRATISING SCIENCE

The existence of the discussed problems at the production and consumption stages of science has multifaceted and far-reaching implications. An overarching problem created by the crisis is the strong disconnect between science and society.[36] This disconnect can be seen in two forms. First, the scientific community often views the rest of the society merely as consumers of science with no participation in its production.[37]

According to Prof. Anil Gupta,

"institutional, linguistic, financial, and pedagogical barriers prevent public participation in science"

Second, scientific research tends to be disconnected from societal needs and concerns.[38] The reason for this could be traced to the inordinate focus of insti-

tutional incentives for researchers on number of publications, as discussed earlier. This could also be due to lack of broader participation of people from diverse backgrounds in the production of science.

A change in the research culture is necessary for the true 'knowledge society' to exist.[39] Such society can only be created through 'democratisation of science'.

Democratisation of science is the process of eliminating barriers and enabling social participation in science. Similar to a political democracy where residents are looked at not merely as 'subjects' but citizens whose participation is indispensable, the process of democratising science changes the top-down approach of science and perceives the public as stakeholders in all stages of science. This also requires changing the perception that 'scientific knowledge' is different and superior to traditional knowledge or 'lay knowledge'.[40] Democratisation of science has the potential to integrate and mutually benefit both science and society. Scientised citizens and democratised science are, therefore, the need of the hour.[41]

WHAT CAN WE DO ABOUT THE CRISIS?

The current crisis in science, as discussed above, has multiple dimensions and consequences. Recognising the crisis is only the first step, which must be followed by devising holistic and effective solutions. Various "open" movements like open access, open data, open educational resources, and open hardware have tried to address different dimensions of the crisis in different ways.

A thread connecting all these open movements is their support for 'commons'. The Oxford English Dictionary defines 'commons' as something that is 'in joint use or possession, to be held or enjoyed equally by a number of persons'.

Examples of commons are varied in nature- a public park may be considered as a commons, as can be a scientific theory. Both are free for someone to use without having to seek permission from anyone else. Some commons pertain to non-rivalrous resources, i.e. resources which can be enjoyed by one without affecting their enjoyment by others; and some others pertain to rivalrous ones. For example, a park can be used simultaneously by different people till it becomes overcrowded. However, theories of physics can be used by different people in different capacities without affecting their use by one another. '

In particular, the internet, which has been envisaged as an innovation commons by scholars like Lawrence Lessig, has supported the growth of these diverse open movements. The internet enables

■ OPEN ACCESS

■ OPEN DATA

■ OPEN EDUCATIONAL RESOURCES

■ OPEN LABNOTES

■ OPEN SOURCE HARDWARE

■ OPEN SOURCE SOFTWARE

ease of sharing and communication of information resources at negligible marginal cost.

According to Benkler, internet increases the information available to individuals, and provides opportunities unhindered by material considerations like high costs or social considerations like institutional constraints. This has enabled individuals to believe that they can create the things they want to, thereby helping in moving away from the paradigm that perceives them simply as subjects. Further, this increases individual autonomy by removing constraints on what the individual can do and allows for the emergence of a more critical culture. Therefore, the internet allows for a decentralised, collaborative, and nonproprietary culture; based on sharing of resources and collaboration among individuals. Moreover, 'Web 2.0' technologies, promoting social media and social networking, have furthered the scope for participation and collaboration in science.[42]

Web 2.0

"Web 2.0" is a term that has been used to indicate a 'second phase' of development of the World Wide Web (the Web), which has encompassed substantial advancement compared to the preceding phases.[43]

The second phase has been characterised by rapid diffusion web applications such as **blogs, podcasts, wikis, and social networking** sites like Facebook, Twitter, etc.[44] Essentially, the Web has become more participative and interactive in nature, and now provides opportunities for **real-time collaboration** and **sharing**; and the boundaries between producers and consumers on the Web have blurred.

Some other features of Web 2.0 are **folksonomies** ("tagging" keywords on websites and links), **video sharing sites** (e.g., YouTube), and **web applications** ("apps"). Other terms used in the context of Web 2.0 include **'social software', 'social computing', 'the participative web', or 'user-generated content'**, among which every expression captures slightly different dimensions of the phenomenon.[45]

The open movements mentioned above do not have universal definitions. This is because many advocates of these movements have sought to understand or define the relevant concepts in their own way within specific contexts. However, it is important to understand some basic characteristics of these terms and movements.

OPEN SOURCE SOFTWARE

Open source software (OSS) was one of the pioneering open movements. It generally refers to computer software whose source code is made available with a licence which permits anyone to study, modify, and distribute the software to anyone and for any purpose.[46]

OPEN ACCESS

The open access (OA) movement pertains to sharing of text, including outputs of scientific research. According to Peter Suber, *open access literature is digital, online, free of charge, and free of most copyright and licensing restrictions.*[47] While there is no singular definition of OA, it is generally accepted that it can be of two kinds - *gratis* OA and *libre* OA. *Gratis* OA refers to removal of price barriers, and *libre* OA refers to removal of other permission barriers beyond merely price barriers.[48] Attribution is generally considered essential to OA.

OPEN DATA

Open data generally refers to data that can be accessed, used, shared, and modified by anyone, without cost or usage restrictions.[49]

OPEN EDUCATIONAL RESOURCES

'Open educational resources (OER)' generally refers to teaching, learning, and research materials that can be accessed, modified, developed, repurposed, and re-shared by anyone without cost restrictions.[50] Usage restrictions, whereby only educational/non-commercial use is permitted, may be present.

OPEN SOURCE HARDWARE

Open source hardware is a term used for tangible resources such as machines and devices, whose designs are released to the public in such a way that anyone can make, modify, distribute, and use such resources.[51]

OPEN LABNOTES

Open labnotes is the practice of sharing the entire records relating to a research project simultaneous to the progress of the project. This includes providing detailed description of all the steps involved in the research, along with the release of any data or material from the project.

OPEN SCIENCE: A MORE HOLISTIC SOLUTION?

The movements discussed above have made substantial contributions in devising solutions to the crisis in science. However, most of them focus primarily on the consumption stage of science. Undoubtedly, greater and more equitable consumption of science will lead to partial solution of problems at the production stage, since the two stages are co-dependent. We need solutions which can address problems at both the stages of science. Open science has been conceptualised as a means to provide such solutions, and perhaps as an end in itself.

Open Science includes all other open movements, and is also broader than all these movements combined. Unlike other open movements which primarily focus on the consumption stage of research, open science distinguishes itself through its focus on *all* stages of science. Open science strategies and policies are a means to support better quality science, increased collaboration, and engagement between research and society that can lead to higher social and economic impacts of research.

WHAT IS OPEN SCIENCE?

(Open (Science) 2.0)

OPEN SCIENCE V. SCIENCE 2.0

Science 2.0 highlights the changes brought about by Web 2.0 technologies, which have challenged the traditional and conventional ways of practising science. Though the term 'Science 2.0' does not have a uniform or universally accepted definition, it generally refers to new practices of scientists who post raw experimental results, nascent theories, claims of discovery and draft papers on the Web for others to see and comment on.[57] It has also been defined as a new approach to science that refers to the transformation and opening up of science through information and communications technologies, and which uses information-sharing and collaboration made possible by network technologies.[58]

Although 'Science 2.0' is another term which encompasses more than just the consumption stage of research, it emphasises on slightly different- albeit related- aspects than open science does. 'Science 2.0' was often used interchangeably with 'open science', although subsequently, open science was understood as a broader term and adopted by many including the EU.[59] Science 2.0 and open science may be referred to as "two sides of the same coin" since the former refers to the practice of science using modern technological tools, which enables the practice of the latter.

It must be mentioned here that in the context of India, where most of the population does not have access to the internet, there is a crucial need to look at implementing open science beyond the contours of online networks.

There is no universally accepted definition of the term 'open science'. The open science movement is understood as an umbrella movement which envisages openness beyond the contours of other open movements which have played an essential role in shaping it.

As part of this project, we tried to map different definitions of 'open science'. We were able to identify more than 30 ways of defining or characterising the term in different disciplines- and by different people, organisations, and initiatives.[52] The detailed mapping of these definitions can be accessed from the lab note provided on our project home page.

Understandably, every definition caters to the specific context in which it was developed. While every definition or characterisation has its own contribution, defining the term in a broad, inclusive, and flexible manner is important. This way, it can include requirements of diverse disciplines and help the discussions, debates, and policymaking surrounding this movement.[56]

According to Michael Nielsen,

*"Open science is the idea
that scientific knowledge of
all kinds should be openly
shared as early as is practical
in the discovery process".*[53]

**In the context of Horizon
2020 projects, 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 towards
collaboration and openness
in research. Open science
makes scientific processes
more efficient, transparent
and effective by offering new
tools for scientific collab-
oration, experiments and
analysis and by making sci-
entific knowledge more easily
accessible."*[54]

**In 2016, in the Dakar Dec-
laration on Open Science
in Africa, the signatories
agreed that**

*"Open science is a means and
not an end in itself and it is
much more than just open ac-
cess to publications or data;
it includes many aspects and
stages of research processes
thus enabling full reproduc-
ibility and re-usability of
scientific results".*[55]

Therefore, we have attempted to evolve a more comprehensive definition based on the existing definitions and understanding of the term:

Open science broadly refers to scientific inquiries wherein the characteristics of **accessibility, transparency, usability, non-** or **minimal** existence of **IP restrictions,** are evident and exist throughout all stages of research. It is also characterised by openness to **inclusiveness, collaboration,** constant and continuous **transfer of knowledge** between producers and users of knowledge, and prioritisa-tion of research and innovation based on **social needs.**

SOME BENEFITS OF OPEN SCIENCE

SOCIETY

Higher social relevance in research

Citizen participation in all stages of science

Greater scope for public scrutiny of science

Diversity of perspectives in science

Faster and wider transfer of knowledge

Increase in innovation

RESEARCHERS AND RESEARCH ORGANISATIONS

Better research (e.g. through greater access to research resources)

Optimal use of scarce resources (e.g. by sharing of resources, avoiding duplication of existing research)

More visibility (e.g. accessibility of research outputs can lead to more citations)

Increased funding (e.g. through more visibility)

Quality improvement through feedback

New professional contacts

Invitations for collaborations

FUNDING AGENCIES

Better research

Increased impact of research

Greater insight into quality/ credibility of the researcher (e.g. through increased access to the researcher's work)

Cost-effectiveness due to optimal use of scarce resources

02

The emergence of various open movements globally has had an impact in India. Most of these initiatives focus primarily on the consumption side of science and therefore may not encompass all aspects of open science. Most of them fall within the contours of open movements like open access and open data. In this context, it may be useful to note that owing to the varying usages of the term 'open science', even the few Indian initiatives which are referred to as 'open science initiatives' may not be envisaging the term as broadly as we do.

For a broader picture of the open initiatives in India, one of the potential approaches could be to analyse the initiatives taken within specific spheres of different open movements mentioned in the previous chapter. While it is not feasible to provide an exhaustive account of all open initiatives taken in India in one chapter, discussing a few prominent initiatives, and examining the content and implementation of existing policies and mandates may help in getting a better picture of the broader contexts in which the open movements operate, and the diverse challenges faced by them. This would also help in offering appropriate legal and policy recommendations for a stronger and sustainable open science movement in India, as it encompasses all the other open movements.

OPEN INITIATIVES

ES, SOURCE SOFTWARE, SCIENCE, ACCESS, DATA, EDUCATIONAL RESOURCES, CITIZEN SCIENCE, SOURCE HARDWARE, LABNOTES, SOURCE SOFTW

OPEN SCIENCE

AFFORDABLE HEALTH CARE

Open Source Drug Discovery (OSDD)

- Council of Scientific and Industrial Research (CSIR), '08

Participating scientists aggregated and shared the biological and genetic data

One of the most prominent open science initiatives in India is the Open Source Drug Discovery (OSDD) project, which was launched in September 2008 by the Council of Scientific and Industrial Research (CSIR).[1] While the project may not have used the term 'open science', many scholars use OSDD as an example of 'open science' due to diverse aspects of collaboration and openness within the project. It was started with a vision to provide affordable healthcare to the developing world. It provided a global platform where the best minds could collaborate and collectively endeavour to evolve novel solutions for diseases like malaria and tuberculosis. Participating scientists used to aggregate and share the biological and genetic data available freely on the platform. The Government of India had committed ₹ 1,500 million (US $38 million) towards this project. However, this initiative has unfortunately been stalled after a change in leadership in the project.

OPEN ACCESS

2001
INDIA'S FIRST REPOSITORY

EPrints@IISc

■ NATIONAL CENTRE FOR SCIENCE INFORMATION, IISC

While it is nearly impossible to precisely identify the beginning of the open access movement in India, some initial traces of openness in respect of scientific publications can be seen from the year 2001, when Dr T B Rajasekhar of the National Centre for Science Information, IISc, initiated the setting up of a repository.[2] India's first repository, EPrints@IISc[3], was set up at a time when not many repositories were there in the world. Even though only registered users could access the content on this repository, this initiative was noteworthy for being one of the first in the country to operationalise an institutional repository.

Institutions such as National Institute of Technology (NIT), Rourkela; the International Crops Research Institute for the Semi-Arid Tropics, the Indian Academy of Sciences, and Indian National Science Academy have since then adopted open access policies for some of their outputs. For example, NIT Rourkela provides access to theses written by its students for partial fulfilment of their degrees, while the others mentioned here have made some journals accessible and downloadable by any interested user.[4]

A significant effort towards open access was seen in November 2006, when representatives from three developing countries – India, China, and Brazil- met in Bangalore. The meeting gave birth to the **'Bangalore Commitment'**[5], which advocated for open access self-archiving in these countries and thereby setting an example for the rest of the world. The motto was:

'Self-archive unto others as you would

have others self-archive unto you'

The Bangalore Commitment, 2006

Unfortunately, despite the symbolic significance of this meeting, it failed to lead to any concrete mandate for researchers in India.

DBT-DST

OPEN ACCESS POLICY,

2014

FIRST MAJOR
MANDATE FROM
THE CENTRAL
GOVERNMENT

The first major mandate from the side of the central government came in 2014, when an open access policy was adopted by the **Department of Science and Technology (DST)** and the **Department of Biotechnology (DBT)**.[6]

The DBT-DST policy applies to the full text of final accepted manuscripts, and associated metadata and supplementary material, arising out of projects that are in whole or part funded by DBT/ DST.

It also includes within its scope, projects which are performed using infrastructure built with DBT/ DST support. The policy mandates institutions receiving 'core funding' from DBT/ DST to create and run institutional repositories for uploading the mentioned material and making it accessible, and also recommends other institutions to do the same. In case institutional repository is not available, the policy envisages the sharing of material on central repositories created by DBT/ DST.

The CSIR (Council of Scientific & Industrial Research) Open Access mandate[7] and **ICAR (Indian Council of Agricultural Research) Open Access Policy**[8] are some other prominent efforts taken by institutions at the central level. They are important especially as they are public institutions which receive substantial public funding for research and play a significant role in scientific research in India.

The CSIR policy pertains to all CSIR journals, published research data, full text of papers submitted from CSIR laboratories and supported by CSIR grant, and associated metadata.

It mandates institutional repositories to be created by every CSIR lab, and urges the labs to progressively make all their publications open access.

One of the CSIR institutes, CSIR- Unit For Research & Development of Information Products (CSIR- URDIP)

has also developed 'Listing of Open Access Databases' (LOADB)[9], which has created a web-enabled, linked, classified, and categorised collection of Open Access databases which can be accessed from a single portal. It primarily focuses on science and technology subjects, but aims to gradually include all subject areas.

The ICAR Open Access Policy covers all publications, M.Sc. and Ph.D. theses and dissertations, summaries of completed projects, and associated metadata.

It pertains to outputs of research conducted at ICAR institutes and funded wholly or in part by ICAR or other public funds at ICAR establishments. It also mandates the setting up of institutional repositories by such establishments in which the relevant authors must deposit the final version of their manuscripts. Interestingly, it clearly provides that the licence for use, re-use, and sharing of the material is only for academic and research purposes. Written permission from ICAR, the copyright holder, is necessary for commercial or other uses.

The Universal Library Project[10] of the Government of India, also deserves mention in this context. The goal of this project is to provide free and searchable access to a collection of 1 million books, copyright in which has expired. The government has contributed by providing scanning facilities and personnel to help the project materialise.

In the context of open access movements, it is interesting to observe that some of the states in India have also started taking noteworthy measures for increasing access to knowledge. For example, Tamil Nadu, one of the states in the southern part of the country, has recently issued an instruction to **Tamil University and all other government departments and institutions** to release all their publications, archives and collections under Creative Commons Share-Alike licence.[11] While it is yet to be seen how this directive will be implemented, such mandates are especially significant because their effects permeate beyond specific institutional boundaries, and make

works in regional languages more accessible.

It is also important to observe that one can see more collaborative efforts between the government and different external funding agencies for ensuring open access to research outputs from joint efforts. The alliance formed by the **Department of Biotechnology (DBT)** with **Wellcome Trust,** one of the leading funding agencies in the world, is an example in this regard.[12] The Wellcome Trust and DBT formed the alliance in 2008 for the purpose of a £160 million initiative equally funded by both parties. This initiative supports outstanding Indian scientists working in areas such as basic biomedical research, and clinical and public health research, with fellowships at four levels: early career, mid-career, senior, and 'Margdarshi' (in leadership positions). All fellows of the Wellcome Trust – DBT India Alliance are required to make their research publications open access, a practice followed by the Wellcome Trust whenever it funds research.

DBT   WELLCOME TRUST

2008

£160 m.

WORKING IN AREAS SUCH AS BASIC **BIOMEDICAL** RESEARCH, AND **CLINICAL AND PUBLIC HEALTH** RESEARCH

INDIAN SCIENTISTS
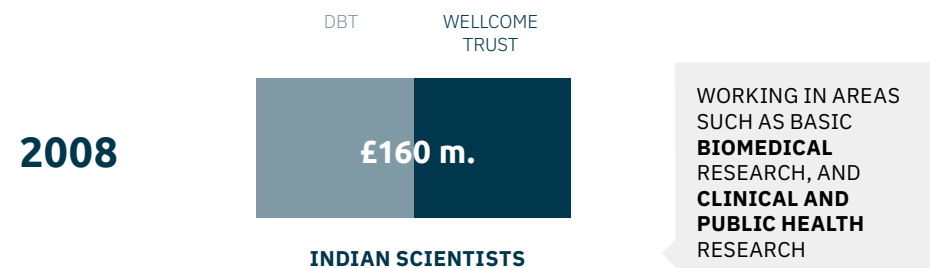
In terms of more specific open access initiatives, the **Indian Medlars Centre**[13] is a prominent example. It is a joint effort of ICMR and the National Informatics Centre (NIC), and it commenced hosting open access versions of many Indian medical journals in 2003. This was done to supplement a bibliographical database of Indian biomedical research which was already in existence, with full-text articles. Most of them are published by professional societies.

THE DELHI DECLARATION ON OPEN ACCESS

The Delhi Declaration on Open Access is an initiative by Open Access India (OAI), which is a community dedicated to advocating open access and open education in India; its aim is to open up access to publicly funded research. Among its other initiatives are AgriXiv, a preprint repository for papers on agriculture, and a draft National Open Access Policy for India, which aims to mandate open access to publicly funded research and teaching in the country. OAI intends to crowdsource inputs for this draft and submit it before the Ministry of Human Resource Development (MHRD), and the Ministry of Science and Technology, for their consideration. OAI also has a 'CrowdSource' project which maps all journals issued ISSN (International Standard Serial Number, a unique identifier for serial publications) by National Institute of Science Communication and Information Resources (NISCAIR). The project aims to build a comprehensive database of relevant information, including copyright policies of these journals.

Finally, it needs to be mentioned that there are also many other grassroots-level open access movements from the side of researchers in India. For example, the **Delhi Declaration on Open Access**[14], signed in February 2018, is an effort by some researchers to promote open science and open scholarship in India. The signatories declared that they would be taking certain steps individually and within their institutions to ensure access to research outputs for public good, accelerate progress of research, and address societal challenges through research. Remarkably, they have emphasised on the importance of communicating interim research outputs, preprints, open peer review, open access institutional repositories, alternative models of open access, evaluation, and reward systems for researchers. The signatories not only intend to follow the steps mentioned in the declaration, but to also spread awareness among stakeholders such as scholars, editors, universities and their libraries, and policymakers regarding the steps they can take towards implementing open access.

All the above initiatives have marked important developments in the Indian open access movement, especially because they have broad and pervasive effects on multiple institutions and researchers. Some of the above-mentioned policies and mandates will be discussed in detail in the following section of this chapter.

OPEN DATA

■ generated

■ collected

■ archived

The most prominent initiatives in the context of open data have been taken in the area of government data. The primary policy guiding government data in India is the National Data Sharing and Accessibility Policy, 2012 ("NDSAP")[15]. It pertains to all data and information created, generated, collected, and archived using public funds. As per the policy document, by making such data publicly available in human-readable and machine-readable formats, the policy aims to serve scientific, economic, and developmental purposes, and meet civil society needs. The underlying idea is that open government data would enable rational debate, better decision-making, and evidence-based planning of socio-economic development. It classifies data into shareable and non-shareable data; and envisages three kinds of access depending on the type of data- open access, registered access, and restricted access. Open Government Data Platform India (OGD platform) launched by the government of India in October 2012 is used as a common platform where various government datasets can be accessed.

Open Government Data (OGD) is a philosophy- and increasingly a set of policies - that promotes transparency, accountability and value creation by making government data available to all. Public bodies produce and commission huge quantities of data and information. By making their datasets available, public institutions become more transparent and accountable to citizens. By encouraging the use, reuse and free distribution of datasets, governments promote business creation and innovative, citizen-centric services.

The Organisation for Economic Co-operation and Development (OECD)
http://www.oecd.org/gov/digital-government/open-government-data.htm

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■ using
■ public funds

NDSAP, 2012

NDSAP requires the ministries/ government departments to undertake the following tasks-

a. Nominate data controller
b. Data controllers in turn should nominate data contributors
c. Set up NDSAP cell
d. Identify datasets
e. Publish catalogs and resources (datasets/ apps) on the OGD platform
f. Prepare negative list of datasets (non-shareable data)
g. Create action plan for regular release of datasets on the OGD platform
h. Monitor and manage the open data programme of the department

It is important to note that the **NDSAP is not legally binding, and only provides guidelines to government departments and ministries to evolve their open data plans.** Different ministries and government departments can be seen following different approaches with regard to data sharing based on the broad guidelines. For example, the Ministry of Statistics and Programme Implementation (MoSPI) has recently evolved its data guidelines.[16] DST has been assigned the nodal functions of overall co-ordination, formulation, implementation, and monitoring of the policy.

Some of the state governments have also initiated state-level data sharing. For example, Sikkim was the first Indian state to launch its own open government data portal.[17] More recently, the state of Telangana has also framed its own open data policy.[18] The Telangana policy is on similar lines as NDSAP. It is important to note, however, that unlike NDSAP, the Telangana policy specifically mentions that relevant departments should

Sikkim

the first Indian state to launch its own open government data portal

endeavour to provide time-sensitive and transient data such as those relating to weather, pollution, and traffic, in real-time.

Some other initiatives such as **Datameet**[19] and **OpenCity**[20] must also be mentioned in the context of open data. Datameet was started in January 2011 by a group of data enthusiasts for primarily sharing data and tips for collecting and using data. They have since then organised many meetups, camps, hackathons, and other events to discuss current issues relating to data. They organise an Open Data Camp annually for people who are working with data from many different sectors to come together and share their projects and ideas. Examples of outputs arising out of the data shared within their community include free and open maps of Indian village boundaries and municipal data. Datameet, along with Oorvani Foundation, launched OpenCity in April 2016. OpenCity is a repository of city-related public data from government sources, collected via applications under the Right to Information Act or open data processes. By providing access to the data in open data format under open licences, it aims to ensure that citizens can better understand the state of their localities and make appropriate demands of the government.

DEVELOPED AND MANAGED BY
the Center for Open Data
Enterprise, Washington, D.C.

Open Data Impact Map

FUNDED BY
IDRC and the
World Bank

The Open Data Impact Map[21] is a database which provides information about the organisations which use open data around the world. It contains information on organisations (corporations, non-Profit, academic institutions) on the basis of the kind of open data which is used by them. For example, UNDP provides detailed information on the multiple projects which are undertaken by the UNDP all over the world. By providing information on all the projects, it aims to improve accountability, trust, and efficiency. Open Data Impact Map is funded by the International Development Research Centre (IDRC) and the World Bank. It is developed and managed by the Center for Open Data Enterprise, Washington, D.C.

OPEN EDUCATIONAL RESOURCES

In the context of open educational resources (OER), efforts made by governmental bodies as well as institutions are significant.

SAKSHAT

One of the most prominent among them is SAKSHAT.[22] It is an initiative launched by MHRD in 2006 to develop an education portal for addressing education and learning related needs of students, scholars, teachers, and other learners. The portal is expected to be the main delivery platform for the content developed under the National Mission on Education through ICT (NMEICT). It contains many e-repositories for school and higher education. These include e-PG Pathshala, National Program on Technology Enhanced Learning (NPTEL) and A-View Virtual Classrooms. The website is compatible with assistive technologies, such as screen readers and magnifiers, for persons with visual impairment/disabilities. However, the contents of the website are not permitted to be reproduced partially or fully, without due permission from the MHRD. It is also mentioned explicitly that they cannot be used in any "misleading or objectionable context".

NATIONAL PROGRAM ON TECHNOLOGY ENHANCED LEARNING (NPTEL)

NPTEL[23] is another OER project, initiated by seven IITs and IISc, and is funded by the MHRD. Since having gained popularity with more than 90 million views and over 11,00,000 subscribers on its YouTube channel, NPTEL has adopted a CC BY-SA licence.[24] The video content, which focuses on engineering-related classes is available in MPEG-4, flv, and 3gp formats, and can be accessed for free through their YouTube channel as well as website.

SHODHGANGA

One of the other prominent initiatives as regards OER is 'Shodhganga'[25], a repository of Indian Electronic Theses and Dissertations. The responsibility of setting-up, hosting and maintaining the digital repository of Indian electronic theses and dissertations and making it accessible to all institutions and universities is assigned to Information and Library Network (INFLIBNET) Centre. Shodhganga has been providing access to resources from diverse disciplines, and updating the repository in a regular, timely manner.

NATIONAL DIGITAL LIBRARY OF INDIA

More recently, the National Digital Library of India (NDL)[26], developed by IIT Kharagpur, has been launched by Ministry of Human Resource Development (MHRD) under its National Mission on Education through Information and Communication Technology. It seeks to provide a single window search facility to act as a one-stop shop for all digital resources. Information can be personalised based on the education level, choice of language, difficulty level, media of content, author, source etc. The NDL system is accessible to all users for general browsing, free of charge. However, one needs to register with a user id and password and login using those for accessing some classified materials. Moreover, accessibility of materials which may reside on other institutions' servers is determined by the policy of those institutions and their access rules.

SWAYAM

SWAYAM[27], an initiative of MHRD and the All India Council for Technical Education (AICTE), also has free online courses on subjects relevant for students at different levels - from the 9th standard in school until post-graduation. It aims to provide accessible, equitable, and quality education through interactive courses in English and Hindi. Video lectures, printable and downloadable reading material, self-assessment tests, and online discussion forum for doubt resolution, are available. Although the courses themselves can be availed free of cost, fee is charged in case certification is requested.

NATIONAL REPOSITORY FOR OPEN EDUCATIONAL RESOURCES

National Repository for Open Educational Resources (NROER)[28] is another interesting initiative at the central level. It is a web platform intended for collaborative creation of digital content. It was initiated by the Central Institute of Educational Technology (CIET), National Council for Educational Research & Training (NCERT), and Homi Bhaba Centre for Science Education. Since all the materials on the platform are provided under CC-BY-SA licence, anyone can adapt and modify it before sharing with others. However, if one looks at the platform, it seems like the collaborative aspects of the platform have been inactive for some time, though the platform still has some accessible material.

PEOPLE'S SCIENCE/ CITIZEN SCIENCE

In the context of open science, it is crucial to also look at 'people's science' or 'citizen science' initiatives, apart from the formally recognised 'open movements'. As discussed previously, the scope of the open science movement extends beyond open movements and includes elements such as public engagement, collaboration, and addressing distance between formal science and society. Therefore, initiatives wherein local communities have been recognised as and included in the capacity of active stakeholders need to be highlighted. Due to the lack of uniformity in the nomenclature and absence of internet presence for many such efforts in India, we may have unintentionally left out many important examples. However, in this section we are highlighting some of the prominent initiatives, information about which we were able to obtain through internet searches, telephonic interviews, and personal interviews.

The nature and extent of involvement of different stakeholders varies across these initiatives. Some cases involve interaction or consultation with the community for the purpose of solving local issues. In some other cases, the issues to be resolved may pertain to society at large, but certain communities' participation may be more relevant in the process of resolution. This is especially significant in efforts regarding environmental issues. Some efforts seek to sensitise or raise awareness among people in relation to their beliefs and actions.

Possibly, some of the fullest extents of citizen science are realised when the **local community members** are perceived as **equals-** or the most important **stakeholders-** in the process of science, issues pertinent to them are brought to the forefront, their **knowledge** and **experience** are recognised, and respectful **collaboration** takes place keeping in mind the **language** and **lifestyle** they are familiar and comfortable with. In many such cases, the community members themselves are the **initiators of the movements**.

In this context, one of the pioneering and highly successful organisations in India has been **Kerala Sastra Sahitya Parishad (KSSP)**[29], which was founded in 1962 and literally means 'The Kerala Forum for Science Literature'. It was initially set up to produce scientific literature in Malayalam, the regional language. However, with time, the members realised the need for further steps to address the gaps created by the monopolisation of science by the elite.

In 1972, KSSP adopted the motto "Science for Social Revolution". Hence, it also organises workshops, plays, and talks which are conducted in Malayalam, with a view to ensure that the local community develops interest in science and is self-sufficient in addressing issues pertinent to them.

Some of the areas in which KSSP has made substantial contribution include women's rights, environmental conservation, and education. One of the focal points of KSSP is sustainability and equality in development. Currently, KSSP has over 40,000 members.

Active public participation has also been seen in many projects relating to biodiversity registers and fauna behaviour. For example, the **Asian Waterbird Census**[30], a Wetlands International South Asia initiative in partnership with many other prominent organisations in the field, invites participation from people to observe and collect data regarding waterbirds. The data collected include numbers, behaviour, habitat, and observable patterns pertaining to these birds. The participants are given certificates for their work, and the data is stored in databases and used for mapping trends that may be useful for biodiversity conservation efforts.

Organisations such as **Delhi Science Forum (DSF)**[31], **Himachal Gyan Vigyan Samiti (HGVS)**[32], and **Breakthrough Science Society**[33], which comprise of

Prof. Madhav Gadgil, former professor at the Indian Institute of Science (IISc) and founder of the Centre for Ecological Sciences at IISc, has been an active advocate for citizen science and collaborations in science. During an interview conducted as part of this project, he highlighted different instances which illustrate the importance of ensuring participation of local communities in scientific research. An example he provided in this regard was the ban on buffalo grazing in the wetlands of Keoladeo National Park at Bharatpur, Rajasthan and its impact on the bird population there. Buffalo grazing had been practised by the local community in the region for over two centuries. One of the globally renowned ornithologists, who had done considerable work in the Bharatpur area, recommended a ban on grazing in the 1980s, with a view to improve the condition of waterbirds there. Interestingly, the decision to impose the ban was not based on public consultation and the local population had protested against the ban. The local population argued that buffalo grazing was actually important for maintaining ecological balance in the wetlands. However, the government went ahead with the ban, based on the recommendations of the researcher. A year later, the bird population deteriorated considerably. Further research revealed that buffalo grazing ensured that the water was not covered with a kind of grass that, if left to grow unchecked, made the wetlands too shallow to be the appropriate habitat for most birds.

What does this example illustrate? What do they tell us about the disregard harboured by many 'formally recognised' scientists towards the 'layperson'?

many 'formally recognised' scientists, focus on diverse issues like health and nutrition, accessible scientific communication, energy, agriculture, environmental issues, and questioning superstition and infiltration of religious sentiments in science. DSF and HGVS are part of the All India People's Science Network[34], which is a nation-wide network of many such regional organisations. Many members of the network also actively participate in policy making pertaining to science and education in India. Further, they also organise campaigns like '**March for Science**'. The issues highlighted in the 2018 March for Science include problems pertaining to funding in public institutions, and 'assault on science' by politicians.

Since our definition of science extends beyond natural sciences, we must stress here that citizen science initiatives can be and have been taken up in other fields as well. For example, in the field of law, universities in India have student-run initiatives such as legal aid societies/ committees and legal aid clinics. The purpose of these initiatives is to engage in socio-legal issues relevant to the local communities, conduct awareness programmes, and adopt other tools for effective and accessible communication regarding rights and legal redressal avenues. The 'clinics' are meant to offer customised legal advice free of cost to specific issues of people.

Initiatives such as '**Lawfarm**'[35] offer similar services online- anyone is free to submit their legal queries and receive practical solutions from the team as well as other users. Lawfarm also connects people to pro bono lawyers on request. Such initiatives increase the accessibility of such legal help to internet users by virtue of being online forums, but have their own limitations since most Indians do not have access to online spaces.

Similar to public participation efforts for biodiversity mapping, initiatives like '**I Paid a Bribe**'[36] and '**Bribe Hackers**'[37] provide a platform where anyone who has been asked for a bribe, or who has paid such a bribe, or who has faced harassment related to bribe demands, can post information about the relevant situation. Such information may include the place where the

Delhi Science Forum (DSF)

Himachal Gyan Vigyan Samiti (HGVS)

Other such regional organisations

ALL INDIA PEOPLE'S SCIENCE NETWORK

incident took place and the people involved. Although it is unclear whether the information posted is utilised for any tangible action, such initiatives contribute to relatively open discussions about such rampant social evils. They also provide practical information regarding some pertinent legal procedure and rights so that citizens recognise when an illegal monetary demand is made, and what they can do in such a situation.

But the very fact that citizen science initiatives are the exception rather than the norm is a matter of concern in India, as in most other countries. Moreover, we have also observed that lack of availability of information, lack of continuity of such efforts, and uncertainty as to tangible data or results arising out of such efforts, plague many such initiatives in India. A glaring problem is that, often, even those organisations which focus on and work with local communities fail to recognise the community members as intellectual equals. Rarely are appropriate credits given to their knowledge and efforts in tangible research outputs!

Increasing Diversity by **Increasing Access**

One of the most prominent citizen science initiatives in the field of law is IDIA[38] (Increasing Diversity by Increasing Access), led by Dr Shamnad Basheer[39], which started as a student-run initiative to address the issue of elitism and exclusion in national law schools in India. IDIA has multiple teams working in various states in India in diverse capacities. A majority of their work involves outreach to underprivileged students from urban, semi-urban, and rural areas of India; spurring their interest in law as a career option through talks and skits; and selecting interested and meritorious students for extensive training to prepare them for national level law entrance exams. Apart from financial, linguistic, and regional barriers, IDIA also focuses on other social barriers such as disability. Further, IDIA actively participates in contemporary discussions, lawmaking, and policymaking with regard to accessibility in legal education and the legal profession in India. Inclusion of people from diverse backgrounds in the legal discipline not only has immense intrinsic value, it also gives voice to neglected or marginalised issues, views, and concerns in the field of law. Moreover, efforts made for reducing exclusion pave the way for systemic reduction of elitism in legal education.

STATUS OF CURRENT POLICIES/ MANDATES

Initiation of efforts and building of various platforms for fostering openness is only the first step. It is equally important to ensure proper planning and implementation of the initiatives. In this regard, it is crucial to critically examine the framework and working of the open initiatives in India. While we may not be able to separately report our findings on all the open initiatives in India, this section highlights our empirical observations regarding some of the major open initiatives in India.

OPEN ACCESS

We may first look at the open access initiatives in India. In order to better understand the current state of open access initiatives in the country, we engaged in a three-part study. In the first part, we tried to map and compare the major open access policies in India with some of the most influential open access policies in other parts of the globe, in terms of subject matter covered, scope of rights provided, and compliance mechanisms. These policies are the European Horizon 2020 open access/ FAIR data guidelines; the US National Institutes of Health Public Access Policy; the US National Science Foundation Public Access Plan; the policies of Wellcome Trust, London; the Bill & Melinda Gates Foundation Open Access Policy; and the Open Access Policy of International Development Research Centre, Canada. As discussed earlier, the Department of Science and Technology, Department of Biotechnology, ICAR, and CSIR, are major public institutions in India which have open access policies. In the second part, we conducted a survey on the institutional repositories mandated by the DBT/ DST, CSIR, and ICAR open access policies to analyse how far the researchers and institutions in India comply with those policies.

1

Mapped and compared the major open access policies in India with some of the most influential open access policies in other parts of the globe, in terms of subject matter covered, scope of rights provided, and compliance mechanisms.

2

Conducted a survey on the institutional repositories mandated by the DBT/ DST, CSIR, and ICAR open access policies to analyse how far the researchers and institutions in India comply with those policies

3

Analysed the modes of communication used by one of those institutions (DST) for conveying its open access policy to the researchers funded by it and the compliance mechanisms put in with regard to its open access policy

In the third part of our study, we analysed the modes of communication used by one of those institutions (DST) for conveying its open access policy to the researchers funded by it and the compliance mechanisms put in with regard to its open access policy. This was done with the objective of identifying the potential reasons for non-compliance of researchers and institutions with the open access mandates. All the information for the third part was collected with the help of applications filed under the Right to Information Act.

With regard to the first part of our study, we observe that the policies in India lack clarity with respect to many important aspects like usage restrictions, exceptions, and compliance mechanisms. For example, the DBT/ DST Open Access Policy and CSIR mandate do not clarify the permitted uses of the research outputs. On the other hand, ICAR specifically mentions that permission needs to be sought from ICAR for any commercial use of the content. This approach severely limits the scope of use of the research outputs. The exceptions made for protection of intellectual property rights/ legal commitments, and exemption of material that can be commercially exploited from the scope of the policy, further reduce the scope of open access obligations. Even with regard to the compliance mechanisms, Indian policies portray a very disappointing picture. If one compares the compliance mechanisms envisaged under different open access policies, it can be observed that most of the Indian policies lack robust monitoring and compliance mechanism. This in turn means that these policies are essentially powerless, if institutions or authors do not follow the obligations prescribed by the policies. The detailed comparisons of the policies are given in Table 2.1.

Table 2.1: A comparative analysis of the prominent open access (OA) policies

	DBT/ DST OA Policy[40]	CSIR OA Mandate[41]	ICAR OA Policy[42]	Horizon 2020[43]	NIH[44]	NSF[45]	Wellcome Trust[46]	Bill & Melinda Gates[47]	IDRC[48]
1. What is covered?	Final accepted manuscript (after refereeing, revision, etc.) Full-text Metadata Supplementary materials	OA for all CSIR journals All CSIR publications to be progressively made OA Published research papers Full-text Metadata	OA for all publications IR deposit mandate - Final author's version of manuscripts (preprints & post-prints) M.Sc. & Ph.D. thesis/ dissertations Summary of completed research projects Metadata	All peer-reviewed scientific publications relating to project's results Conference proceedings, Monographs, Book Chapters, etc. Research data validating results and other data as applicable Metadata	Final peer-reviewed journal manuscripts	Version of record or the final accepted manuscript in peer-reviewed scholarly journal Papers in juried conference proceedings or transactions Data resulting from NSF funding Metadata	Research papers that have been accepted for publication in a peer-reviewed journal , monographs and book chapters (full-text monograph or book chapter files, plus associated metadata files if available) Does not cover editorials Letters, conference proceedings, review articles, study protocols Does not apply to PhD theses by Wellcome- funded students. But expected to be made freely available from the EThOS repository as soon as possible.	All peer-reviewed, published research Data underlying published research results (all primary data, associated metadata, and any additional relevant data necessary to understand, assess, and replicate the reported study findings in totality)	Journal articles, books, and grey literature (including final technical reports, theses, papers, workshop reports, conference proceedings, brochures, and audiovisual products)
2. Where to make available/ accessible	Institutional Repository (IR) If IR absent, central repositories set up by DBT/ DST	IR	IR	Encourages deposit in discipline-specific repositories (Ex: PubMed Central, ArXiv, etc.) For monographs, book chapters and other long-text publications –OAPEN library If no appropriate discipline specific repository available, IR or centralised repository Insufficient- personal/ institutional/ project webpage/ accessible dropbox/ websites requiring user registration (Academia.edu, Research Gate, etc.)	PubMed Central	NSF public access repository hosted by the Department of Energy (DOE)	Research papers that have been accepted for publication in a peer-reviewed journal- PubMed Central (PMC) and Europe PMC Monographs and book chapters- PMC Bookshelf and Europe PMC	Published research - Publisher's website - PMC Underlying data - Best practice: Discipline-specific data repository - If discipline-specific unavailable, institutional research data repository or generalist repository (e.g. Dataverse, Dryad, etc.)	Articles and Books - Gold OA encouraged (for articles- OA or hybrid journal) - Green OA- publisher's website or a reasonably well-established and high quality repository Grey literature IDRC Digital Library (only if significantly valuable, as judged by grantees and program officer)

Table 2.1: Cont'd.

	DBT/ DST OA Policy	CSIR OA Mandate	ICAR OA Policy	Horizon 2020	NIH	NSF	Wellcome Trust	Bill & Melinda Gates	IDRC
3. IR requirement	Mandatory for institutions receiving core funding Recommended for others	Mandatory for every CSIR lab	Mandatory for every ICAR institute	No requirement	No requirement	No requirement	No requirement	No requirement	No requirement
4. Projects/ researchers to which/ whom the policy pertains	Projects fully/ partially funded by DBT/ DST, or performed using infrastructure built with support from DBT/ DST	Papers submitted from CSIR labs, and supported by grant from CSIR	Scholarly articles produced from the research conducted at the ICAR institutes, and funded in whole or in part by ICAR or other public funds at ICAR establishments	Every beneficiary of ERC grants except low value grants	Direct funding from NIH grant or co-operative agreement Direct funding from NIH contract Direct funding from NIH Intramural Program NIH employees	Projects funded in whole or in part by NSF grants or cooperative agreements NSF employees Intergovernmental Personnel Act assignees	All original, peer-reviewed, research publications that have been supported, in whole or in part, by Wellcome (through - Wellcome grant - co-authorship by Wellcome Investigator Award holder, Wellcome Fellow or any other individual in receipt of salary support from Wellcome - research at Wellcome Trust Centres and Major Overseas Programmes (MOPS) which has been supported through the Core Award Publications arising from the Medical Humanities Small Grants scheme not required to comply	All peer-reviewed, published research funded by the foundation, whether the funding is in whole or in part. If other funders of a multi-funded grant are concerned about adhering to the policy, discussion with the other funder to understand their concerns.	IDRC-funded project outputs including those produced beyond the funding period Generated by grantees and sub-grantees of IDRC-funded projects
5. When to deposit/ embargo limit	Within 2 weeks following acceptance for publication If the journal insists on embargo – still to be deposited within 2 weeks, but the papers would be made available at the end of embargo	Not mentioned	Immediately following acceptance for publication Max. 12 months embargo	As soon as possible; at the latest upon publication Embargo- Social Sciences and humanities- max. 12 months; Others- max. 6 months	Deposit upon acceptance for publication Max. 12 months embargo	Max. 12 months embargo - If a publisher's embargo exceeds 12 months, NSF will make available the version deposited in the NSF public access repository	Max. 6 months embargo	Accessible and open immediately, no embargo (before Jan 2017- Max. 12 months embargo) Underlying data- immediate OA upon publication of article	Article Available within 12 months of publication (post-print form) Books Available within 12 months of publication

Table 2.1: Cont'd.

	DBT/ DST OA Policy	CSIR OA Mandate	ICAR OA Policy	Horizon 2020	NIH	NSF	Wellcome Trust	Bill & Melinda Gates	IDRC
6. Usage Restrictions	Lacks clarity	Not mentioned	Written permission required from ICAR (which owns the copyright) for commercial or other purposes	Beneficiaries are encouraged to provide broader rights; Cites CC licence models as an example	Fair use	Fair use	Research papers- authors and publishers encouraged (and if Wellcome pays OA fees, requires) using CC-BY to enable free copy and re-use provided that such uses are fully attributed Monographs and book chapters- CC-BY licence preferred; non-commercial and/ or no-derivatives licences (ie CC-BY-NC, or CC-BY-NC-ND) also accepted	All publications published under Creative Commons Attribution 4.0 Generic Licence (CC BY 4.0) or an equivalent licence. Copy and redistribution of the material enabled in any medium or format to transform and build upon the material for any purpose (including commercial) without further permission or fees Data- allow reuse with no more restriction than CC BY 4.0	Creative Commons-Attribution licence [free from restrictions on use or reuse, as long as the original author(s) are properly acknowledged and cited]
7. Exemptions / Exceptions	One of the footnotes (FN1) refer to IP protection – implications not very clear	Not specifically mentioned	Documents having material to be patented or commercialised If OA policy infringed legal commitment by institute and/ or author	Results that are capable of commercial or industrial exploitation	Extreme situations, case-by-case basis Example: Death of sole author	Exceptions can be specified by the funding NSF Program or Division/ Office "for a particular field or discipline to safeguard the rights of individuals and subjects, the validity of results, or the integrity of collections or to accommodate the legitimate interest of investigators"	-	Open access publishing is a non-negotiable term included in all grant agreements No requirement to share ethically unsound or legally encumbered data	Rare exceptions- patentability of research inventions, protection of personal information, protection of researchers or subjects of research, publication in a local language journal that does not offer OA Justification to be explained in research proposal. If requested later, should be discussed with the IDRC program officer and documented

Table 2.1: Cont'd.

	DBT/ DST OA Policy	CSIR OA Mandate	ICAR OA Policy	Horizon 2020	NIH	NSF	Wellcome Trust	Bill & Melinda Gates	IDRC
8. Findability/ ease of reference/ ease of use	Metadata	Metadata Interoperability of IRs	Metadata	Metadata DOI FAIR principles for data (Findable, openly Accessible, Interoperable; increase of Re-use) Information about tools or instruments to validate results Machine readability	-	Metadata Persistent identifier Machine-readable metadata elements PDF/ A	Open access monographs and book chapters will be freely available in both html and PDF format via the repositories Publishers to submit in XML or PDF formats to PMC	Underlying data Compiled into any file type, including any necessary access instructions, code, or supporting information files, to ensure the file(s) can be accessed and used by others Dataset to be assigned persistent and unique identifier (e.g. DOI) Long term storage and preservation (e.g. meeting ISO's trustworthy digital repository standards)	-
9. Compliance/ Sanctions for non-compliance	Deposit ID to be quoted in annual reports and project completion report; and in future funding proposals	-	-	-	-	-	Review of publications during and on completion of grant period Wellcome-funded research papers detailed in applications are reviewed to ensure compliance. Ensuring compliance before formal notification of issue/ renewal of grants Where non-compliant publications are identified in an end of grant report, final 10 per cent of the 'total transferable funds' budget on the grant withheld until all papers comply	Data Checking and tracking through Chronos, a service for Gates-funded researchers co-developed by the foundation. It simplifies and manages the process of publishing under the foundation's OA Policy terms	IDRC program officers consider past compliance when making subsequent grants. Repeat grantees should document their compliance with IDRC's open access policy in new proposals IDRC may periodically undertake high-level studies of compliance across its programs

While one can clearly notice serious deficiencies in terms of the contents/ approaches of the open access policies in India from table 2.1, our findings from parts 2 and 3 of the study show serious issues with regard to the implementation as well. As mentioned earlier, to analyse the implementation of the policies we conducted a survey on the institutional repositories mandated by the DBT-DST, CSIR, and ICAR open access policies. Upon examination, we found that most of the autonomous institutions under DBT (those which are part of 'core funded institutions', as per the DBT/ DST policy) do not yet have repositories on their websites, and they have to be accessed through the central harvester. Moreover, they only contain lists of publications, that too- in some cases- dating back to 2015. The DBT central repository (where research outputs funded by DST are supposed to be published in the absence of institutional repositories), has no paper on it.[50] The DST central repository has only 19 papers in total.[51] For the CSIR institutes, lists of projects, publications (the list, abstract, and metadata), and technologies were available without any actual content. For accessing the full text of the publication, the repositories have also put in login/ registration requirement, and registration is not free or open.

But why is this happening? Our findings from part 3 of the study might throw some light in this regard. As mentioned above, in the third stage, we tried to understand how the DST/ DBT Open Access Policy is implemented; including the communication of obligations, the monitoring process, and the state of compliance. As indicated earlier, the primary tool we used in this regard

MOST AUTONOMOUS (CORE FUNDED) INSTITUTIONS UNDER DBT

- DO NOT YET HAVE REPOSITORIES ON THEIR WEBSITES

- HAVE TO BE ACCESSED THROUGH THE CENTRAL HARVESTER

- ONLY CONTAIN LISTS OF PUBLICATIONS, IN SOME CASES, DATING BACK TO 2015

CSIR OA MANDATE

✔ AVAILABLE
  - LISTS OF PROJECTS
  - PUBLICATIONS
  - TECHNOLOGIES

! BUT WITHOUT ACTUAL CONTENT

✔ LOGIN/ REGISTRATION REQUIRED TO ACCESS FULL TEXT

‼ REGISTRATION NOT FREE/ OPEN

DST CENTRAL REPOSITORY
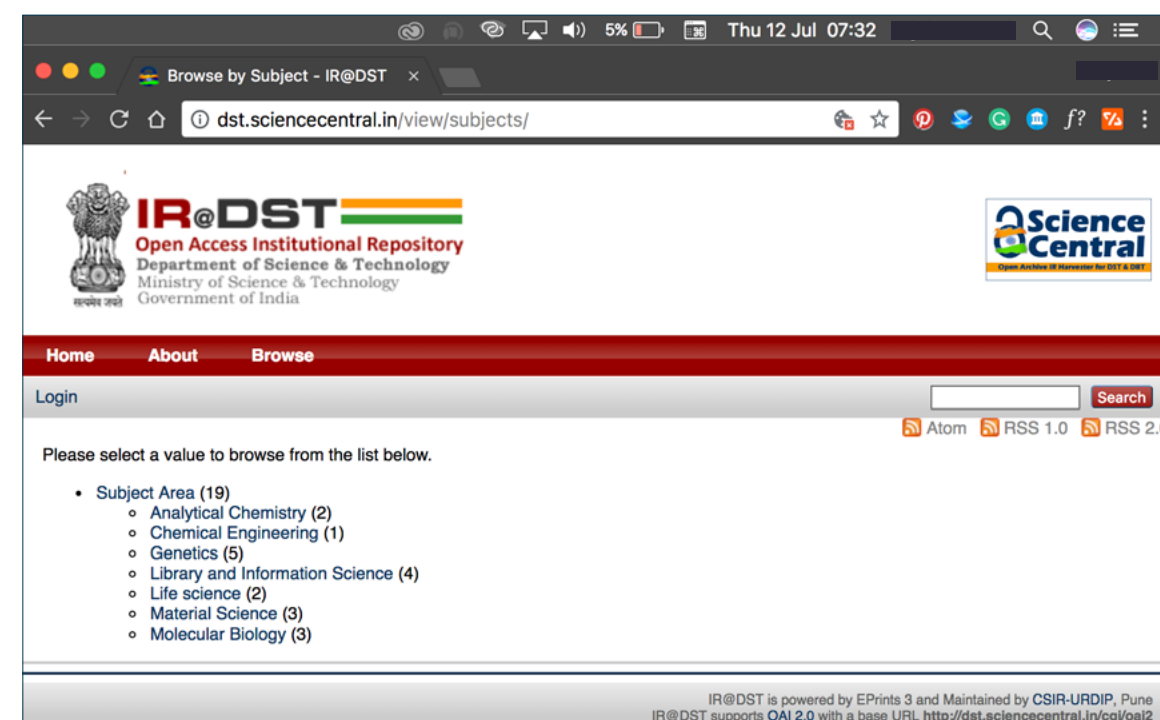
were applications under the Right to Information (RTI) Act. We initially sent an application under RTI Act to DST, requesting for a list of researchers and institutions whose research projects they fund. In response, we received a list of researchers whose projects are funded under its Clean Energy Research and Water Technology initiatives. We followed the list and sent a total of 203 RTI applications to the institutions mentioned in the list. We received a total of 138 replies and the major findings from this study can be encapsulated in three main points.

Firstly, our study shows that there is a general **lack of communication** from DST to individual institutions/ researchers with regard to the mandatory obligations under the open access policy. Among the respondents, 44.9% said that there was no specific communication from DST to the institutions/ researchers about their obligations under the open access policy, whereas 27.5% said that they became aware of these obligations through information available on the DST website.[52] It must be clarified here that in the case of the latter set of respondents as well, there was no specific mention of the policy in the terms and conditions; the sanction letter/ contract merely asked the researchers to refer to the website- not even a specific page within the website- for viewing all obligations.

Secondly, the study shows that only 17.39% researchers said that they have taken specific measures for compliance with the OA policy.[53]

Thirdly, we notice that most researchers are not aware of the mandatory reporting of deposits in open access repositories.

- **LACK OF COMMUNICATION**

- **LACK OF COMPLIANCE WITH THE OPEN ACCESS POLICY**

- **LACK OF PROPER REPORTING MECHANISM**

33.33% of respondents said that they do not have any such reporting mandates, and 5.79% said that they lack awareness about the same.[54] This is a matter of concern, as successful compliance to the provisions of a policy requires the presence of a proper reporting mechanism.

OPEN DATA

A similarly depressing scenario can be observed with regard to open data initiatives as well. For example, India features only at the 33rd position on the Open Data Barometer.[55]

What could be the reasons behind the low scores India receives in this area? In our view,

- **OPEN DATA INITIATIVES IN INDIA ARE FAILING ON TWO FRONTS**

- **SCOPE OF THE OPEN DATA POLICIES IMPLEMENTATION OF THE POLICIES**

As discussed earlier, India has a National Data Sharing and Accessibility Policy (NDSAP). Despite the intended objectives of the NDSAP, this policy- as well as other policies based on it- suffers from major insufficiencies. We would like to highlight some of them.

ONLY 7% OF GOVERNMENTAL DATA ACROSS ALL 115 SURVEYED COUNTRIES IS OPEN
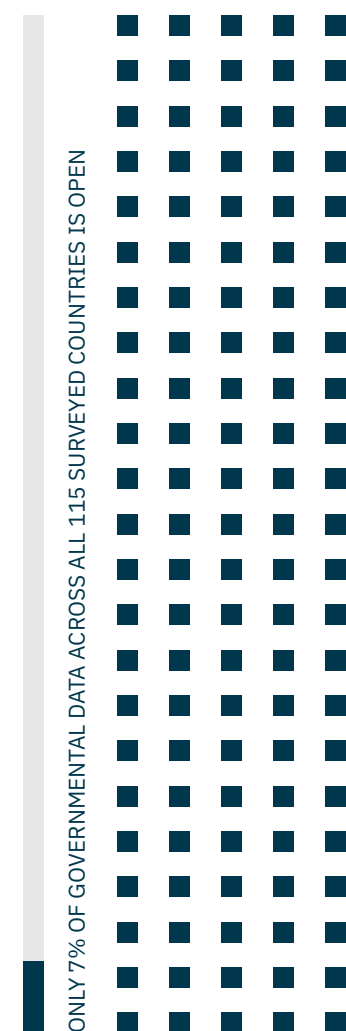
The Open Data Barometer has been produced by the World Wide Foundation and aims to assess the true impacts and prevalence of open initiatives in the entire world. As per the 2017 report of the barometer, only 7% of governmental data across all 115 countries they surveyed is open and it provides various other important statistics in the area.[56]

The most important limitation of NDSAP is that it takes sub-optimal approaches in mandating open access to government data, wherein no privacy concerns or national security concerns exist.

The policy lacks clarity on the grounds on which data can be restricted from being available or what makes a dataset 'high value'.

The concept of '**registered access**' to certain datasets is also problematic. In its current form, the NDSAP includes datasets containing identification particulars in the 'Non-Sharable Data' category. Since identification particulars can be removed while still allowing for the data to be shared, there is no justification for restricting such data entirely. Data that are accessible only through registration are also priced and, as in the case of the recently proposed MoSPI guidelines, many datasets have restrictions with regard to use.

Payment requirements and usage restrictions are contradictory to the concept of open data, and they have no justification in the context of government data. Access should be provided without requiring any permission and without payment of any fees, and restrictions on use should be deleted. This is for two reasons: first, all the data within the scope of NDSAP are generated from public funds and therefore the public should have the right to access and use them without any restrictions; and second, access to complete datasets-

and their unrestricted use- is required for better policymaking/ knowledge creation. This issue is particularly important in an era where policy makers may rely on machine learning and artificial intelligence for drawing policy decisions. Only with more access to quality data, one can reduce the potential biases in the decision making.

The current version of NDSAP also **lacks specific mandates for accessibility of data by persons with disabilities**. Access for persons with disability requires availability of datasets in machine-readable and interoperable formats that are compatible with softwares such as screen readers. The data display should also not lose its quality upon zooming. Moreover, a user should be permitted to reproduce the datasets and mine them in order to adapt them onto software or media of choice, so that it can be accessed by persons with various kinds of disabilities. Lack of specifications as to availability of and compatibility with useful formats, and requirement of permission for reproduction and reuse, is therefore a major drawback of the policy.

It is also important to observe that **no effective communication mechanisms** are specified for query resolution, feedback, and trouble-shooting. This suggests that the policy has envisaged top-down sharing of datasets without any interaction with users as to their needs, preferences, and criticisms. Such an approach not only takes the focus away from the primary stakeholders in any open initiative, but also reduces the ease of use and quality of datasets.

It also needs to be mentioned that there is **no clarity as to the monitoring and safeguarding of datasets** being generated by various government departments. In the absence of well-defined and strong mechanisms for the same, the accountability of the departments and the continuity of the envisaged process are substantially compromised.

Moreover, the policy **fails to recognise the necessity of data skills in government departments**, and doesn't mandate constant capacity building mechanisms. The handling and management of massive numbers of lengthy and complex datasets, and taking care of privacy concerns by removing identifying particulars, require proper training and expertise in the related technologies. A comprehensive policy should provide for the necessary capacity-building for the institutions and persons in charge of the functioning of the policy.

Further, although some usage restrictions are mentioned, it lacks clarity in terms of the exact **copyright licensing.** Mentioning the exact copyright licence will remove any confusion or uncertainty regarding the kind and extent of rights that the users have with respect to the shared datasets. Ideally, all government data - with as few and as well-defined exceptions as possible – should be in the public domain once identifying particulars are removed. The corresponding licence could be something equivalent to the Creative Commons CC0 licence. Detailed discussions on the different kinds of
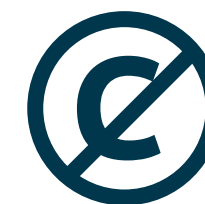
creative commons licences can be found in Chapter 4 of this report.

Open data can contribute substantially to citizen participation in science/ policy making and in this context we need to emphasise that as the NDSAP stands currently, the following are significantly hindered -

(A) EXPLORATION OF THE FULL POTENTIAL OF COLLABORATION IN SCIENCE/ POLICY MAKING;

(B) ENORMOUS SCOPE OF TEXT AND DATA MINING (TDM) FOR BETTER SCIENCE/ POLICY MAKING

Collaboration is significant for many forms of data use, especially in cases where government data is used in citizen participation efforts. Communication of data without restrictions is particularly necessary in this context. In the current technological scenario, collaboration can be done in a holistic manner only if the data is available in formats that are easy to use by and share with different people. It is also important for the data to be easily findable by all collaborators at various points of time through globally unique and persistent identifiers.

The TDM process requires at least a temporary reproduction of the content to be analysed. Therefore, in order to utilise the advantages offered by TDM for analysing data, it must be available in machine-readable and interoperable formats, and the users must have permission to reproduce the data. Although the NDSAP provides for machine-readability, it fails to address the other requirements for facilitating

TDM. Even the machine-readability requirements are often ignored by many of the ministries/ departments.

Finally, as discussed earlier, **the growing reliance on machine learning and AI for various purposes, including making policy decisions, demands free availability and accessibility of the widest possible variety of information.**

This is important not only to enrich the systems, but also to reduce chances of them consuming partial or limited information, which may lead to bias in their functioning. We are of the opinion that the NDSAP in its present form is a disappointing policy in this regard.

Most of the issues we highlighted in the context of NDSAP are equally important for most of the state level data sharing policies also. For example, if one looks at the Telangana Open Data policy, one can observe that the policy hasn't given due importance to usability and privacy protection.[57] It has also adopted a very narrow definition of data. Since the NDSAP guides all state-level policies, this is hardly surprising. However, the reflection of the limitations of NDSAP on the state level policies illustrates the urgency in evolving a more comprehensive national level open data policy.

While the discussions in the preceding paragraphs highlight the limitations with regard to the scope and contents of the
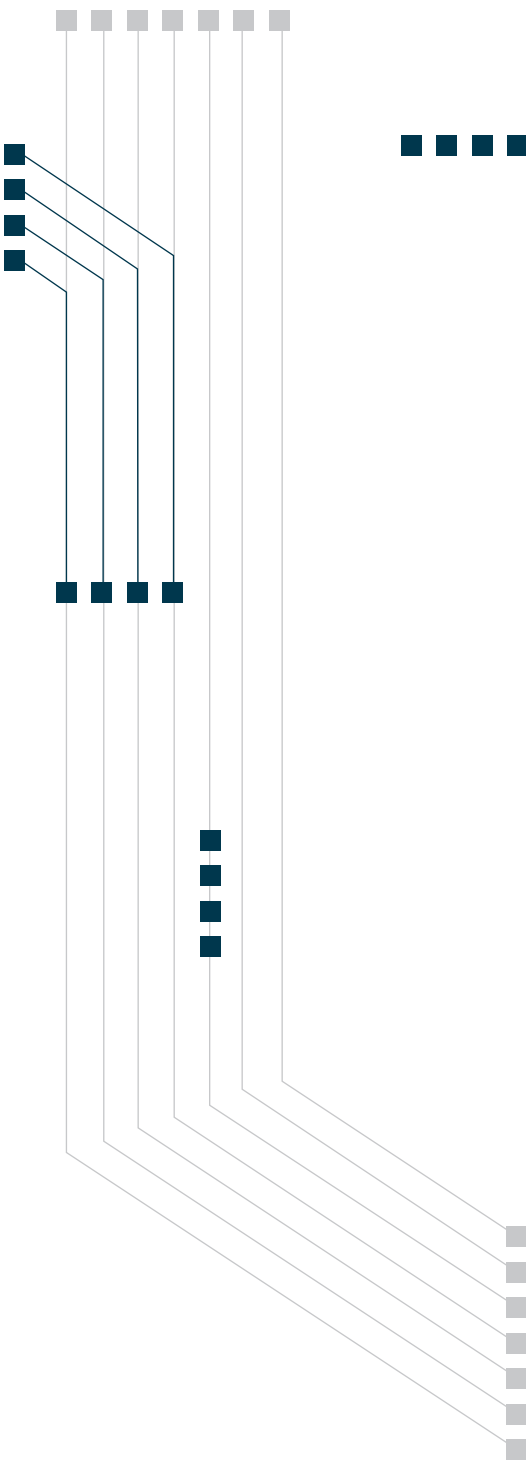
current open data policies in India, it needs to be mentioned here that even the existing provisions in the policies are not properly implemented. For example, users contend that by the time data is published on websites of most ministries, it is already outdated. In some sectors even annual data is **not published timely.** Historical and comparable data are also **difficult to obtain**. While physical and financial data are published more regularly (monthly to annually, depending on the dataset), data on other aspects, such as environment, are released in an irregular and ad hoc manner.

An empirical analysis conducted by us has highlighted some of the specific issues with regard to the implementation of the policy. In order to study compliance to NDSAP by the central and state governments, a thorough search was initially conducted on websites of different ministries and departments to see if any negative list has been uploaded and if any public communication has been made by the department/ Ministry in lieu of compliance with the policy. Following that, the datasets uploaded by the concerned ministry on the data portal were analysed to determine if they were sufficiently complete, updated. Not much was revealed in the first round of research, so a second round was undertaken wherein the Chief Data Officers (CDOs) of the various departments/ ministries were called to extract information regarding compliance by their ministry/ department. Since no satisfactory response was received in the second round as well, an application was filed under the RTI Act with the Department of Science and Technology which is the nodal department for the

implementation of the policy. However, no response to the same has been received yet.

Since NDSAP has been formulated only as a policy and not as a legislation, it has no binding force on the concerned ministries/ departments. As we noted earlier, the policy imposes limited responsibilities on the ministries and departments under the OGD initiative, however even those responsibilities have **not been adequately complied** with by the ministries/ departments.

With regard to the obligation for preparing **'Negative Lists',** we observe that most ministries have not prepared any such list and even in cases wherein they have prepared a list, few made the same public. As per NDSAP, the ministries/ departments were also expected to upload five high value datasets within three months. However, only a few ministries/ departments have followed the same, with some ministries having no dataset on the portal. As per the policy, all the ministries/ departments were also required to upload all datasets on the portal within six months. However, the same has not been done yet and most ministries provide only very few datasets. In this context, it needs to be highlighted that non-disclosure of the list of categories under which a Ministry collects data, and absence of any mandate for such disclosure, also makes it impossible to determine if the Ministry has data on any particular aspect.

As per NDSAP, Ministries/ Departments have to appoint CDOs. However, we

could **not find CDOs for most ministries/ departments** and in some cases, the status was shown as "awaiting new nomination". In some cases, the CDOs we contacted did **not seem to be aware of their responsibilities as per NDSAP.** Since the CDO has an important role to play in the implementation of the policy, absence of appointment means that there may not be any compliance with the policy.

NDSAP requires the data to be in open data formats. Data often exists in formats other than the formats specified in the guidelines. Therefore, **machine readability, interoperability are not ensured.** As per NDSAP, the designated officer is also required to "prepare and contribute the metadata in predefined format for the Catalogs and Resources (Datasets/ Apps)". The key metadata elements are 'Title, Description, Category, Sector/ Sub-Sector, Dataset Jurisdiction, Keywords, Access Method, Reference URLs, Data Group Name, Frequency, Granularity of Data and Policy Compliance. All the metadata elements must be filled with utmost quality and ease of use". Unfortunately, metadata are missing in many of the datasets.

To summarise, India currently lacks a comprehensive and enforceable open data sharing policy at the national level as well as the state levels. As our study indicates, it is also important to have monitoring and compliance mechanisms.

Some of the major limitations with regard to the working of the Indian Government Open Data Portal have been highlighted by three researchers who conducted an empirical study on open government data in India. Though based on a very small sample, their study shows that only half of their respondents have used the OGD portal.[58] As many as 24.1% respondents who had used the portal also stated that they found the quality of data on the portal to be poor.[59]

OPEN EDUCATIONAL RESOURCES

As one may recall from the discussions in the earlier part of this chapter, India has taken many initiatives in the area of open educational resources (OER). But, as in the case of open access initiatives and open data initiatives, we see a huge gap between the noble goals behind many of the initiatives and the way they are implemented. While some of the problems are attributable to lack of clarity on many critical areas like scope of rights provided to users, some of the other issues are with regard to the way content is handled, including lack of regular updates.

While a detailed discussion on the failures of the current OER initiatives in India may not be warranted for the purposes of this report, the following table (Table 2.2) can provide readers some insights on how issues like accessibility, lack of clarity regarding the licenses, and lack of regularity in updating contents severely limit the potential of many open educational resources in India.

Table 2.2:	Founders	Components	Language	Accessibility	Licence	Limitation	Regularity of update/ last update
TESS India	The Open University and Save The Children India, funded by UK Aid	Text and video based OER-Teacher professional development programme;OER to support the adoption of more learner-centred, inclusive, participatory, engaging, effective classroom pedagogy	In addition to pan-Hindi and pan-English versions, there are translated, localised versions in three varieties of Hindi, as well as Odia, Kannada, Assamese and Bengali.	-	Except where otherwise noted, content licensed under a Creative Commons Attribution-ShareAlike 3.0 Unported License	-	Not clear; but last tweet was a year ago
National Digital Library of India	Ministry of Human Resource Development; developed by IIT- KGP	Virtual repository of learning resources with a single-window search facility. Digital content including books, articles, videos, audios, theses etc. from various disciplines, and for users from varying educational levels and capabilities. IIT also has a YouTube channel	English, Hindi, Bengali	-	Depends on permissions given by the source organisation of the content.	Browsing can be done without any restriction/ requirement, but registration and login required to access full text. Moreover, although the website itself is free and metadata of content can be accessed, full-text can be accessed depending on rights reserved by source organisations.	Not clear; but last tweet was a year ago
National Repository of Open Educational Resources (NROER)	Department of School Education and Literacy, Ministry of Human Resource Development, Government of India. Managed by the Central Institute of Educational Technology, National Council of Educational Research and Training.	Digital and digitisable resources across all stages of school and teacher education, and multiple disciplines. Web platform intended for collaborative creation of digital content as well as its organization along a concept map	Resources are available in about 29 different languages, including tribal languages	-	Creative Commons-Attribution-ShareAlike	-	Collaborative aspects of the platform have seemingly been inactive for some time, though accessible material is hosted on the website
National Institute of Open Schooling (NIOS)	MHRD	Vocational, Life Enrichment and community oriented courses besides General and Academic Courses at Elementary, Secondary and Senior Secondary level	English, Hindi	Has screen reader access; text can be resized; contrast can be adjusted	Material can be reproduced free of charge in any format or media without requiring specific permission. Attribution required. This is subject to the material being reproduced accurately and not being used in a derogatory manner or in a misleading context.	The courses are not free, although concessions are given to certain categories of students. Some material explicitly identified as being the copyright of a third party. Authorisation to reproduce such material must be obtained from the copyright holders concerned.	-

Table 2.2:	Founders	Components	Language	Accessibility	Licence	Limitation	Regularity of update/ last update
Karnataka - Open Educational Resources (KOER)	Karnataka's Department of State Educational Research and Training (DSERT)	Wiki for contextual teaching resources for all grades and subjects for Karnataka school teachers. There is an option to contribute as well	English, Kannada	-	Creative Commons-Attribution-NonCommercial-ShareAlike	Only non-commercial use	-
Open Educational Resources for Schools	Homi Bhabha Centre for Science Education (HBCSE), Tata Institute of Fundamental Research (TIFR), Maharashtra Knowledge Corporation Limited (MKCL), and Indian Consortium for Educational Transformation (I-CONSENT)	Educational resources for teaching and learning Science and Math, for Grades 1 to 10	English	-	Although the material can be used for free, the website mentions that they are reserving copyright	Registration and login are necessary to access the material, and although registration is free, one needs to provide specific details of institution and location in order to register. Also, website mentions that copyright is reserved.	-
SAKSHAT	MHRD	The portal is expected to be the main delivery platform for the contents developed under the National Mission on Education through ICT (NMEICT). It contains many e-repositories for school and higher education. These include e-PG Pathshala, National Program on Technology Enhanced Learning (NPTEL) and A-View Virtual Classrooms.	English, but has a google translate option	Font size can be adjusted	Contents may not be reproduced partially or fully, without due permission from MHRD. Proper acknowledgment necessary. Contents cannot be used in any "misleading or objectionable context".	Contents of the website are not permitted to be reproduced partially or fully, without due permission from the MHRD. They also cannot be used in any "misleading or objectionable context".	-
Shodhganga	INFLIBNET centre	Repository of Indian Electronic Theses and Dissertations	English	-	-	-	-

Table 2.2:	Founders	Components	Language	Accessibility	Licence	Limitation	Regularity of update/ last update
NPTEL	Seven IITs (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee), IISc, and other premier institutions around India and funded by the MHRD	Learning materials in Science and Engineering adhering to the syllabi of All India Council for Technical Education and the slightly modified curricula of major affiliating Universities. Videos on technical lectures (content available in MPEG-4,flv, and 3gp formats, and can be accessed for free through their YouTube channel and the website)	-	-	Creative Commons-Attribution-NonCommercial-ShareAlike	-	-
Open Source Courseware Animations Repository (OSCAR)	IIT Bombay	Repository of web-based interactive animations and simulations, referred to as learning objects (LOs), for teaching and learning concepts in science and technology. These could be useful not only for a classroom environment but also for enabling independent learning and distance education.	English	-	Creative Commons-Attribution-NonCommercial-ShareAlike 2.5 India	-	-
SWAYAM	MHRD and AICTE	Free online courses (taught in classrooms from 9th standard till post-graduation)	English and Hindi	-	Contents may not be reproduced free of charge, without due permission from MHRD. Proper acknowledgment necessary. Contents can not be used in any "misleading or objectionable context". In case 3rd party copyright involved, permission to be obtained from such 3rd party	Permission required, cannot be used in 'misleading or objectionable context'. Fee charged for certification for course	Seems regular, latest course mentioned starts from June 2018.

REPLICATION STUDY
INNOVATION POLICY
PLATFORM FINDINGS

Finally, we would also like to share some of our findings with regard to a replication study we conducted on the 'Open Science Country Note - India', available on the Innovation Policy Platform.[60] Since it is one of the only efforts that have been made to study the status of open science in India, our objective was to test whether their findings with regard to the working of the mentioned organisations match our results. It must be mentioned here that in the note, although they have used the word 'open science', they have primarily focused on organisations which claim to provide access to their resources free of cost.

Interestingly, contrary to many of the findings in the note, we found that many of the databases mentioned in the note do not provide access to the resources mentioned without restrictions.

For example, the note says that National Spatial Data Infrastructure (NSDI) was set up to make spatial data available and accessible. However, during our analysis we observed that apart from data standards, details of officers, and reports, not much else is available on NSDI webpage. Similarly, the note has mentioned that the National Remote Sensing Centre (NRSC) archive allows the user to select, browse and download data products. However, our research found that data products actually have to be purchased on the site, and the list of open/ free data is completely empty.

It is possible that the country note has given an overview of the claims made by various organisations regarding openness, without verifying those claims.

It needs to be specifically mentioned that most of the mentioned organisations do not have adequately searchable or user-friendly websites.

Some organisations like ICAR also impose various usage restrictions through their policy, as discussed previously. In many cases, such restrictions contradict the organisations' claims of being 'open'. In many ways the results of this replication study is providing just a mirror image of the status of open initiatives in India - many of the open initiatives in India started with noble objectives and major claims; but as the empirical data in this chapter shows, many of them are far away from what they claim to be, both in terms of contents as well as implementation!

The previous chapters highlighted the need for openness in science, the severe insufficiencies of attempts made to address the crisis in science, and the chronic issues in implementation of various open initiatives in India. It is clearly evident that the status quo needs to be challenged and changed. But how can the status quo be changed to enable a stronger/ sustainable open science movement in India? Can top-down approaches bring in the desirable changes? As one may notice from the discussions on the implementation of different open access/ open data policies in India, top-down approaches often fail in implementation due to non-participation of key stakeholders and their disconnect from practical realities. If the aim is to effect sustainable changes in science, a grassroots-level, bottom-up approach, that takes into consideration the perspectives of diverse stakeholders, is required. It is in this context that we conducted a survey among one of the most important stakeholders - researchers to better understand the challenges involved in implementing open science practices.

The survey data provides insights on attitudes and practices of Indian researchers with respect to issues like open access, transparency, reproducibility, and desirability of legal/ policy changes in the area. This survey was conducted in two phases, and the detailed methodology is available in Appendix 1. The questionnaire used for this survey is available in Appendix 2. This chapter reports the findings based on merged data from both phases. We have merged the data for two reasons- similarity in data trends in both phases, and ease of communication of findings.
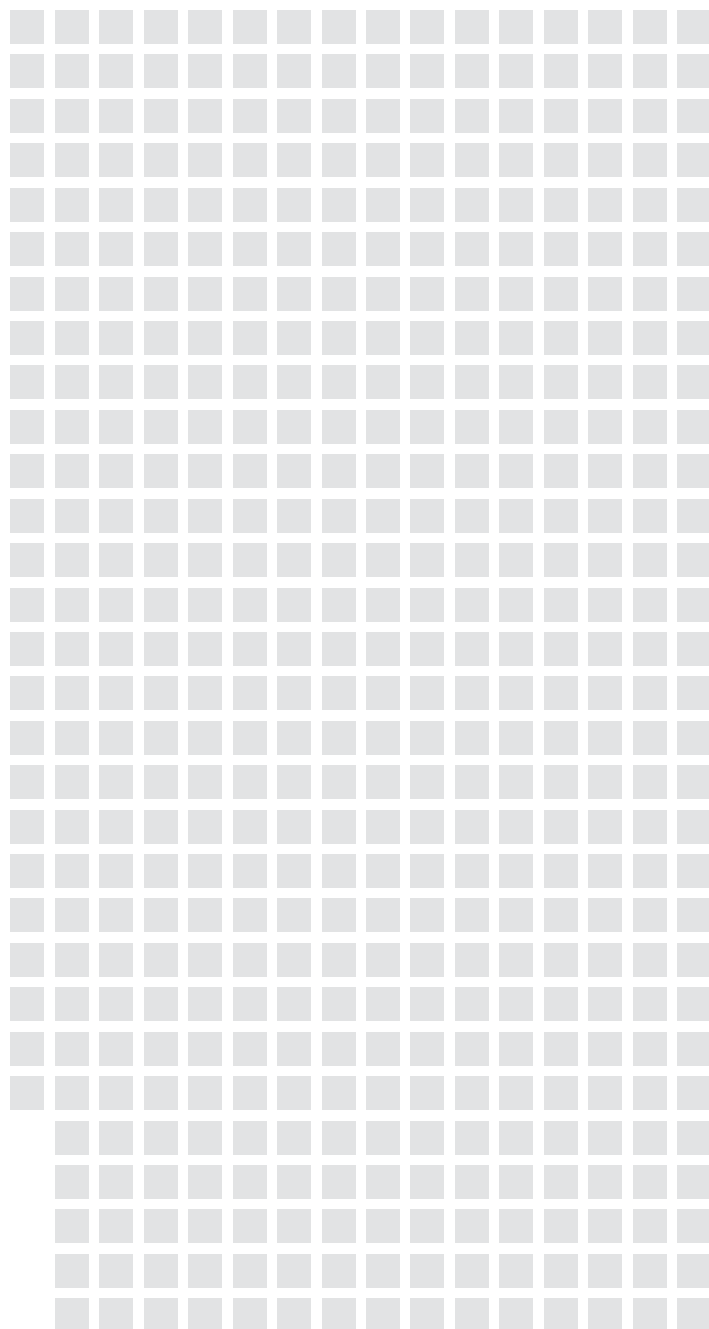
Survey Methodology

The primary purpose of the survey was to gain more insights on attitudes and sharing practices of Indian researchers with respect to issues like open access, open science, transparency, reproducibility, and collaborations.

PHASE I

The first phase of the survey was conducted between January 21st, 2017 and June 21st, 2017. The survey instrument was a questionnaire containing 45 questions in English. It was divided into nine sections- basic information, open access, open science, collaborations, transparency, accessibility, reproducibility, legal and policy measures, and institutional practices.

RESPONDENTS

Due to feasibility concerns, the sample was restricted to a limited number of disciplines and institutions. The fields of Economics, Law, Mechanical Engineering, Medicine, and Physics were selected in this regard to ensure diversity. Upon selection of these disciplines, the top three institutions in these fields, in terms of research outputs and quality of faculty, were identified. Since many of the existing ranking systems have serious methodological limitations, an alternative approach was adopted in this regard. Three researchers from every one of these fields were requested to rank top institutions in their area. In cases where uniformity was observed in the responses, we selected those institutions. In cases where differences of opinion were observed among the researchers, we approached more researchers until a majority opinion was observed. However, for one discipline (Physics), despite these efforts, there was consensus only with regard to two institutions. The researchers working in the selected institutions were identified using the respective institutional websites, and their email addresses were collected from there.

An online link to the survey questionnaire was sent through an online platform (Survey Monkey) to the above identified sample. In cases of low responses, the institutional heads were contacted for permission to conduct the survey on campus. Our team members made personal visits to those campuses where permission was granted. During those visits, some respondents filled the physical copies of the questionnaire, while others preferred to complete the survey online due to environmental concerns or paucity of time.

FIG. 01.1. GENDER

66.60%
MALE

0.21%
OTHERS

33.19%
FEMALE

FIG. 01.2. CURRENT ACADEMIC POSITION

25.52%
PH.D. FELLOW

6.28%
RESEARCH FELLOW

17.36%
OTHERS

28.24%
ASSISTANT PROFESSOR

11.51%
ASSOCIATE PROFESSOR

11.09%
PROFESSOR

FIG. 01.3. DISCIPLINE

16.53%
MECHANICAL ENGINEERING (MEC. E.)

17.15%
LAW

20.29%
OTHERS

12.13%
PHYSICS

9.62%
ECONOMICS
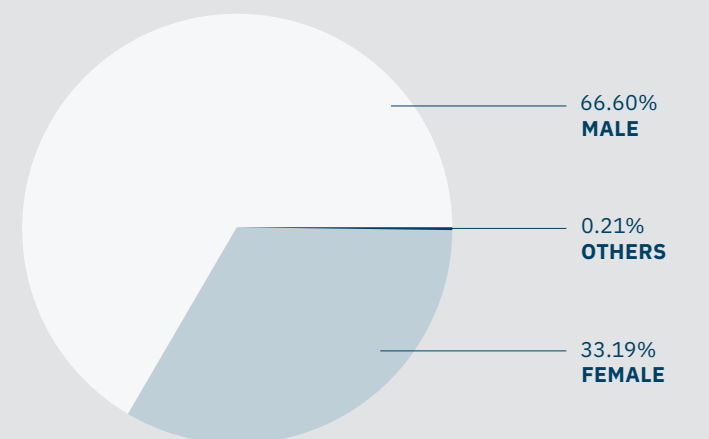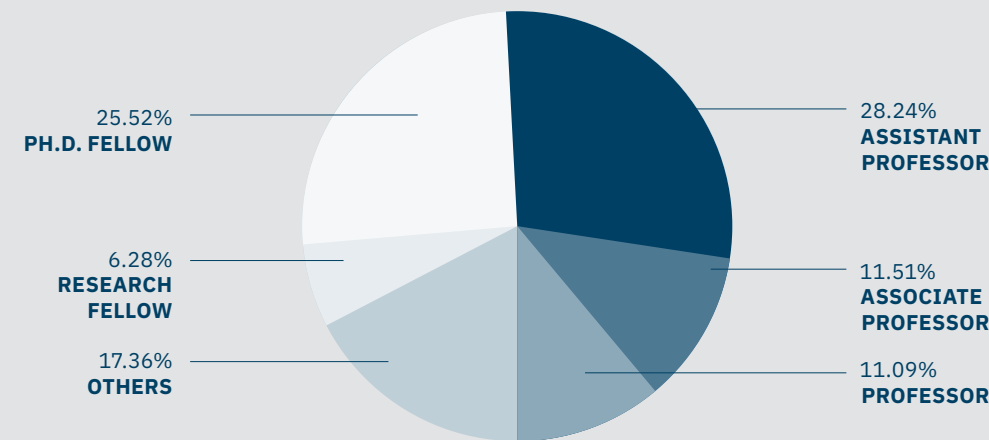
24.27%
MEDICINE

PHASE II

In Phase II of our survey, the scope of the survey was expanded to include researchers from any discipline and any institution located in India. The sampling approach for Phase II is therefore different from that in Phase I; a single open web link was used for collecting responses. This link was sent to various Indian academic/ research institutions; and also shared on social media and through personal contacts. Although the survey instrument is essentially the same as the one used in Phase I, slight modifications had been made to accommodate more disciplines and also to correct some errors observed in the questionnaire used in Phase I.

This chapter provides an overview of the findings from this survey. It also provides category-wise data wherever relevant.

The complete data from the survey can be accessed at **https://osf.io/9c6af/**, and the readers are encouraged to use the data for any purpose, including more analyses and replication studies.

PERCEPTIONS REGARDING OPEN SCIENCE

In order to understand the respondents' perceptions regarding open science, the survey had asked them if they were familiar with the concept of open science, and if they thought that open science was important for research. We also asked questions regarding openness as a value, if they thought publicly funded research should be openly available, and the perceived effects of open access.

FIG. 02. FAMILIARITY WITH OPEN SCIENCE
Are you familiar with the concept of 'open science'?

■ YES   ■ NO

Yes 55.29 %   **No** 44.71 %
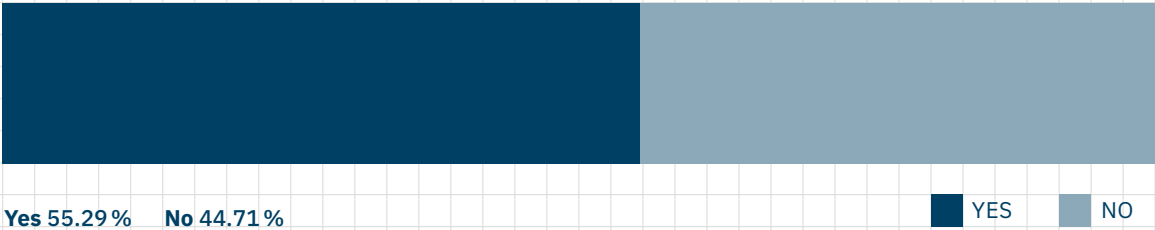
Among the respondents, 55.29% stated that they are familiar with the concept of open science.[1] It is important to note, however, that only 78.58% of the total number of respondents have responded to this question, which implies that some who were not familiar with the concept may have skipped the question instead of choosing the 'no' option. Familiarity seems to be the highest in the field of Mechanical Engineering (67.65%) and lowest in Economics (30.56%).[2]

FIG. 02.1. DISCIPLINE

ECONOMICS

30.56%   69.44%

MEDICINE

48.19%   51.81%

LAW

53.23%   46.77%

PHYSICS

60.00%   40.00%

OTHER DISCIPLINES

63.63%   36.36%

MEC. E.

67.65%   32.35%

FIG. 02.2. CURRENT ACADEMIC POSITION

ASSISTANT PROFESSOR

45.71%   54.29%

ASSOCIATE PROFESSOR

46.67%   53.33%

OTHER DISCIPLINES

53.33%   46.67%

PH.D. FELLOW

63.64%   36.36%

PROFESSOR

65.85%   34.15%

RESEARCH FELLOW

68%   32%

■ YES   ■ NO
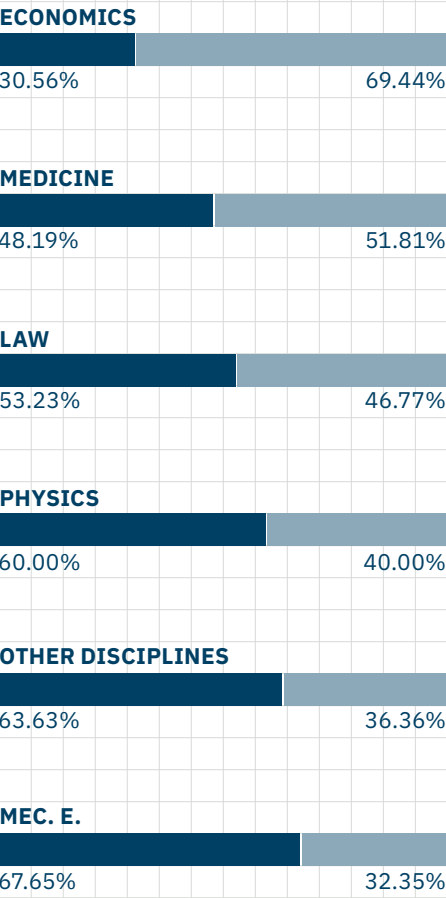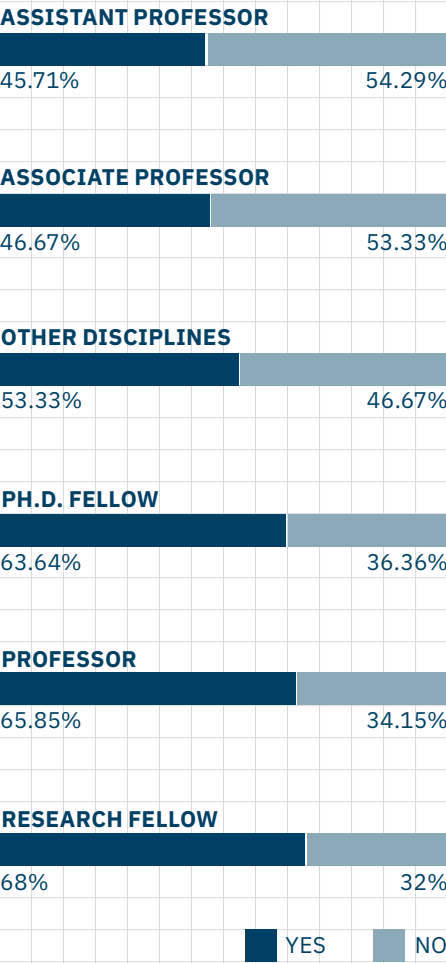
FIG. 03. SIGNIFICANCE OF OPEN SCIENCE
Do you believe that open science is important for research?

Yes 89.74 %   **No** 3.08 %   **I don't know** 7.18 %

■ YES   ■ NO   ■ I DON'T KNOW
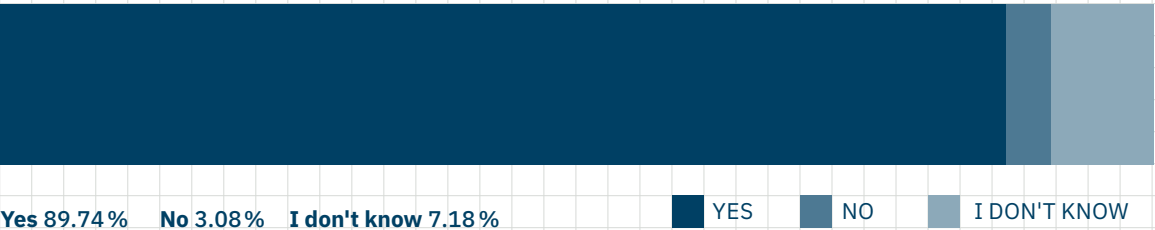
A majority of the respondents were of the view that open science is important for research (89.74%;)[3], and that all publicly funded research should be openly available (91.96%)[4]. Among various disciplines, the percentages of respondents who feel that open science is important for research are similar and overwhelmingly high (Law- 96.67%, Medicine- 91.89%, Physics- 88.89%, Mechanical Engineering- 88.37%, Economics- 81.82%, Other Disciplines- 87.23%).[5]

In fact, there also seems to be some amount of agreement regarding openness being a core value of science (86.86%)[6]; and that open access improves research (84.71%)[7], provides for more equitable distribution of information (87.4%)[8], and ensures reproducibility (75.82%)[9]. Moreover, it was interesting to observe that there does not seem to be an agreement on the statements that open access reduces the quality of research (18.15%)[10] and leads to free riding (31.3%)[11].

FIG. 04. PERCEPTIONS REGARDING OPENNESS AND OPEN ACCESS
Do you agree or disagree with the following statements?   (in %)

STRONGLY AGREE	AGREE	NEITHER	DISAGREE	STRONGLY DISAGREE

A. Openness is a core value of science

| 43.43 | 43.43 | 9.65 | 2.95 | 0.54 |

B. All publicly funded research should be openly available

| 52.01 | 39.95 | 4.29 | 2.14 | 1.61 |

C. Open access will improve research

| 48.79 | 35.92 | 11.80 | 2.41 | 1.07 |

D. Open access provides for more equitable distribution of information

| 46.65 | 40.75 | 8.58 | 2.68 | 1.34 |

E. Open access ensures more reproducible research

| 36.96 | 38.86 | 17.66 | 5.16 | 1.36 |

F. Open access will reduce the quality of research

| 6.23 | 11.92 | 20.33 | 34.69 | 26.83 |

G. Open access will lead to free riding on research

| 9.97 | 21.33 | 31.86 | 25.76 | 11.08 |

Many respondents have cited 'contribution to society and social needs' as one of the important factors that motivated them to become a scientist or a researcher (42.47%)[12].

FIG. 05.1. MOTIVATION FOR BECOMING RESEARCHER/ SCIENTIST
Which of the following factors influenced your decision to become a researcher/ scientist?   (in %)

59.62   I enjoy research/ intellectual pleasure

42.47   Contribution to society/ addressing social needs

35.98   Intellectual growth

24.27   Contribute to the progress of science

20.50   Professional gains

6.28   Family/ peer influence

5.65   Financial reasons
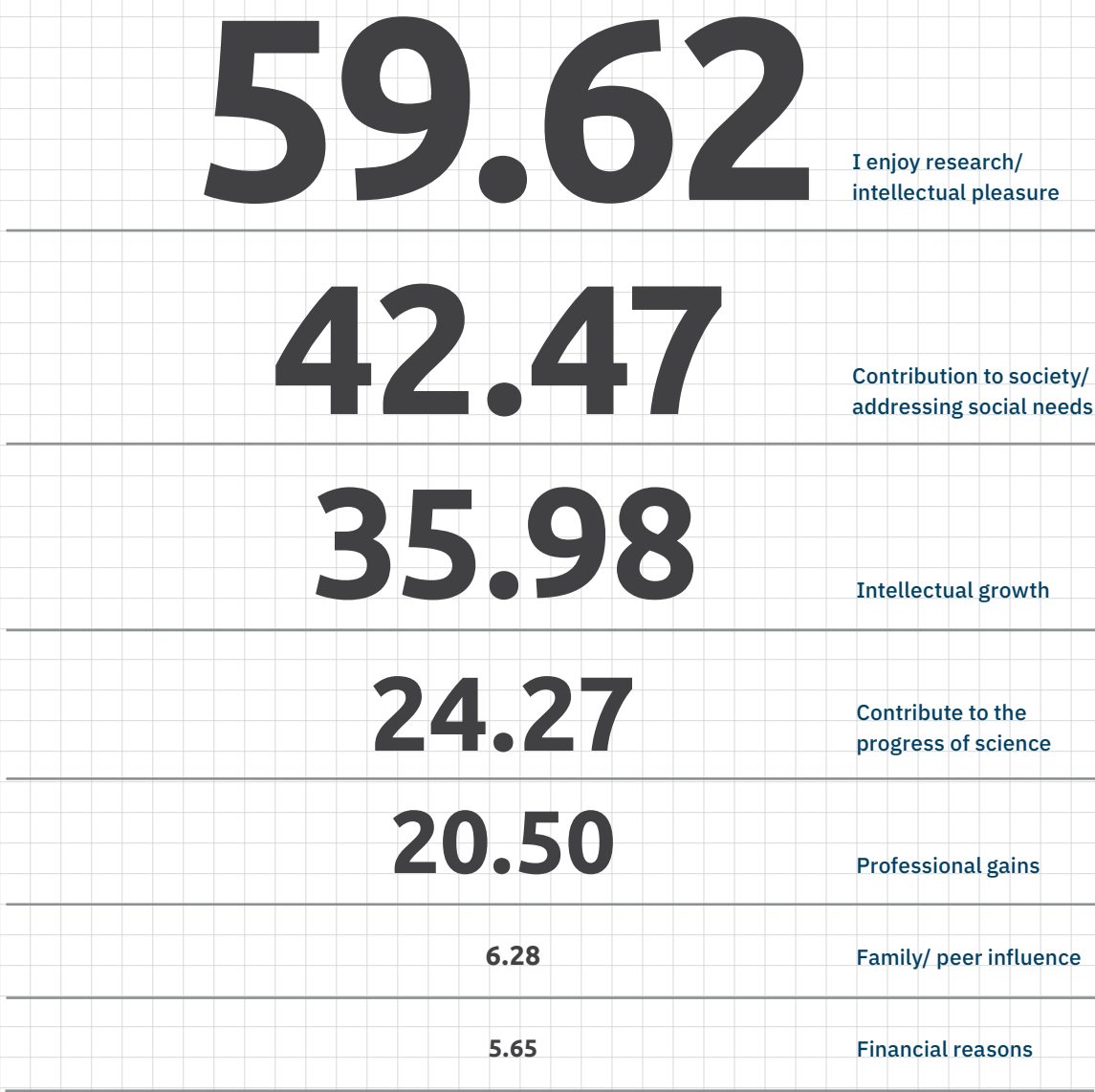
Has this motivation been demonstrated in their practices?

Unfortunately, no!

As expected, a majority of the respondents have relied upon data (59.5%)[13] or publications (78.76%)[14] openly available on the internet for their research

FIG. 05.2. USE OF OPENLY AVAILABLE PUBLICATIONS/ DATA
For your research have you ever used any publications/ data available openly on the internet? (in %)

PUBLICATION

Yes 78.76   **No** 16.40   **I don't know** 4.84

DATA

Yes 59.50   **No** 33.64   **I don't know** 6.85

■ YES   ■ NO   ■ I DON'T KNOW
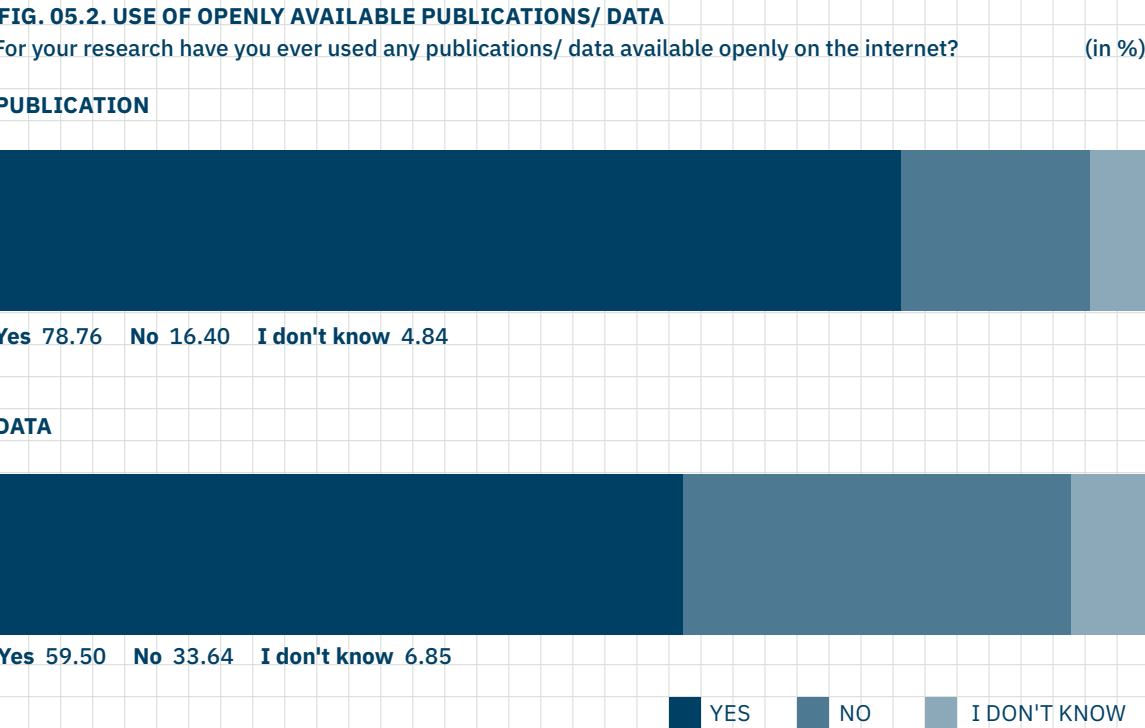
Have they adopted open sharing practices to contribute to the knowledge pool that they themselves have benefited from?

FIG. 05.3. USE VS. SHARING

31.78%
RESPONDENTS WHO
SHARE DATA THROUGH
OA REPOSITORIES

RESPONDENTS
WHO RELY ON DATA
OPENLY AVAILABLE

RESPONDENTS WHO
RELY ON PUBLICATION
OPENLY AVAILABLE

36.74%
RESPONDENTS WHO
SHARE PUBLICATION
THROUGH OA
REPOSITORIES
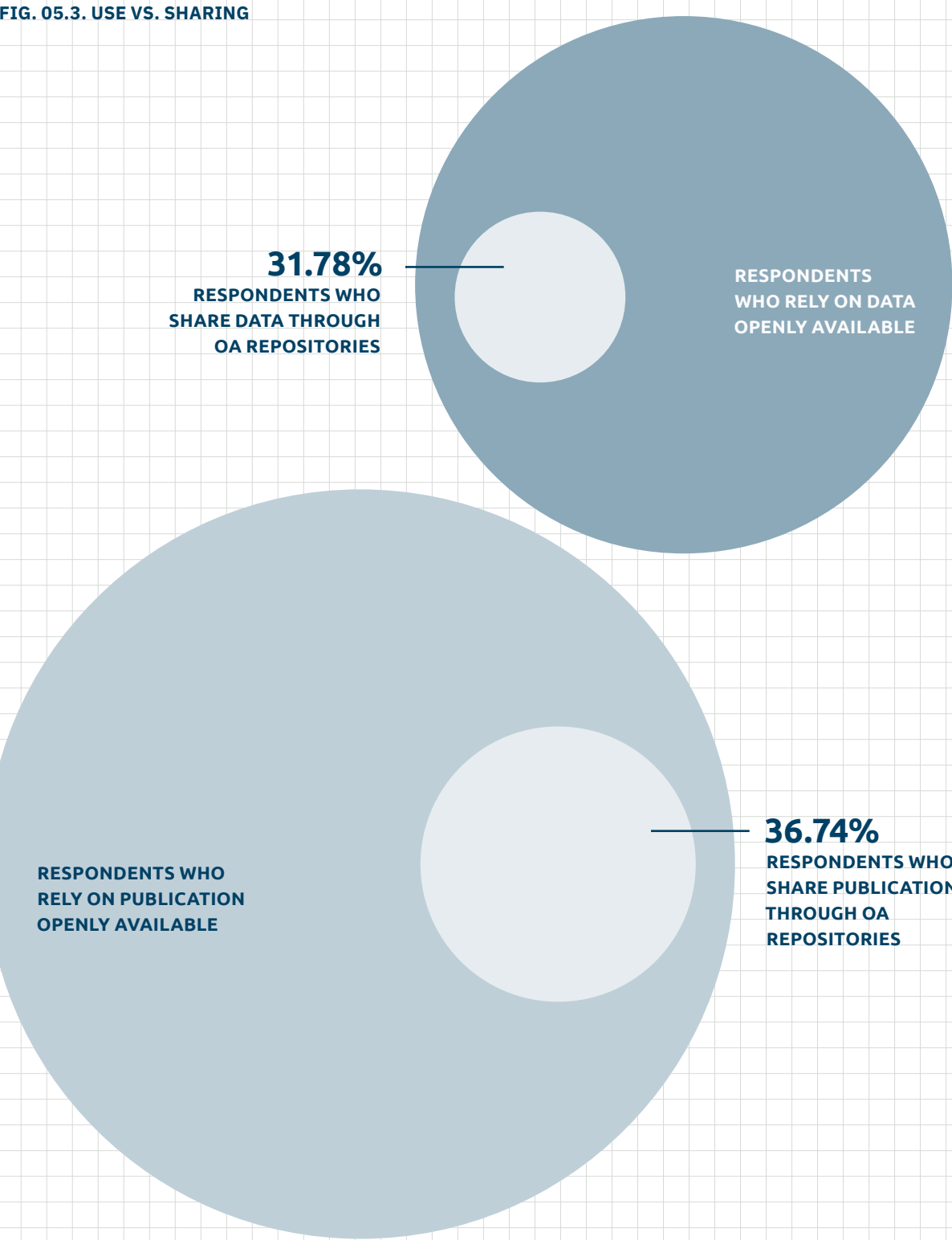
FIG. 05.4. COMMERCIAL USES OF RESEARCH OUTPUTS BY OTHERS
Should other researchers be allowed to make commercial uses of your research outputs? (in %)

8.45
Yes, if I get a share of
non-monetary benefits

14.08
Yes, if I get a share of
monetary benefits

36.90
Yes, if I get a share of
both monetary and
non-monetary benefits

16.62
Yes, even if I do not
receive any monetary or
non-monetary benefits

4.79
Other

19.15
No
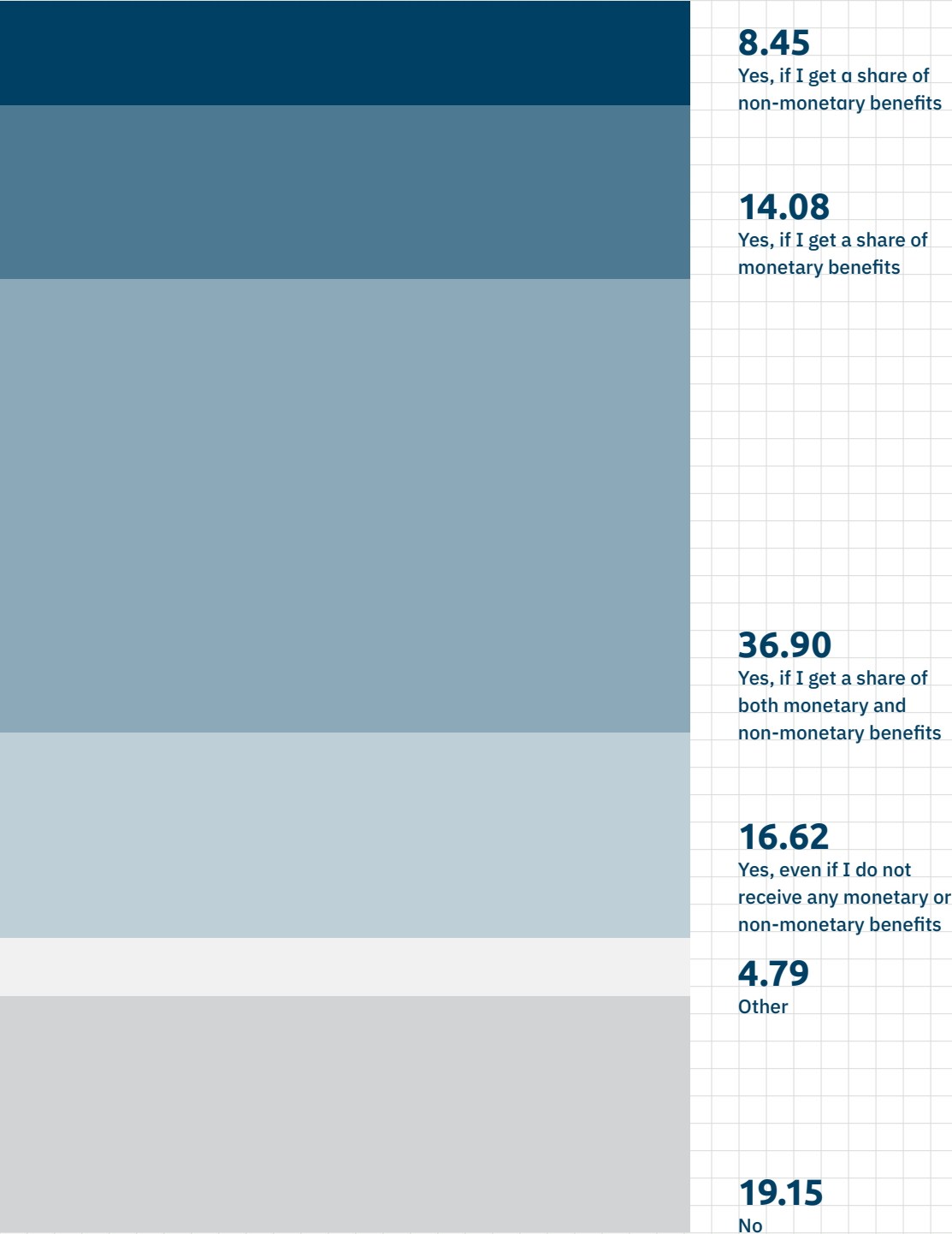
The data shows that only 35.06%[15] of the respondents share their publications through open access repositories, while only 8.4%[16] stated that they share their data through open access repositories! Even if one adds the 9.72% who have stated that they share their publications through their personal website without restrictions and 3.09%[17] who mentioned that they share data through personal websites, the overall percentage of respondents who share publications and data without restrictions appear to be very low. Furthermore, a majority believe that other researchers should be allowed to make commercial uses of their research outputs only if they get a share of both monetary and non-monetary benefits (36.9%)[18].

FIG. 06. SHARING PRACTICES
Which of the following best characterises the way/ with whom you share publication/data?

▪ PUBLICATION ▪ DATA

WHOEVER ASKS
56.6 %

TEAM
48.67 %

TEAM
47.22 %

WHOEVER ASKS
37.17 %

OA REPOSITORIES
35.07 %

ACQUAINTANCES
25.22 %

ACQUAINTANCES
34.03 %

INSTITUTION
20.35 %

INSTITUTION
31.6 %

NO SHARING
16.37 %

NO RESTRICTIONS
9.72 %

OA REPOSITORIES
8.41 %

NO SHARING
3.82 %

NO RESTRICTIONS
3.10 %

NO SHARING
I don't generally share with anyone

NO RESTRICTIONS
Majority can be accessed by anyone

OA REPOSITORIES
I share through an open access repository

INSTITUTION
I actively share with any researcher working in my institution

ACQUAINTANCES
I actively share with close friends or trusted acquaintances

WHOEVER ASKS
I share with anyone who asks for them

TEAM
I actively share with researchers working in my team

Our data shows that a vast majority of the respondents share their publications only upon request (56.6%).[19] This practice was seen to be most prevalent in the legal discipline (65.31%).[20] As one can imagine, sharing publications on request is not the most optimal approach as it would be very difficult for people to find those publications and, in many cases, people may not even be aware of the existence of those publications. In most cases, people would likely be too hesitant to approach the author(s) even if they did know the publication exists.

34.03% respondents share their publications with close friends and trusted acquaintances, 47.22% share with researchers working in their team, and 31.6% share with researchers working in their institution.[21]

With regard to sharing of data, as discussed earlier, the percentage of respondents who share data through open access repositories or personal website without restrictions are quite low. 25.22% respondents mentioned that they share data with close friends or trusted acquaintances, while 37.17% do so with anyone who asks for them.[22] 16.37% stated that they do not generally share data with anyone, which is substantially higher than the corresponding percentage for publication-sharing.[23] The field of law had the highest percentage stating that they do not generally share their data (31.43%), although this might be explained by current research practices in the field where empirical or data analysis is unfortunately not the norm.[24] However, in a field in which data is as heavily used as Economics, as much as 28.57% respondents stated that they do not share their data![25]

57.89%

RESPONDENTS FROM PHYSICS SHARE PUBLICATIONS THROUGH OPEN ACCESS REPOSITORIES

FIG. 07. MUTUAL SHARING WITHIN INSTITUTION
Researchers within my institution share their research publications/data amongst one another   (in %)

	PUBLICATION	DATA
STRONGLY AGREE	12.33	7.74
AGREE	57.33	29.29
NEITHER AGREE NOR DISAGREE		33
DISAGREE	19	24.92
STRONGLY DISAGREE	8.67	5.05
	2.67	
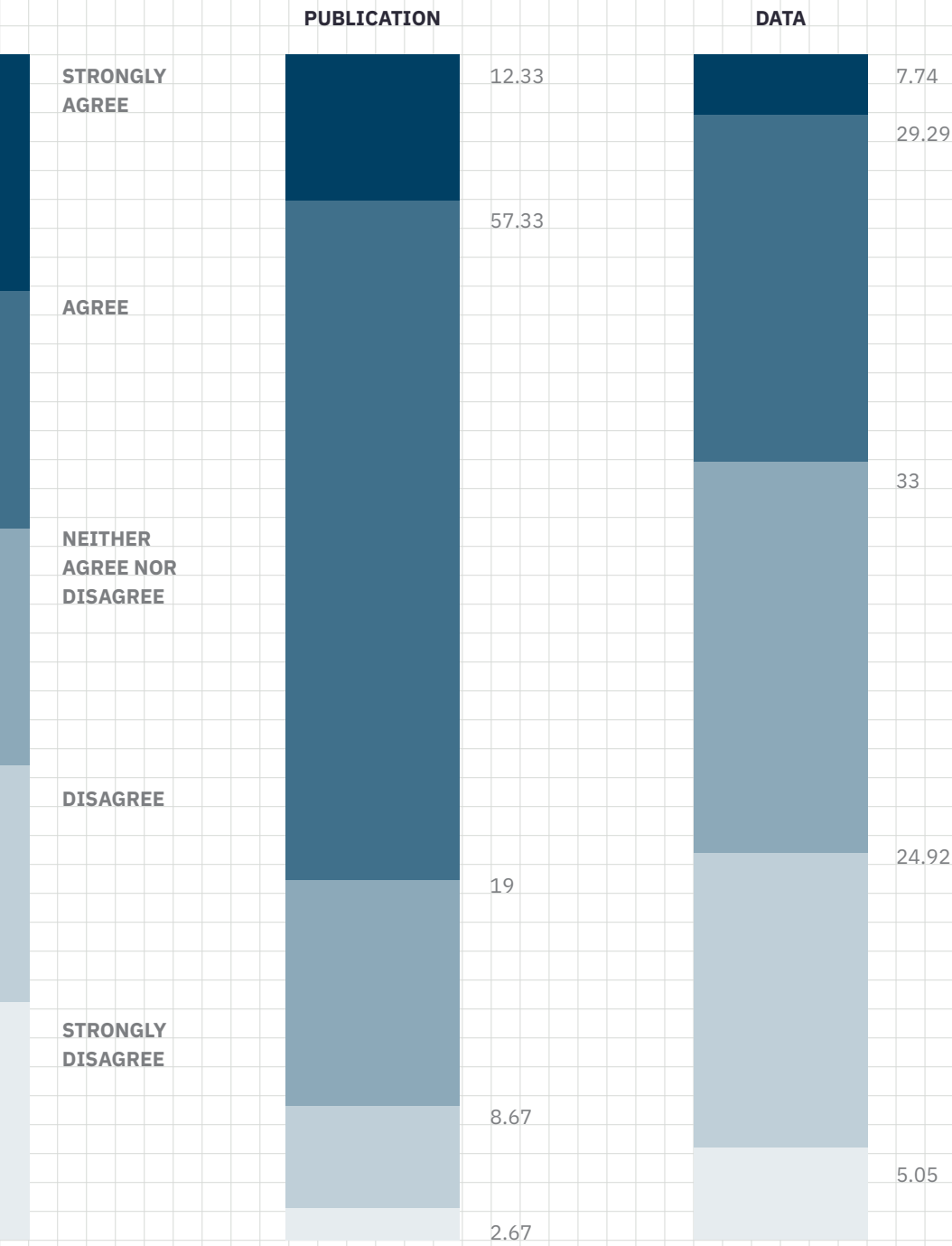
To get a more realistic picture of sharing, apart from the direct question on their sharing behaviour, the survey used one of the common approaches for addressing social desirability bias - asking how their peers/ friends would behave in that particular context. Some of the questions in the survey focused in particular on sharing practices of researchers working in their institution. Among the respondents, 69.66%[26] agreed that researchers in their institution share their publications among one another, while only 34.34%[27] agreed the same for data sharing.

SOCIAL DESIRABILITY BIAS

"Social desirability is the tendency of some respondents to report an answer in a way they deem to be more socially acceptable than would be their 'true' answer.

"They do this to project a favorable image of themselves and to avoid receiving negative evaluations. The outcome of the strategy is overreporting of socially desirable behaviors or attitudes and underreporting of socially undesirable behaviors or attitudes. Social desirability is classified as one of the respondent-related sources of error (bias)."

- Encyclopedia of Survey Research Methods (https://bit.ly/2myYgiS)

BENEFITS OF SHARING

The survey had asked the respondents who have shared their publications/data openly whether they received any benefits from sharing of those knowledge resources. 42.39%[28] mentioned greater visibility (e.g. through increased citations) as a benefit they received from sharing publications. While 23.87% stated that they received new professional contacts, 24.28% could perceive quality improvement in their work due to feedback from those who accessed them. 20.99% had also received invitations for collaborations, while 2.88% received more funding for research. But it is important to notice that 42.8%[29] mentioned that they haven't received any benefits from sharing publications.

With regard to the perceived benefits from data sharing, as high as 60.84%[30] of the respondents mentioned that they haven't received any benefits from sharing data. While 17.47%[31] of the respondents mentioned greater visibility as a benefit, 16.27% stated that they received new professional contacts and 18.67% could perceive quality improvement in their work due to feedback from those who accessed it. 17.47% received invitations for collaborations and 3.01% received more funding for research.

FIG. 08. PERCEIVED BENEFITS OF SHARING
If you have shared your publications/ data openly, have you ever received the following benefits?

■ PUBLICATION   **■ DATA**

PUBLICATION	DATA
NO BENEFIT 42.80 %	**NO BENEFIT** 60.84 %
VISIBILITY 42.39 %	**QUALITY** 18.67 %
QUALITY 24.28 %	**COLLABORATION** 17.47 %
NEW CONTACT 23.87 %	**VISIBILITY** 17.47 %
COLLABORATION 20.99 %	**NEW CONTACT** 16.27 %
FUNDING 2.88 %	**FUNDING** 3.01 %
FINANCIAL 0.82 %	**FINANCIAL** 1.20 %
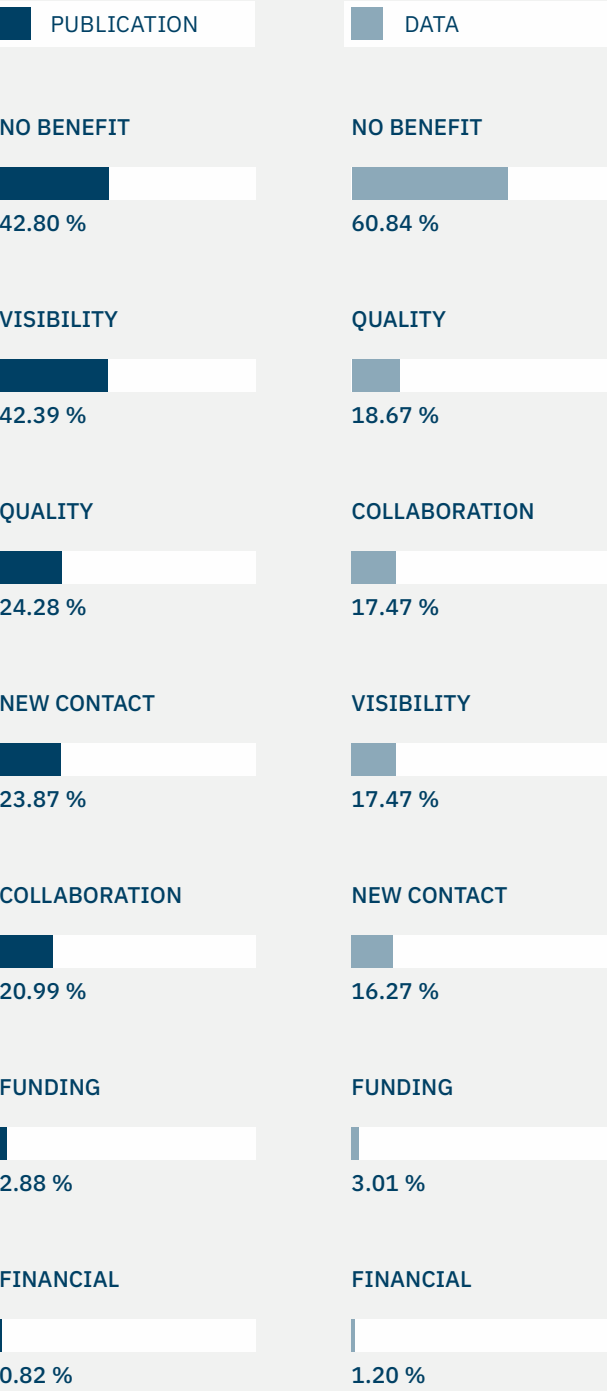
NO BENEFIT
I have not received any benefits

NEW CONTACT
A new professional contact

VISIBILITY
More visibility (e.g., more citations)

QUALITY
Quality improvement through feedback from people who accessed them

COLLABORATION
Invitations for collaborations from people who have accessed my work

FINANCIAL
Personal financial benefits

FUNDING
More funding for research

WHY ARE RESEARCHERS NOT SHARING THROUGH OPEN ACCESS MODES?

Our results show that an unwillingness to pay (42.75%) and an inability to fund (28.26%) article processing charges (APCs) are the two most prominent reasons which discourage researchers from sharing their publications openly.[32] Other factors include desire to improve the quality of the work before sharing it openly (21.74%), fear of plagiarism (15.22%), fear of use by others for their professional benefits (9.42%), and lack of awareness of OA options (12.68%).[33] Some respondents also stated that there are no reputed OA journals in their field (9.42%), while others stated that OA options were not available in the journal(s) they wanted to publish their work in (22.46%).[34] Interestingly, 11.23% among all respondents said that they do not consider sharing publication in OA modes to be important.[35] The data indicate that monetary factors might be discouraging many of the researchers from sharing their publications through OA modes, although lack of both awareness and inclination to share are important factors as well.

FIG. 09.1. FACTORS DISCOURAGING OPEN SHARING OF PUBLICATION
Which of the following factors have discouraged you from publishing through open access modes? (in %)

9.42 — There are no reputed open access journals in my field

9.42 — I fear that people may use my publications for their professional benefits (for example, producing a better product or research using my publication)

11.23 — I did not think it was important

12.68 — I was not aware of any options for publishing through open access modes

15.22 — I fear that people may plagiarise my publications

21.74 — I wanted to improve the quality of the work before sharing it openly

22.46 — Open access was not an option available for the journal(s) where I wanted to publish

28.26 — I was unable to fund the article processing charges (APC)

42.75 — I am not willing to pay money to the publisher to publish an article (Article Processing Charges/ APC)
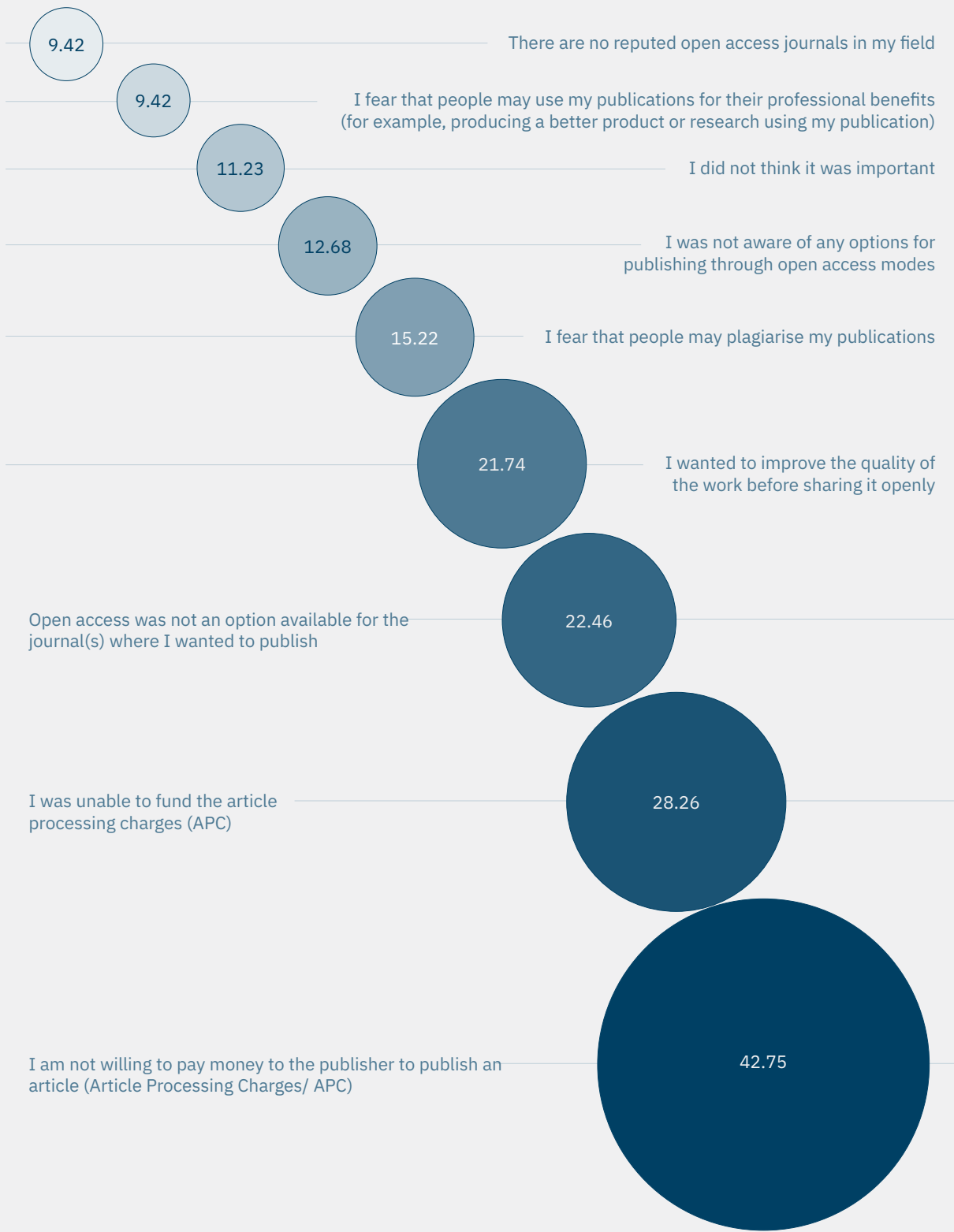
FIG. 09.2. FACTORS DISCOURAGING OPEN SHARING OF DATA

Which of the following factors have discouraged you from sharing data openly?　　　　(in %)

Data has commercial value for my organisation (for example, my organisation sells services relating to data or data analysis expertise) — **6.74**

I was not confident with the quality of my data to share it openly — **7.49**

Lack of adequate resources to upload the data to the data repositories (for example, reliable internet connection, software, etc.) — **7.49**

My funding agency does not mandate sharing of data — **11.24**

I don't consider data sharing as important — **11.61**

There are no reputed open data repositories in my field — **13.48**

Lack of time to upload data to the data repositories — **14.98**

My institution does not mandate sharing of data — **15.73**

19.10 — I fear people may use my data for their professional purposes (for example, producing a better product or research using my data)

24.34 — I can share data only after proper curation (for example, putting it in a format that is understandable to and useable by others)

44.19 — I can share data openly only when all research and publications based on those data are completed

On the other hand, when it comes to data sharing, a reluctance to share data before having completed all possible research/publications based on that dataset appears to play a major role for 44.19% respondents. Similarly, 24.34% of respondents were of the view that they can share data only after proper curation.[36] Lack of confidence regarding quality of data was cited by 7.49% respondents , while fear of use of shared data by others for professional benefits was cited by 19.1% of the respondents. While there were also other factors, it needs to be specifically highlighted here that lack of mandates from their funding agency (11.24%) and institution (15.73%) also appear to be discouraging a not so small percentage of respondents from sharing data.[37]

15.73%
WERE DISCOURAGED FROM SHARING DATA BY THE ABSENCE OF INSTITUTIONAL MANDATE

11.24%
WERE DISCOURAGED FROM SHARING DATA BY THE ABSENCE OF FUNDING AGENCY MANDATE.

When it comes to using open access journals, the majority believe that reputed open access journals exist in their field (62.23%).[38]

FIG. 10. Are there reputed open access journals in your field?

Yes 62.23%   No 11.44%   I don't know 26.33%

■ YES   ■ NO   ■ I DON'T KNOW

ECONOMICS   %
Yes 40.54   No 24.32   I don't know 35.14

MEC. E.   %
Yes 44.12   No 19.12   I don't know 36.76

OTHER DISCIPLINES   %
Yes 58.67   No 12   I don't know 29.33

LAW   %
Yes 60.66   No 11.48   I don't know 27.87

PHYSICS   %
Yes 76   No 2   I don't know 22

MEDICINE   %
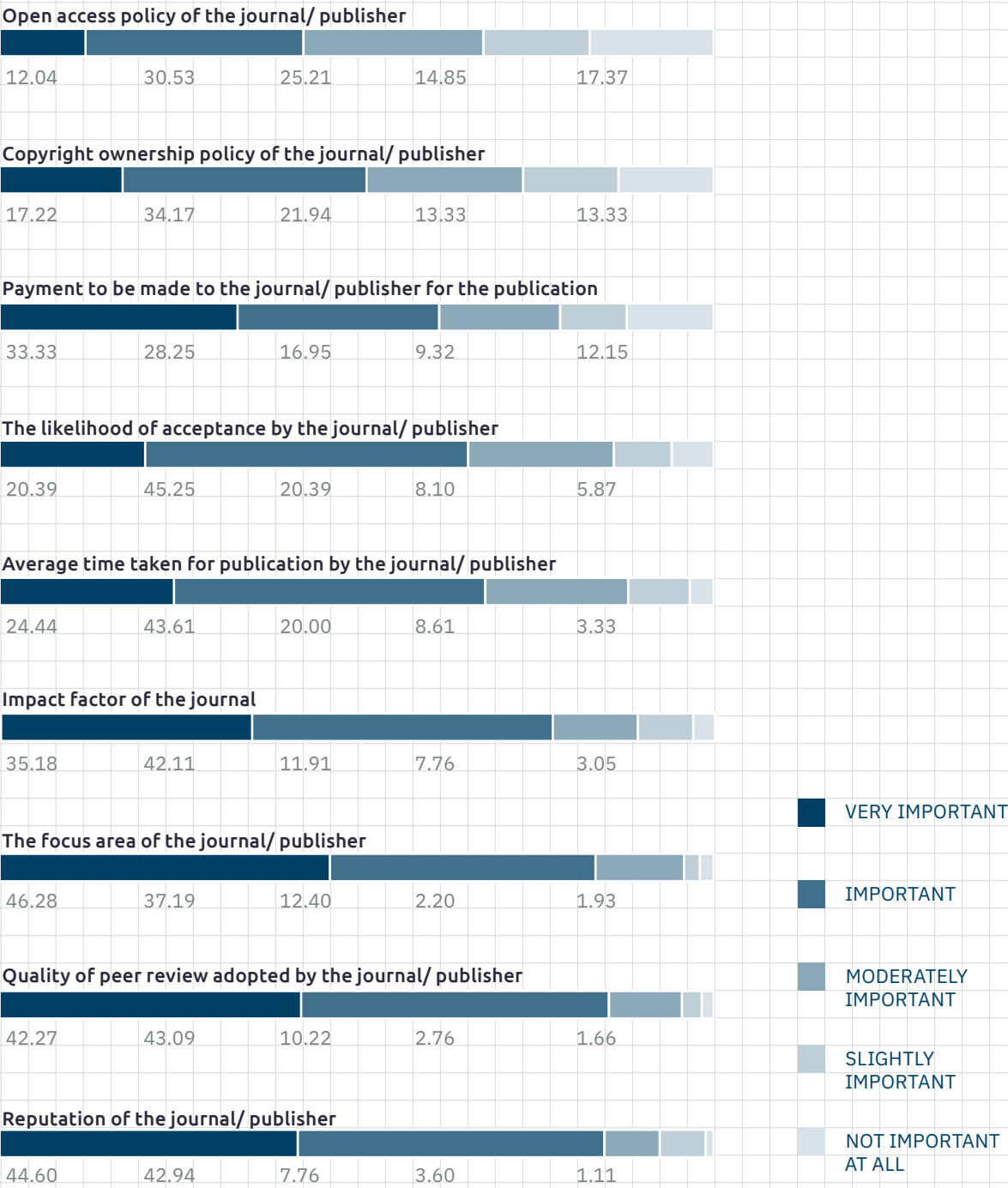Yes 83.13   No 4.82   I don't know 12.05
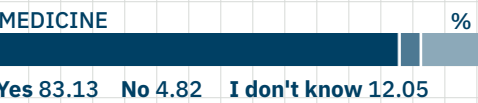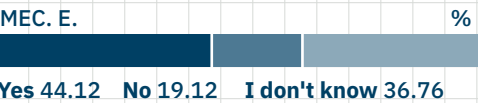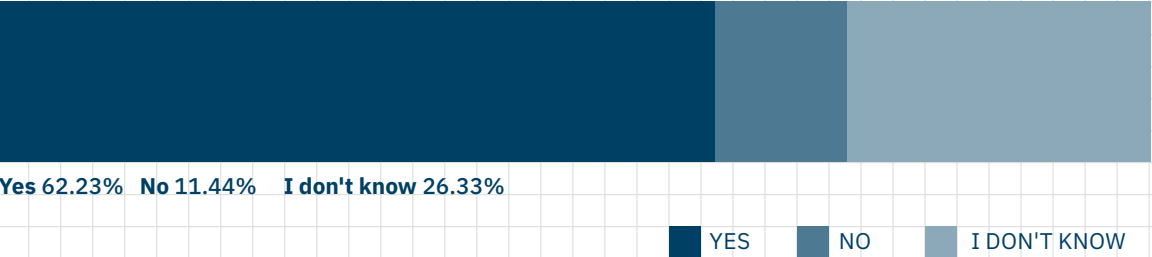
However, while taking decisions regarding where to publish their works, the impact factor (77.29%)[39], reputation of the journal (87.54%)[40], and payment requirements (61.58%)[41] are important factors taken into consideration by the respondents. In this context, it needs to be highlighted that, publisher policies pertaining to open access (42.57%)[42] and copyright ownership (51.39%)[43] are considered to be important by fewer respondents. Factors such as focus area of the journal (83.47%)[44], quality of peer review (85.36%)[45], likelihood of acceptance (65.64%)[46], and average time taken for publication (68.05%)[47] were considered important by respondents.

FIG. 11. FACTORS INFLUENCING CHOICE OF JOURNAL
How important are the following factors when publishing your research outputs in a journal/ book chapter/ book?   (in %)

Open access policy of the journal/ publisher
12.04   30.53   25.21   14.85   17.37

Copyright ownership policy of the journal/ publisher
17.22   34.17   21.94   13.33   13.33

Payment to be made to the journal/ publisher for the publication
33.33   28.25   16.95   9.32   12.15

The likelihood of acceptance by the journal/ publisher
20.39   45.25   20.39   8.10   5.87

Average time taken for publication by the journal/ publisher
24.44   43.61   20.00   8.61   3.33

Impact factor of the journal
35.18   42.11   11.91   7.76   3.05

The focus area of the journal/ publisher
46.28   37.19   12.40   2.20   1.93

Quality of peer review adopted by the journal/ publisher
42.27   43.09   10.22   2.76   1.66

Reputation of the journal/ publisher
44.60   42.94   7.76   3.60   1.11

■ VERY IMPORTANT

■ IMPORTANT

■ MODERATELY IMPORTANT

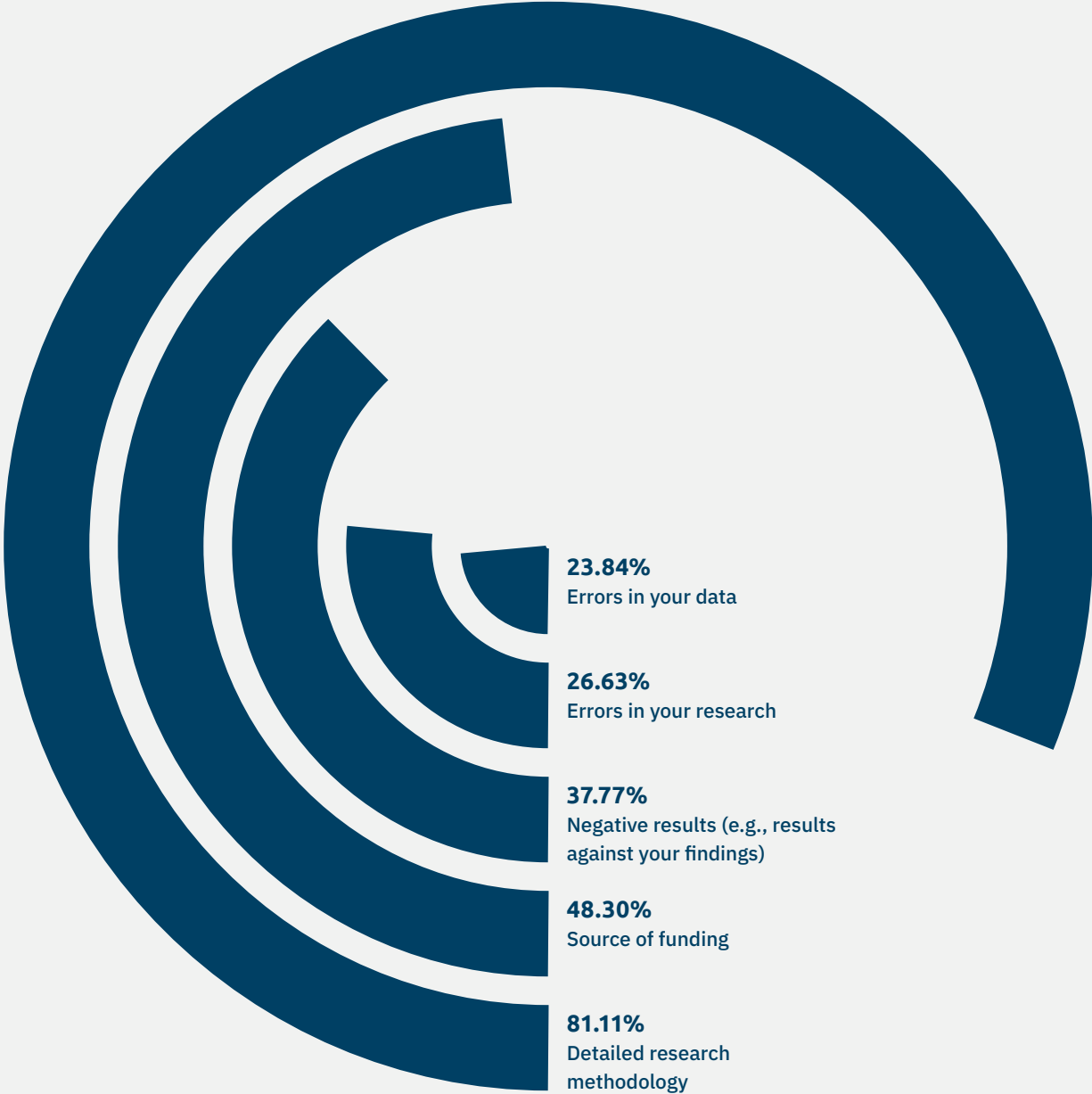■ SLIGHTLY IMPORTANT

■ NOT IMPORTANT AT ALL

TRANSPARENCY

Transparency in research is one of the most integral aspects of open science and the movement demands transparency at all stages of research. As part of the survey, we had tried to explore the extent to which the researchers in India follow transparency. Among the respondents, while 81.11% said that they share detailed research methodology, only 37.77% stated that they regularly share negative results. Only 23.83 % shared errors in data and 26.62% shared errors in research. Though transparency with regard to source of funding is very important, only 48.29% were found to be sharing source of funding.

NEGATIVE RESULTS ARE
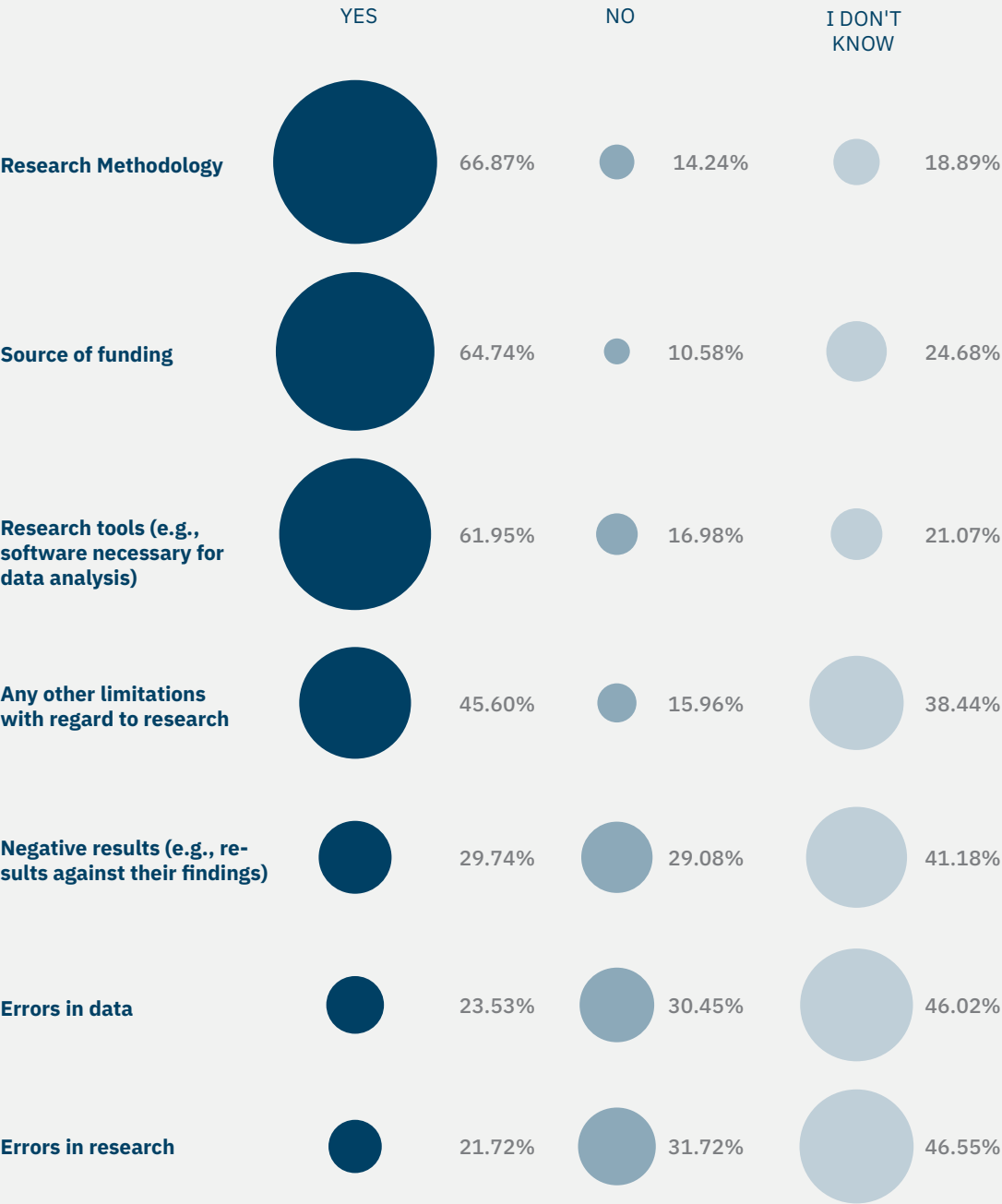ROUTINELY SHARED BY ONLY

37.77%

FIG. 12.1. DISCLOSURE PRACTICES
Which of the following do you routinely share as a part of your research publications?   (in %)

23.84%
Errors in your data

26.63%
Errors in your research

37.77%
Negative results (e.g., results against your findings)

48.30%
Source of funding

81.11%
Detailed research methodology

FIG. 12.2. DISCLOSURE PRACTICES - OTHER RESEARCHERS WITHIN THE INSTITUTION
Do researchers working in your institution routinely share any of the following as a part of their research publications?

	YES	NO	I DON'T KNOW
Research Methodology	66.87%	14.24%	18.89%
Source of funding	64.74%	10.58%	24.68%
Research tools (e.g., software necessary for data analysis)	61.95%	16.98%	21.07%
Any other limitations with regard to research	45.60%	15.96%	38.44%
Negative results (e.g., results against their findings)	29.74%	29.08%	41.18%
Errors in data	23.53%	30.45%	46.02%
Errors in research	21.72%	31.72%	46.55%

In order to gain more insights on open science practices within their respective institutions and also avoid the influence of social desirability bias in responses, the survey also asked respondents whether their colleagues share details like research methodology, source of funding, and negative results.

While transparency with respect to research methodology (66.87%)[48], research tools (61.94%)[49], and source of funding (64.74%)[50] was stated as common institutional practice by respondents, sharing of negative results appears to be relatively rare (29.73%).[51] The percentage of respondents who stated that researchers in their institution routinely share details regarding errors in research (21.72%) errors in data (23.52%) were also very low.

GOOGLE CONTROVERSY

The significance of disclosing source of funding is particularly highlighted by controversies such as the Sugar Research Foundation funded study highlighted in the first chapter. A recent report published by the **Campaign for Accountability** regarding academic funding by Google has once again triggered debates in this area.[52] The report argues that many academicians who have received funding from Google for their research did not disclose the source of funding adequately in the publications or other submissions before relevant authorities. Ironically, CfA has refused to disclose its funders.

INCLUSIVENESS

As discussed in Chapter 1, one of the essential components of open science is the existence of systemic structures which ensure that the production as well as consumption of science is inclusive and accessible. Appropriate measures need to be adopted to include persons with disabilities and persons outside formal knowledge systems within science.

MEASURES TAKEN FOR PEOPLE WITH DISABILITIES

Persons with disabilities are often excluded from the knowledge creation process. In order to address this issue, institutional facilities for researchers with disabilities, as well as measures to enable ease of access to research produced, are necessary. The data from the survey shows that while ramp (71.76%) and wheelchair (55.48%) facilities are now available in a majority of the institutions, facilities like audiobooks (18.27%) and braille textbooks (11.29%) are rarely provided.[53]

Moreover, a large majority of respondents (76.82%) were also unaware of any steps taken by their institution to ensure that research outputs produced in the institution are accessible to people with disabilities.[54] This clearly indicates that conversations about the need to include persons with disabilities in the research process are still not a priority for most institutions.

FIG. 13. INSTITUTIONAL MEASURES FOR ACCESS TO RESEARCH OUTPUTS
Are there any steps taken for persons with disability by your institution to ensure ease of access to the research produced in your institution?
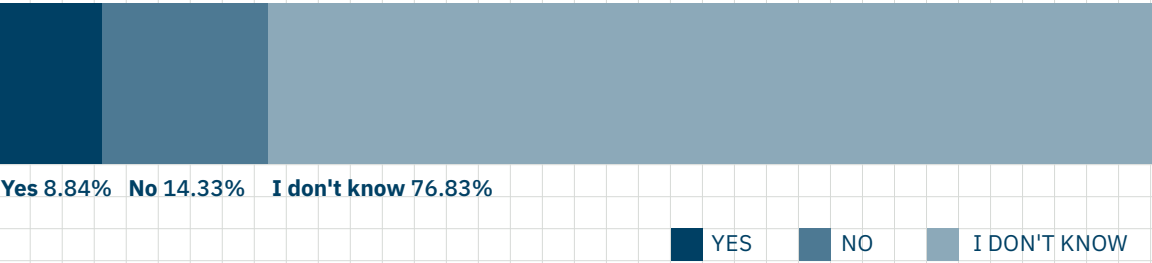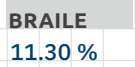
Yes 8.84%   **No** 14.33%   **I don't know** 76.83%
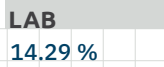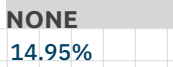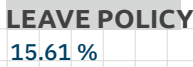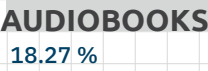
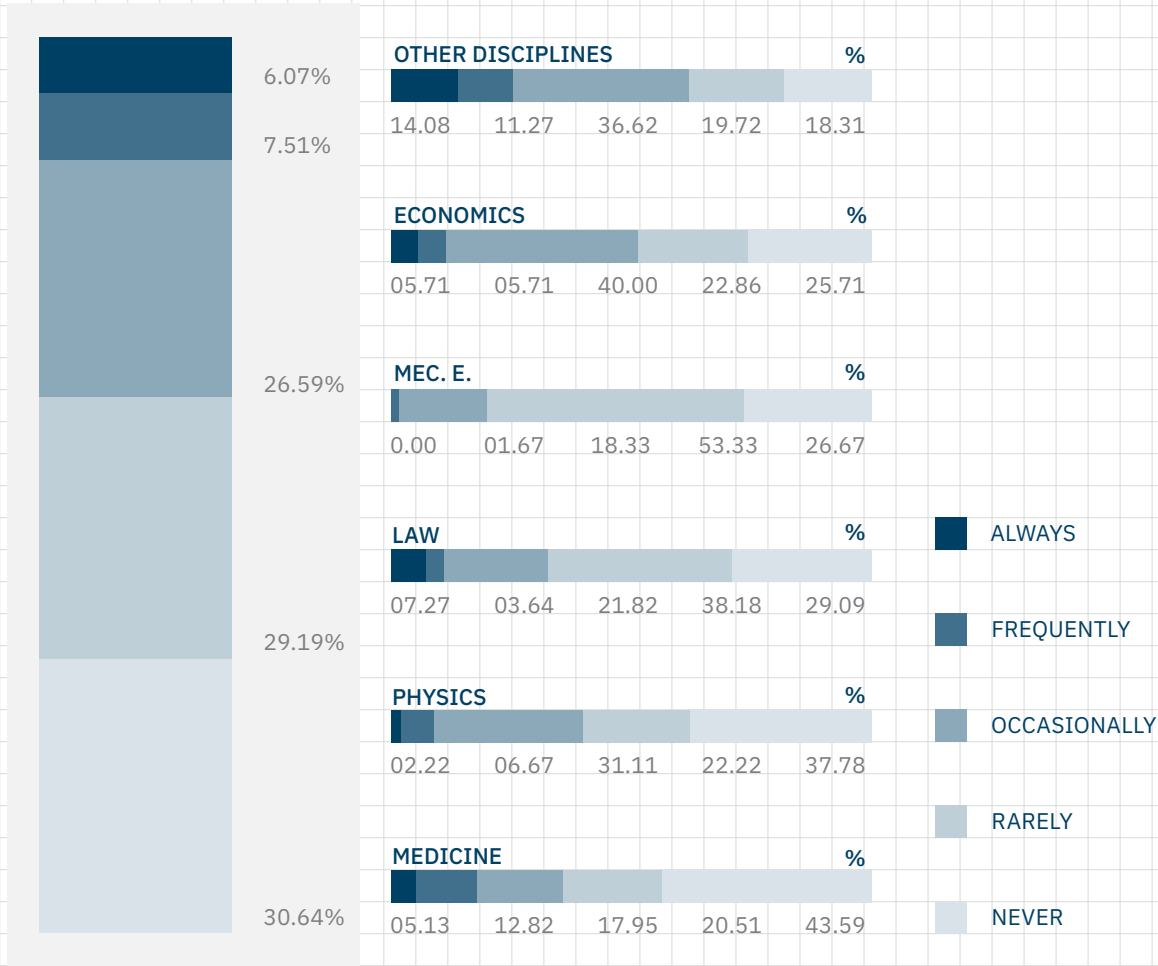■ YES   ■ NO   ■ I DON'T KNOW

FIG. 14 INSTITUTIONAL FACILITIES FOR INCLUSIVE KNOWLEDGE CREATION
Which of the following facilities are available in your institution for researchers with a physical disability?

RAMP
71.76%

WHEELCHAIR
55.48 %

RESTROOMS
40.86 %

AUDIOBOOKS
18.27 %

LEAVE POLICY
15.61 %

NONE
14.95%

LAB
14.29 %

BRAILE
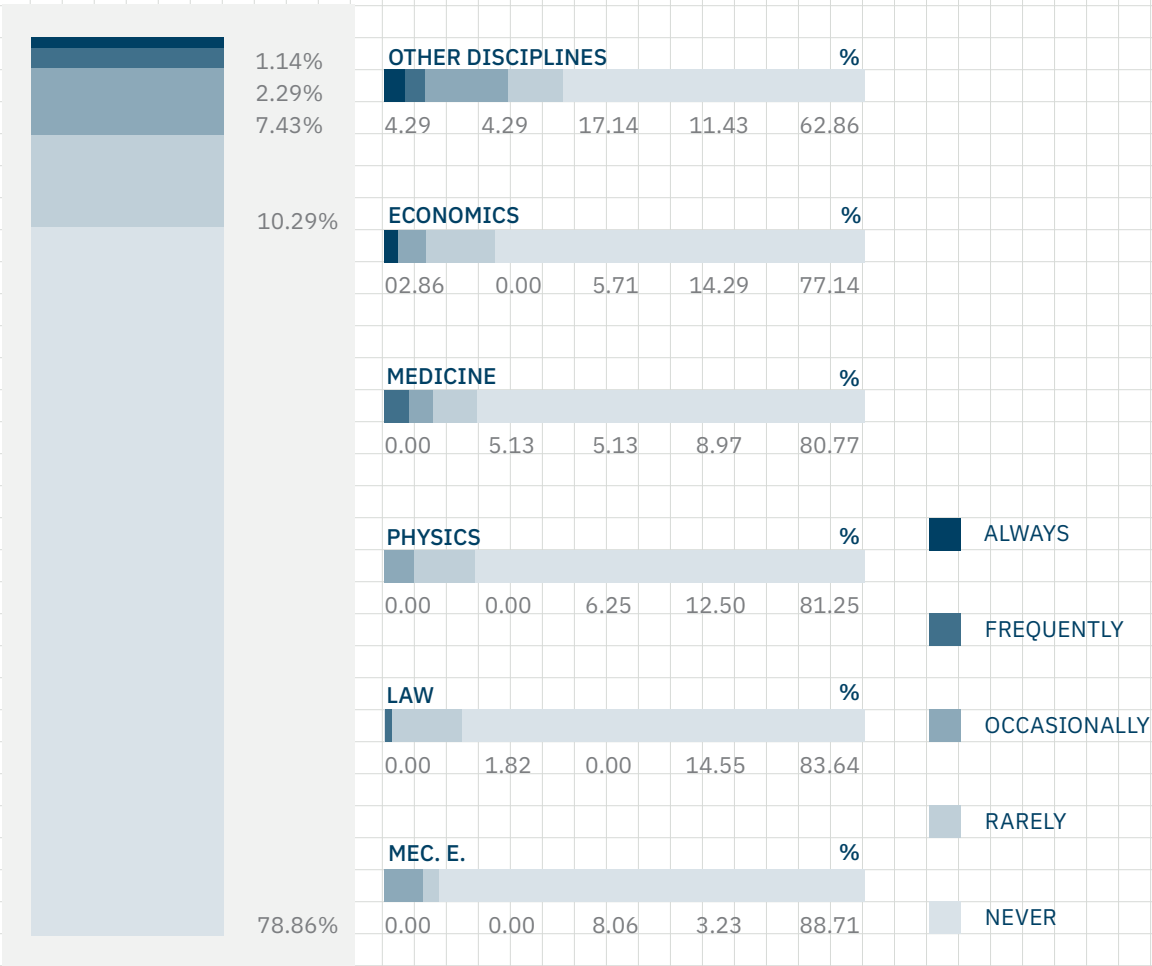11.30 %

LINGUISTIC ACCESSIBILITY AND COMPREHENSIBILITY

One of the major reasons for the divide between science and society is the inaccessibility of scientific expressions for those not well-versed in the specific technicalities of the relevant discipline. Democratisation of science can happen only if science is practised in an inclusive and accessible manner. One of the important steps in this regard is publishing simplified versions of research findings. **Our survey indicates 30.63% of respondents never shared any simplified versions of research findings, while 29.19% do so only rarely.**[55]

Moreover, in a diverse, multilingual country such as India, publishing primarily in the English language leads to millions of people being further excluded from participation in science. **The survey indicates that the vast majority of respondents (78.85%) never shared translated versions of their research in regional languages.**[56]

FIG. 15. FREQUENCY OF PUBLISHING SIMPLIFIED VERSIONS
Do you publish a simplified version of your research findings for a layperson?

	6.07%
	7.51%
	26.59%
	29.19%
	30.64%

OTHER DISCIPLINES %
14.08 | 11.27 | 36.62 | 19.72 | 18.31

ECONOMICS %
05.71 | 05.71 | 40.00 | 22.86 | 25.71

MEC. E. %
0.00 | 01.67 | 18.33 | 53.33 | 26.67

LAW %
07.27 | 03.64 | 21.82 | 38.18 | 29.09

PHYSICS %
02.22 | 06.67 | 31.11 | 22.22 | 37.78

MEDICINE %
05.13 | 12.82 | 17.95 | 20.51 | 43.59

■ ALWAYS
■ FREQUENTLY
■ OCCASIONALLY
■ RARELY
■ NEVER

FIG. 16. FREQUENCY OF PUBLISHING TRANSLATED VERSIONS
Do you publish a translated version of your research findings in any of the regional languages in India?

	1.14%
	2.29%
	7.43%
	10.29%
	78.86%

OTHER DISCIPLINES %
4.29 | 4.29 | 17.14 | 11.43 | 62.86

ECONOMICS %
02.86 | 0.00 | 5.71 | 14.29 | 77.14

MEDICINE %
0.00 | 5.13 | 5.13 | 8.97 | 80.77

PHYSICS %
0.00 | 0.00 | 6.25 | 12.50 | 81.25

LAW %
0.00 | 1.82 | 0.00 | 14.55 | 83.64

MEC. E. %
0.00 | 0.00 | 8.06 | 3.23 | 88.71

■ ALWAYS
■ FREQUENTLY
■ OCCASIONALLY
■ RARELY
■ NEVER

REPRODUCIBILITY

FIG. 18. IS FAILURE TO REPRODUCE RESEARCH A MAJOR PROBLEM?
Do you agree or disagree that the failure to reproduce scientific studies is a major problem in your field?

STRONGLY AGREE **13.86**

AGREE **35.21**
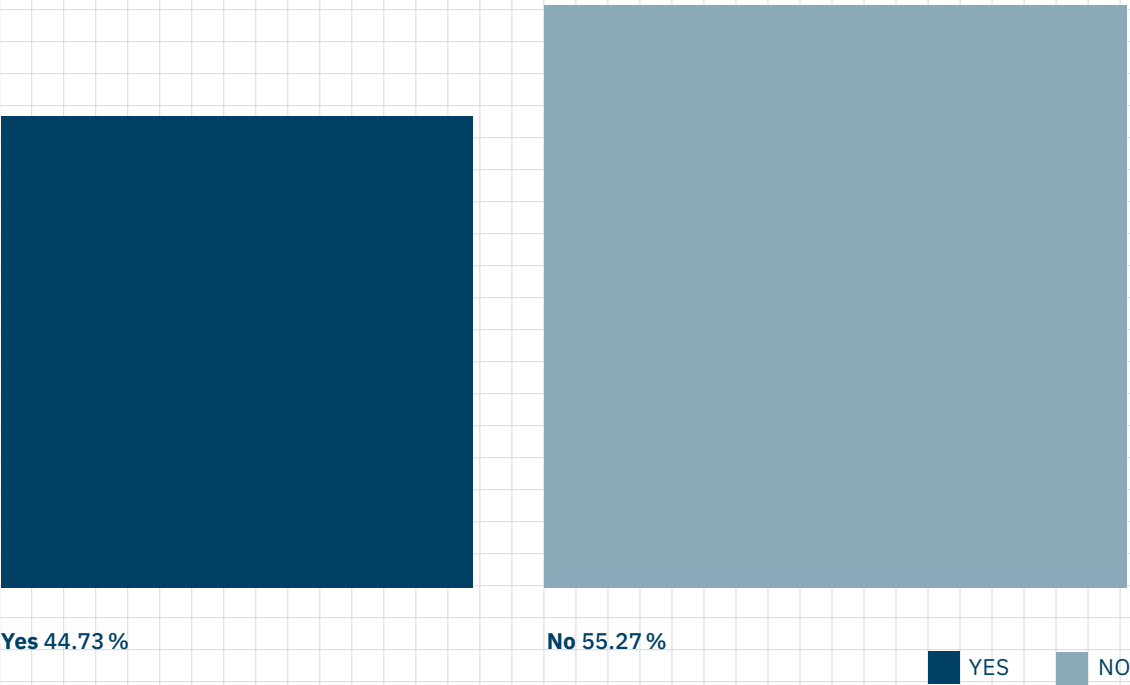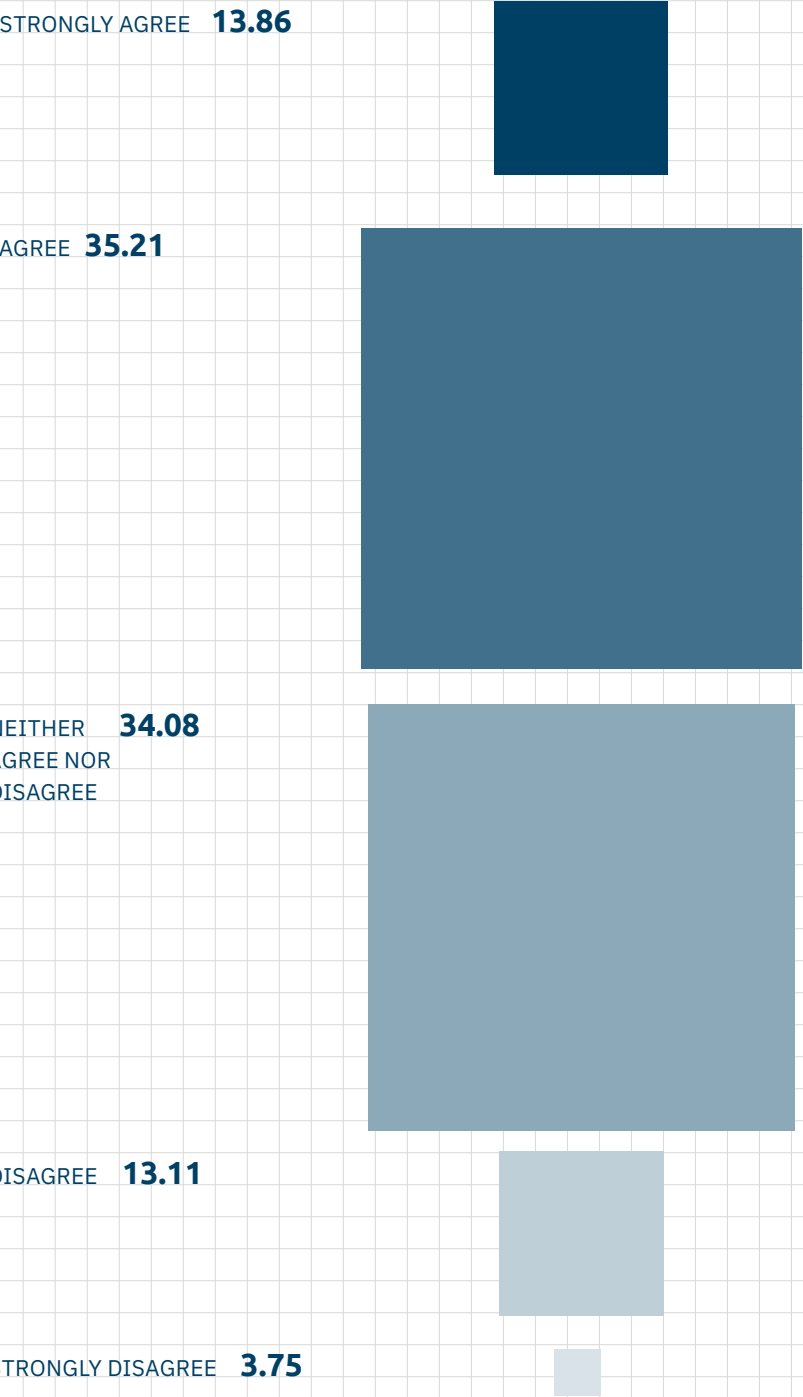
A majority of the respondents (55.27%)[57] reported that they have never tried to reproduce the results of someone else's published research. But many respondents (49.06%)[58] agreed that failure to reproduce scientific studies is a major problem in the respective fields of the researchers.

NEITHER **34.08**
AGREE NOR
DISAGREE

FIG. 17. ATTEMPT TO REPRODUCE RESEARCH
Have you ever tried to reproduce someone else's published research?

DISAGREE **13.11**

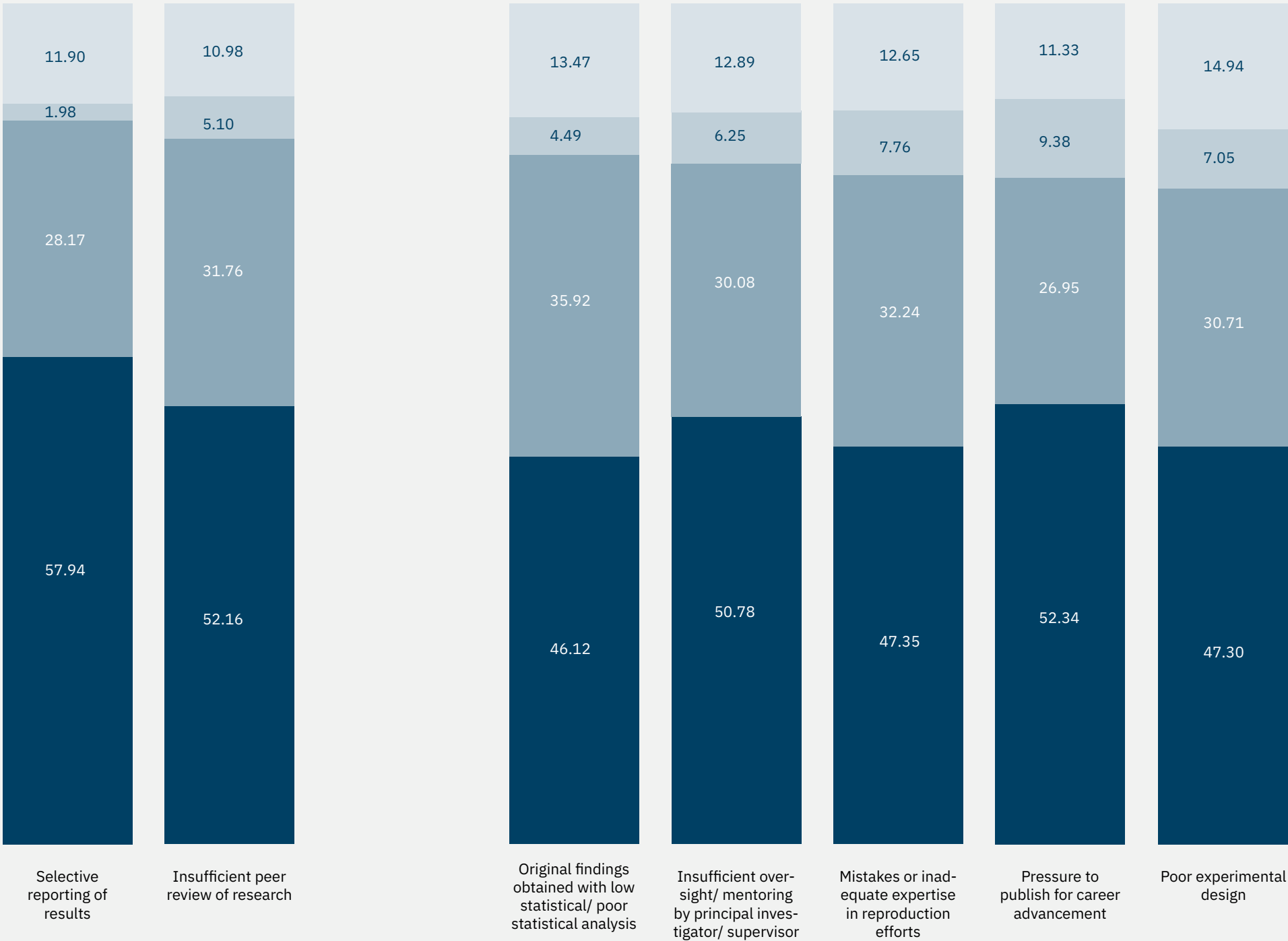**Yes** 44.73 %   **No** 55.27 %

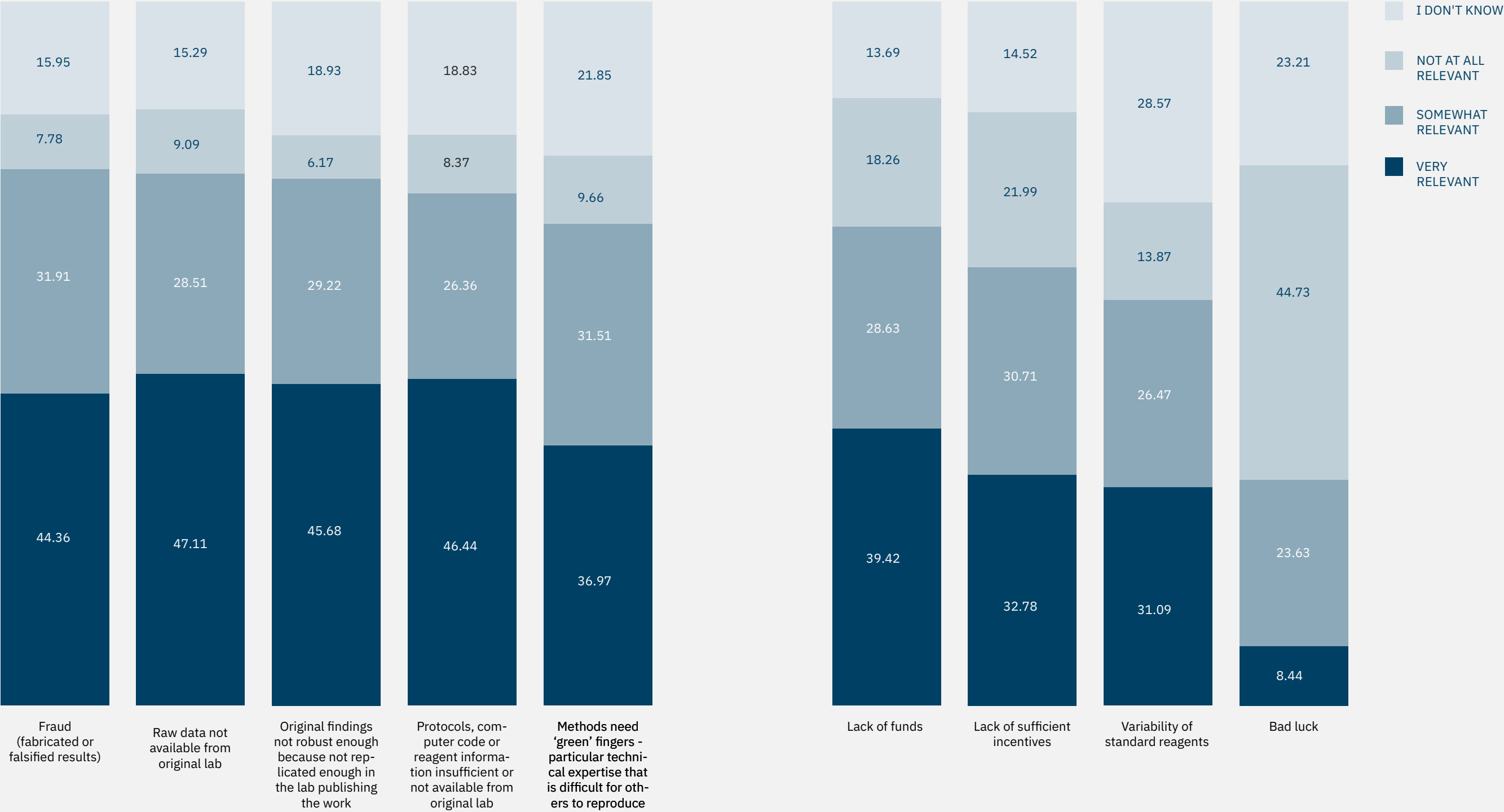◼ YES   ◼ NO

STRONGLY DISAGREE **3.75**

Some of the factors that were considered by the respondents as relevant factors behind the failure to reproduce include pressure to publish for career advancement (79.29%)[59] , insufficient peer review (83.92%), insufficient oversight by principal supervisors (80.85%)[60], and selective reporting of results (86.11%).[61] Only 40% agreed that there are practices in place in their institution to ensure reproducibility of research.[62]

FIG. 19. RELEVANT FACTORS – REPRODUCIBILITY CRISIS
In your opinion, how relevant are the following factors in the failure to reproduce results?

I DON'T KNOW

NOT AT ALL RELEVANT

SOMEWHAT RELEVANT

VERY RELEVANT

	Selective reporting of results	Insufficient peer review of research	Original findings obtained with low statistical/ poor statistical analysis	Insufficient over-sight/ mentoring by principal investigator/ supervisor	Mistakes or inadequate expertise in reproduction efforts	Pressure to publish for career advancement	Poor experimental design
I don't know	11.90	10.98	13.47	12.89	12.65	11.33	14.94
Not at all relevant	1.98	5.10	4.49	6.25	7.76	9.38	7.05
Somewhat relevant	28.17	31.76	35.92	30.08	32.24	26.95	30.71
Very relevant	57.94	52.16	46.12	50.78	47.35	52.34	47.30

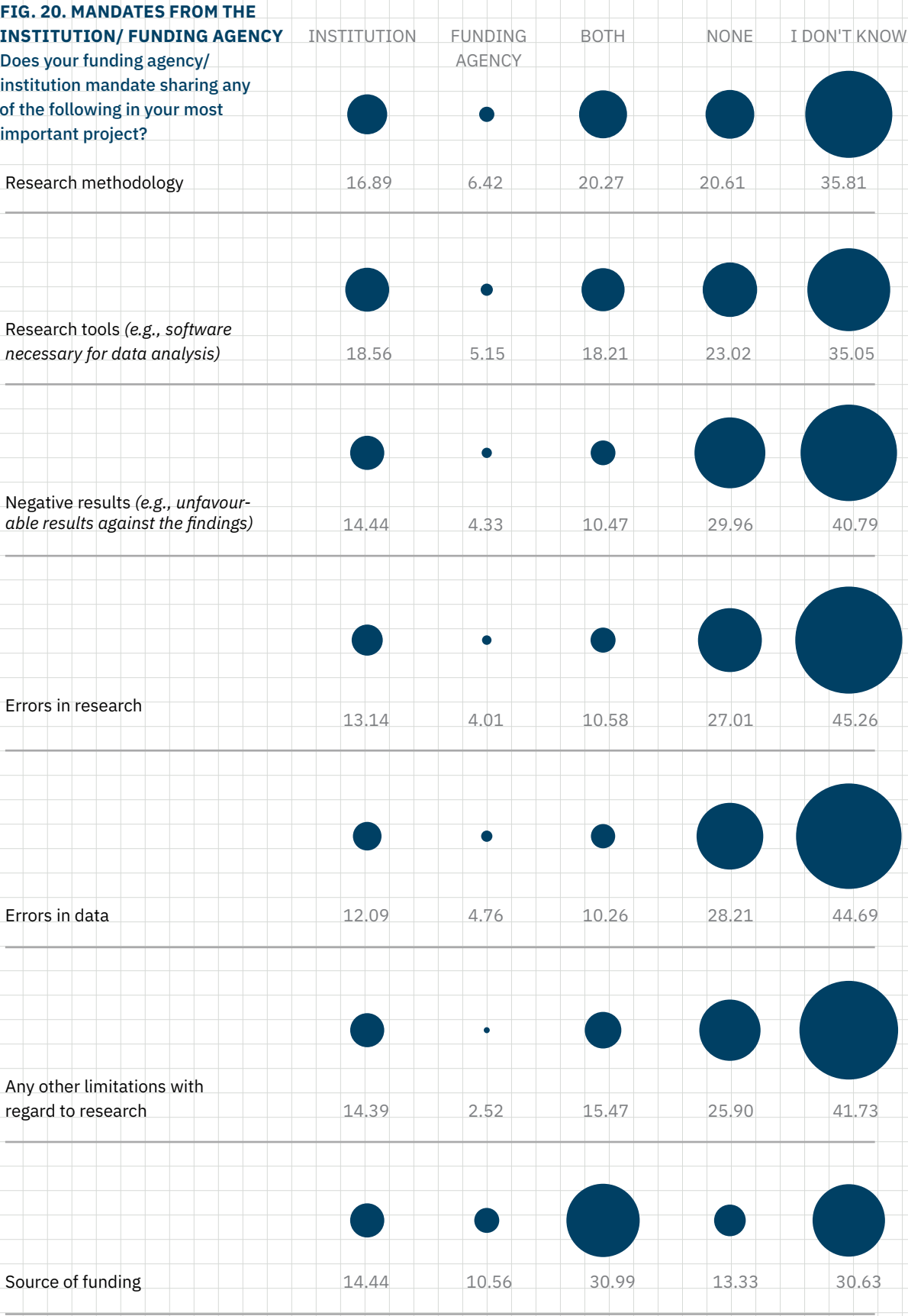|	I DON'T KNOW	NOT AT ALL RELEVANT	SOMEWHAT RELEVANT	VERY RELEVANT
Fraud (fabricated or falsified results)	15.95	7.78	31.91	44.36
Raw data not available from original lab	15.29	9.09	28.51	47.11
Original findings not robust enough because not replicated enough in the lab publishing the work	18.93	6.17	29.22	45.68
Protocols, computer code or reagent information insufficient or not available from original lab	18.83	8.37	26.36	46.44
Methods need 'green' fingers - particular technical expertise that is difficult for others to reproduce	21.85	9.66	31.51	36.97
Lack of funds	13.69	18.26	28.63	39.42
Lack of sufficient incentives	14.52	21.99	30.71	32.78
Variability of standard reagents	28.57	13.87	26.47	31.09
Bad luck	23.21	44.73	23.63	8.44

MANDATES/ POLICIES REGARDING OPENNESS

MANDATES REGARDING TRANSPARENCY

While open science promotes sharing of the vital information discussed above, it is interesting to observe from our data that, in a large number of cases, neither the funding agencies nor institutions mandate any such disclosure. It is important to note that even for crucial details such as negative results, and errors in research and data, the lack of mandates for their transparency is worryingly rampant.

In some other cases, respondents mentioned that they were unaware of mandates regarding research methodology (35.81%); research tools (35.05%); source of funding (30.63%); negative results (40.79%), errors in research (45.25%), errors in data (44.68%), and any other limitations related to research (41.72%).

One may infer from the lack of awareness about the mandates that even if mandates do exist, they are not likely to have robust monitoring or compliance mechanisms.

FIG. 20. MANDATES FROM THE INSTITUTION/ FUNDING AGENCY
Does your funding agency/ institution mandate sharing any of the following in your most important project?

	INSTITUTION	FUNDING AGENCY	BOTH	NONE	I DON'T KNOW
Research methodology	16.89	6.42	20.27	20.61	35.81
Research tools (e.g., software necessary for data analysis)	18.56	5.15	18.21	23.02	35.05
Negative results (e.g., unfavour-able results against the findings)	14.44	4.33	10.47	29.96	40.79
Errors in research	13.14	4.01	10.58	27.01	45.26
Errors in data	12.09	4.76	10.26	28.21	44.69
Any other limitations with regard to research	14.39	2.52	15.47	25.90	41.73
Source of funding	14.44	10.56	30.99	13.33	30.63

Mandates regarding transparency

POLICIES REGARDING IP OWNERSHIP AND OPEN ACCESS

The survey also tried to explore whether the respondents were aware of any institutional, funding agency, or government policy regarding IPR over research outputs. While the data indicate that institutions seem to be more proactive than the funding agencies or the government with regard to these policies, it is pertinent to note that we had asked those who were not aware of such policies to skip the question. The number of respondents who have answered the question versus that of those who have skipped may be indicating the rareness of these policies (43.65%).[63]

43.65%

ANSWERING THE QUESTION MAY BE INDICATING THE RARENESS OF THESE POLICIES

FIG. 21. POLICIES REGARDING OWNERSHIP OF INTELLECTUAL PROPERTY
Are you aware of any specific policies by the institution/ funding agency/ government with regard to the following?

	INSTITUTIONAL POLICY	FUNDING AGENCY POLICY	GOVERNMENT POLICY
IPR Intellectual Property Rights over your research outputs like articles and data	76.19%	36.67%	22.38%
DATA OWNERSHIP Ownership rights over data generated by you	70.48%	30.48%	10.95%
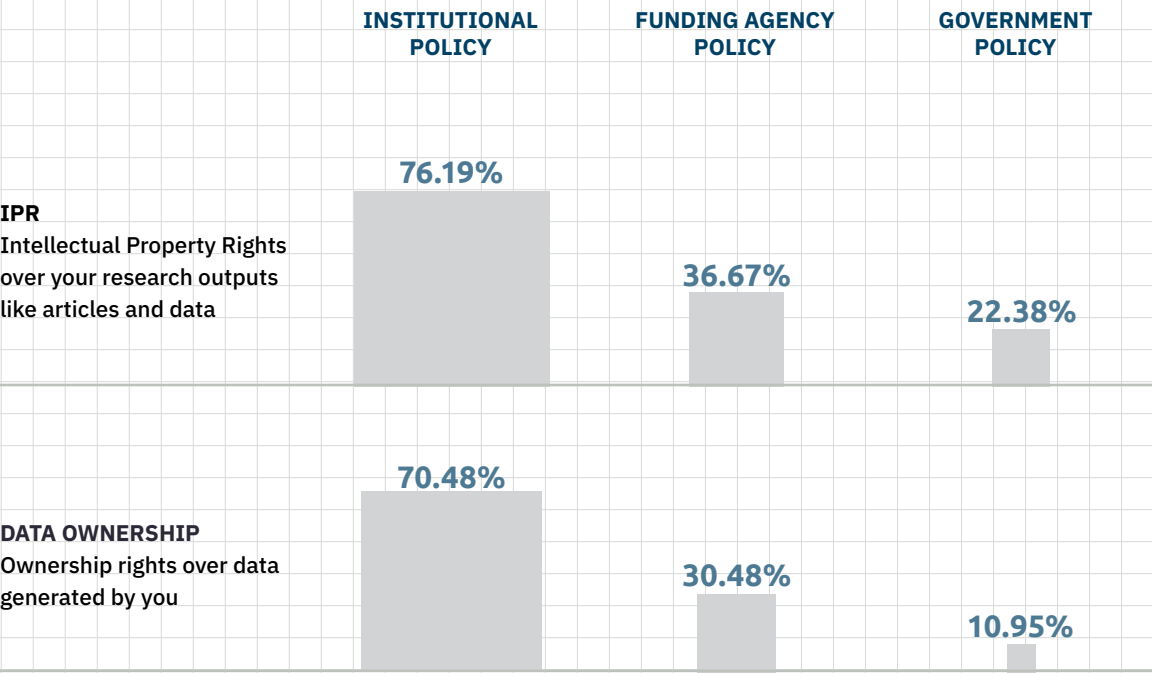
FIG. 22. POLICIES REGARDING OPEN ACCESS
Are you aware of any specific policies by the institution/ funding agency/ government with regard to the following?

	INSTITUTIONAL POLICY	FUNDING AGENCY POLICY	GOVERNMENT POLICY
OA PUBLICATION Open access to publications	53.33%	26.19%	10.48%
OA DATA Open access to data	50.95%	24.76%	10.48%
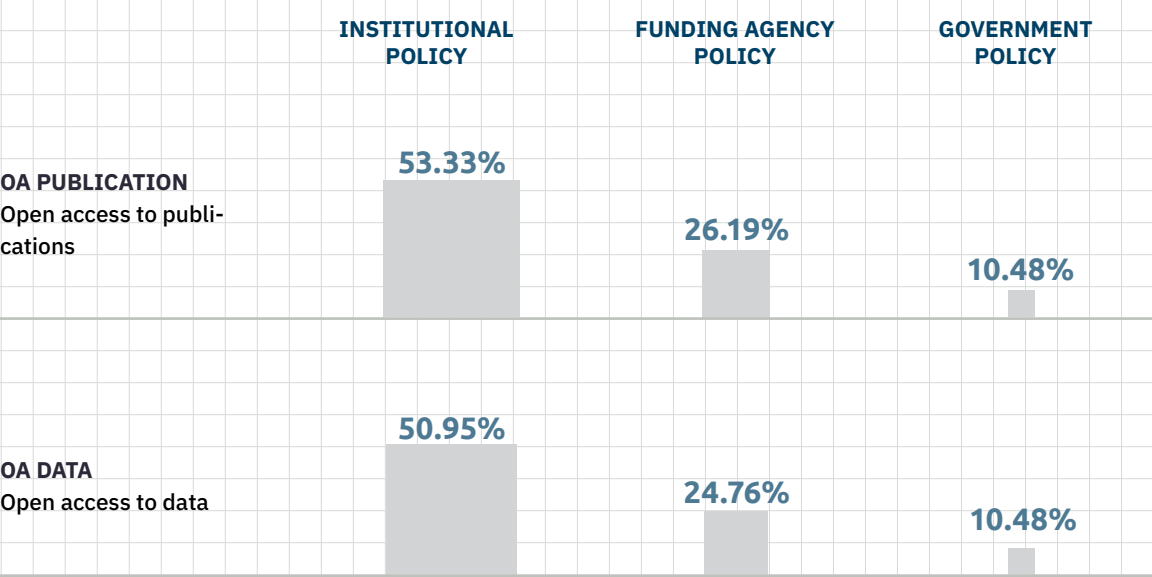
Some respondents stated that they do not know who has ownership rights over data (10.8%).[64] A majority of the respondents stated that they themselves own data from their projects (35.54%).[65]

FIG. 23. OWNERSHIP RIGHTS OVER DATA
Who has ownership rights over data from your project?

THE INSTITUTION
27.18%

MYSELF
35.54%

**FUNDING AGENCY
(PRIVATE/ GOVT.)**
12.2%

LEAD RESEARCHER
18.82%

ENTIRE TEAM
25.78%

OTHER
2.1%

NONE
1.05%

I DON'T KNOW
10.8%
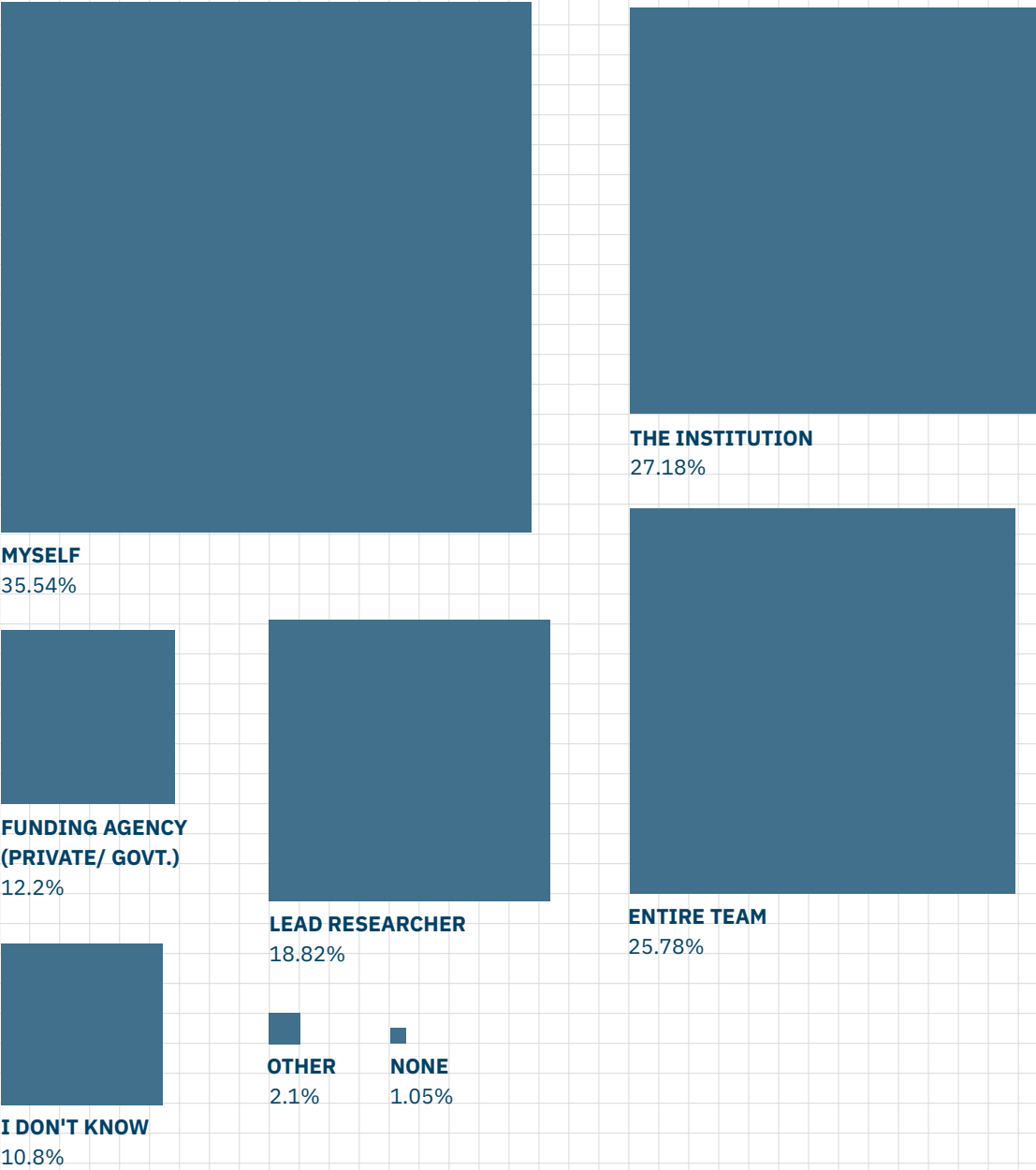
DO FUNDING AGENCIES MONITOR POLICY COMPLIANCE?

When it comes to the monitoring of compliance to policies of funding agencies regarding the above aspects, a substantial percentage (42.14%) of respondents state that they do not know whether any measures are taken.[66] As mentioned above, lack of awareness about monitoring efforts may be indicating the lack of robust mechanisms for the same.

FIG. 24. MONITORING BY FUNDING AGENCY

33.93	42.14	10.71	0.36	12.86
YES	I DON'T KNOW	NO	OTHER	NOT APPLICABLE
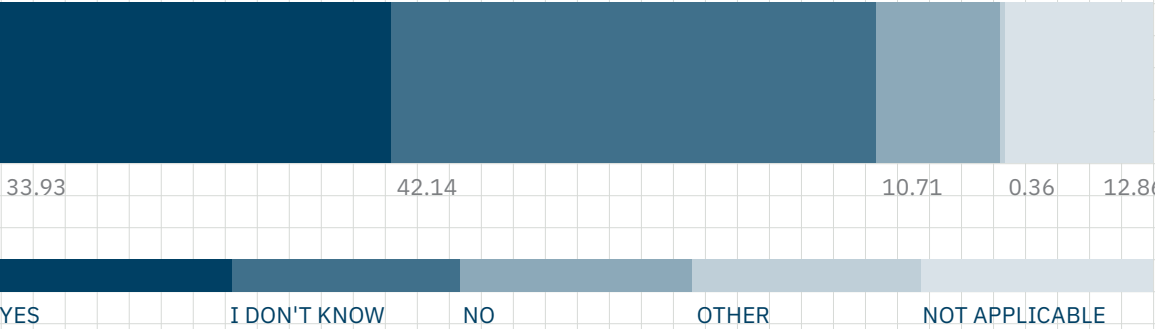
This lack of awareness regarding the policies, as well as the insufficient robustness of the policies, may also be read with the RTI data relating to the DBT/ DST OA policy, discussed in Chapter 2. It may be fair to state that there is systemic and widespread insufficiency when it comes to such policies and their implementation in India.

CHALLENGING
THE STATUS QUO

SATISFACTION OR COMPLACENCY?

Finally, it is important to highlight that respondents appeared to be satisfied with the status quo regarding certain pertinent institutional practices. The data shows that satisfaction levels are quite high regarding policies on issues such as intellectual property rights (IPR) over research outputs (59.2%)[67], open access to publications (55.08%)[68], and open access to data (46.55%).[69] This was observed even for policies relating to ownership rights over data generated (60.97%)[70], data sharing (57.56%)[71], and publication and use of research outputs (62.02%)[72]. Respondents were also seen to be satisfied with how research is taken up (58.4%)[73], conducted (63.67%)[74], and disseminated (55.69%)[75] at/ by their institutions. One needs to look at these figures also in the context of data discussed in previous sections, which showed that most institutions do not mandate sharing of publications or data. The satisfaction levels with the existing institutional practices is worrisome in such a scenario.

FIG. 25. SATISFACTION WITH EXISTING RULES (in %)

	EXTREMELY SATISFIED	SATISFIED	NEITHER	DISATIS-FIED	EXTREMELY DISATIS-FIED	POLICY DOES NOT EXIST IN MY INSTITU-TION
IPR Intellectual Property Rights over your research outputs like articles and data	12.80	46.60	18.40	5.60	4.80	12.00
DATA OWNERSHIP Ownership rights over data generated by you	17.07	43.90	17.89	6.10	3.66	11.38
DATA SHARING Data sharing	15.55	42.02	20.59	5.04	2.94	13.87
OA PUBLICATION Open access to publications	14.41	40.68	18.22	8.90	5.08	12.71
OA DATA Open access to data	12.93	33.62	25.86	7.76	5.17	14.66

FIG. 26. ATTEMPTS TO CHALLENGE THE STATUS QUO
As a researcher, how often have you tried to change the rules/
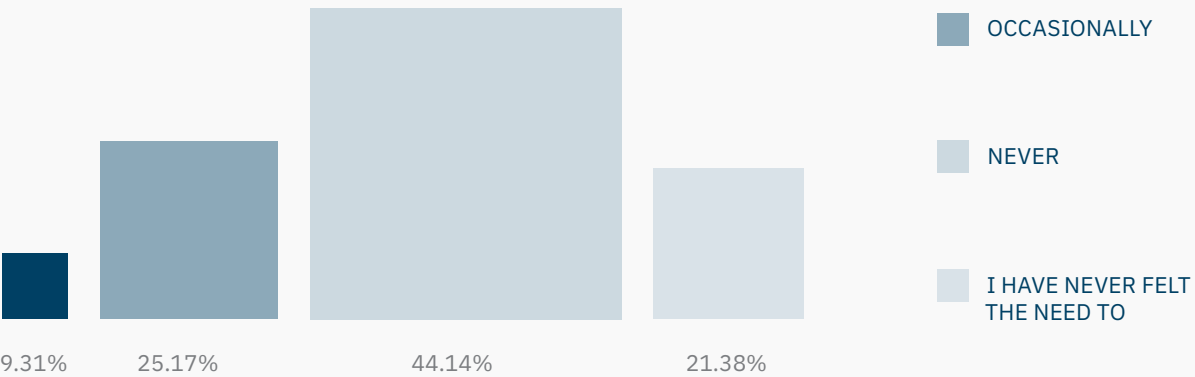practices in your institution with regard to the following?

26.1. WHAT RESEARCH IS TAKEN UP

5.44%   27.89%   44.90%   21.77%
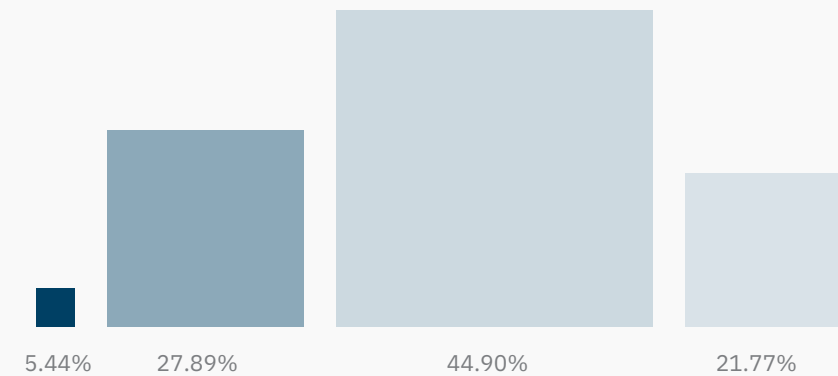
26.2. HOW RESEARCH IS CONDUCTED

10.24%   27.99 %   40.61%   21.16%

26.3. HOW RESEARCH IS DISSEMINATED

9.31%   25.17%   44.14%   21.38%

■ FREQUENTLY

■ OCCASIONALLY

■ NEVER

■ I HAVE NEVER FELT
   THE NEED TO
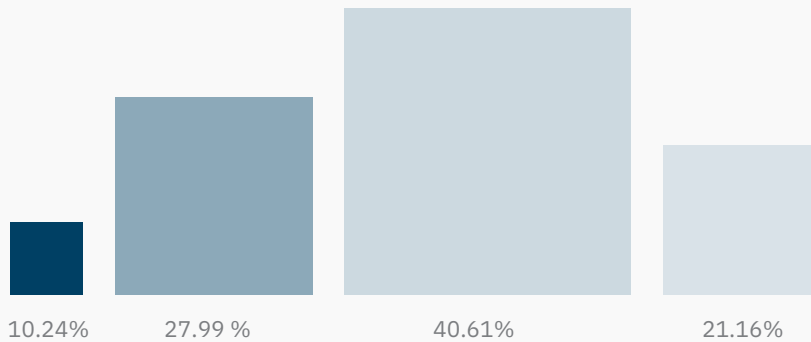
Noticeably, 44.89%[76] respondents have never made an attempt to change the institutional rules or practices regarding what research is taken up, 40.61%[77] have not made this attempt regarding the way in which research is conducted, and 44.13%[78] have not tried to change rules or practices regarding dissemination of research outputs.

While it may not be reasonable to expect all individuals to lobby for changes, it is worrying to see that as many as 21.76%[79] have never felt the need to change rules/ practices regarding selection of research, while 21.16%[80] and 21.37%[81] have never felt this need regarding conduct and dissemination of research respectively. We should view all this data in the context of the limited sharing seen among the respondents and insufficient institutional policies incentivising sharing.

All these data may be pointing towards the abysmal insufficiency of awareness regarding the importance of sharing and transparency in research. Many dimensions of data discussed in this chapter also illustrate the lack of sufficient incentives for openness.

Despite the serious problems existing at every stage of production and dissemination of science,

many researchers in India seem to be worryingly satisfied with the status quo.

In light of the multifaceted crisis in science, and the worrying attitudes and practices pertaining to knowledge sharing and inclusion in the mainstream process of knowledge creation, it is important to challenge the status quo and take holistic measures to address the crisis.

This chapter describes some of the steps that can be taken by different stakeholders towards the goal of a sustainable open science movement in India. In addition, it challenges the perception that sharing of resources and outputs disadvantages some for the benefit of others, and offers perspectives on the benefits that can accrue to all stakeholders from practising open science.

All stakeholders, including policymakers, lawmakers, funding agencies, institutions, publishers, and researchers, must work in their own capacities and in collaboration with one another, to effect meaningful changes to foster inclusiveness and accessibility in science.

OVERAR**CHING**
CHA**NGES**

I

AWARENESS CREATION

The first and most important measure for bringing any meaningful change is to create awareness about the crisis in science and the need for open science. Stakeholders across all levels should make attempts to introduce these concepts to their peers, and institutions and the government must make concerted efforts to orient researchers to the importance of open practices, and the avenues and incentives available for the same. Awareness creation should begin at the undergraduate stage for researchers, so that their education and training can imbibe open science principles, and the importance of knowledge sharing is ingrained meaningfully.

WHAT CAN YOU DO?

POLICYMAKERS
- Policies/ incentive structures which prioritise openness are required to orient stakeholders in the direction of open science

RESEARCHERS
- Discussions and advocacy among peers and other stakeholders, especially within their institutions

INSTITUTIONS
- More awareness creation programmes within institutions (starting from the undergraduate level)

- Incentive structure conducive to open science is likely to influence researchers to recognise the importance of open science

II

PRIORITISING OPEN SCIENCE

A significant way to address the crisis in science in a holistic manner would be to make open science a priority in science and innovation policies. Currently, most of the focus in such policies continues to be on numbers of patents, publications, citations, and educational qualifications, as opposed more comprehensive measures of quality and innovation. On the basis of evidence-based research, policies should be evolved- and existing ones modified- at the central and state levels to create incentive structures conducive to open science. This will also sensitise diverse stakeholders in the scientific research ecosystem to open science.

Inspiration from the European scenario?

The European Commission has undertaken the 'Horizon 2020' initiative, one of whose aims was to remove barriers from the science and innovation processes.[1] They have also started working on its successor, Horizon Europe.[2] As part of these initiatives, detailed guidelines for open access and open data have been evolved, along with strong compliance mechanisms for the same. These guidelines focus not just on availability and accessibility, but finer aspects such as usability and findability. Additionally, regular surveys on the state of implementation are conducted to track the progress of the initiatives and stakeholders' contribution to their execution.

While some may argue that Europe has considerable socio-economic advantages compared to India that enable the extent of budget allocation on an initiative such as this, it is important to understand two things.

First, even if Indian policymakers find it infeasible to allocate as much funding to similar initiatives in India, it is imperative to at least begin with creating awareness about the extent of crisis in science, and how open science may address some of the challenges in this regard.

Such awareness creation may pave for non-monetary incentives for researchers to adopt open science practices.

Secondly, such initiatives, rather than being impractical in a developing country context, are actually crucial to enable inclusive development.[3]

WHAT CAN YOU DO?

POLICYMAKERS
- Make open science a priority at national and state-level and evolve specific policies that take into consideration the local socio-economic and cultural contexts

- Periodic review of the implementation/ functioning of those policies

- Suitable budget allocation
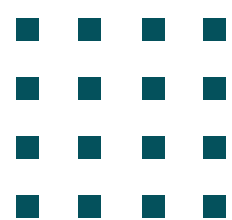
a. Mandatory open access to publicly funded research

The rationale for mandating open access to publicly funded research is quite straightforward. Since public money is being used to enable the production of the outputs- for the infrastructure, laboratories, libraries, communication, remuneration, etc.- the public at large cannot be refused unrestricted access to the same. Therefore, it must be compulsory for various outputs from publicly funded research- articles, data, labnotes, etc., to be made accessible to the public, immediately or within a reasonable embargo period.

WHAT CAN YOU DO?

RESEARCHERS
- Researchers should make publicly funded research available and accessible

INSTITUTIONS
- Institutions receiving public funds for research should mandate access to research outputs

- If the institution receives public funds supporting only part of their research, at least the relevant research outputs must be openly accessible

POLICYMAKERS
- Enact law mandating open access to research outputs from publicly funded research

b. Focus on creating shared resources

It is important to recognise that although knowledge and information might be non-rivalrous resources, i.e., consumption by one does not deplete their availability to others, resources required to create knowledge are often rivalrous and scarce. In most cases, resources such as research laboratories, libraries, and computer systems are available only to 'mainstream' researchers working in well-funded institutions. **In the Indian context, where such facilities are functions of rare privilege rather than the norm, there should be policy focus on creating shared resources.**

While some incubation centres for startups and laboratories to encourage scientific research by students have been established through initiatives such as **STARTUP INDIA ACTION PLAN, 2016** and **ATAL INNOVATION MISSION,** it is unclear whether such spaces are accessible to the public at large.[4] The Report of the UGC Pay Review Committee, 2017 has highlighted the need for setting up of research centres with cutting-edge facilities in different parts of the country, so that common facilities are made accessible for all academic institutions in the catchment area of such centres.[5] This report has recommended the setting up of innovation centers with common resources and knowledge pools so that institutions from various parts of the country, even remote rural areas, can participate in the innovation process.

THE REPORT OF THE
UGC Pay Review Committee
2017

- NEED FOR SETTING UP OF RESEARCH CENTRES WITH CUTTING-EDGE FACILITIES IN DIFFERENT PARTS OF THE COUNTRY,

-NEED FOR SETTING UP OF INNOVATION CENTERS WITH COMMON RESOURCES AND KNOWLEDGE POOLS

This is definitely a step ahead of the **current situation where many premier institutions do not allow outsiders to access their laboratories even if public funding has led to the creation of the laboratories.**

However, it still excludes researchers who are not part of mainstream academic institutions. It is important to make laboratory facilities and research infrastructure accessible to the community at large, which will lead to optimum utilisation of scarce resources. This is especially relevant for public institutions, since public should not be denied access to infrastructure that has been supported by public money.

SRISTI natural product lab, which was established by the Honeybee Network, for providing facilities to any person seeking resources to conduct research, is a model worth replicating as regards shared research infrastructure.[6]

WHAT CAN YOU DO?

POLICYMAKERS
- Introduce policies that can enable access to infrastructure created from public money

- Create an e-library network in the country and provide free and unlimited access to digital resources through publicly funded libraries.

- Introduce policies enabling library networks so that the physical copies of books can be shared on request

III

FINE-TUNING THE IP SYSTEM

Intellectual Property (IP) protection may be one of the many tools for fostering creativity and innovation, but a singular focus on the IP to the exclusion of others can have the counter effect of impeding creativity and innovation.

Inequitable access to both tangible and intangible resources, results in a situation wherein only socio-economically privileged persons can participate in science.

a. Copyright exceptions

i. GENERAL EXCEPTIONS

In this context, it is important for the Indian legal system to take a more balanced approach to IP protection and creativity/ innovation. This is particularly important with regard to copyright law, as protection is accorded as soon as works are published, without requiring any registration. Currently, the Copyright Act, 1957 provides a combination of a fair dealing exception and set of enumerated exceptions for acts that would not constitute copyright infringement. The scope of 'fair dealing' has been understood primarily through a number of court decisions and most courts have taken a relatively liberal approach with regard to interpretation of the fair dealing exception, as long as the use of the work in question was for a purpose specifically mentioned under the fair dealing exception. However, in order to enable open science in India, it is important to broaden the scope of exceptions provided under the copyright law.

Two approaches are possible in this regard. One approach could be replacing the fair dealing exception with a broader fair use exception. While the scope of application of the fair dealing exception is limited to the specific purposes mentioned in the provision, there are no such purpose-related restrictions under a fair use exception. South Africa is one of the countries which are currently exploring the possibilities of such a shift and it is certainly a laudable attempt.[7]

- REPLACE THE FAIR DEALING EXCEPTION WITH A **BROADER FAIR USE EXCEPTION.**

- EXPAND THE LIST OF ENUMERATED EXCEPTIONS PROVIDED UNDER THE INDIAN COPYRIGHT LAW, WITH **MORE SCIENCE-FRIENDLY, ACCESS-FRIENDLY EXCEPTIONS.**

The second possible approach would be to expand the list of enumerated exceptions provided under the Indian copyright law, with more science-friendly, access-friendly exceptions. For example, in the absence of a shift to the fair use system, India should consider creating a new exception for TDM, the significance of which has been explained in Chapter 1, so that researchers can benefit from the full potential of TDM without fear of copyright infringement allegations against them.

ii. EXCEPTIONS TO ENABLE ACCESSIBILITY FOR PERSONS WITH DISABILITIES

A specific point that must be made here pertains to exceptions for persons with disabilities. The Marrakesh Treaty, which India has signed and ratified, and which came into force in 2016, includes a provision for implementing copyright exceptions for persons with visual or other print disabilities. These exceptions include the provision of accessible formats of text to persons with visual/print disabilities. If one looks at the Indian copyright law, it can be seen that the Act mentions that the adaptation, reproduction, issue of copies, or communication of a work can be allowed if the same is meant to make it accessible for personal use for educational/ research purposes by persons with disabilities. However, the exception is worded in such a narrow manner, that only very specific persons and organisations, have been given the right, that too for restricted purposes.

Therefore, lawmakers should modify and broaden these exceptions, based on sustained engagement with persons with disabilities, educationists, TDM experts, and other stakeholders.

The Marrakesh Treaty:

Provision for implementing **copyright exceptions** that include provision of **accessible formats of text** to persons with **visual or other print disabilities.**

iii. AUTHORS' COPYRIGHT OVER PREPRINTS

Our survey data show that a considerable number of respondents do not consider the copyright policy of publishers to be an important factor for selecting journals to publish their works in. Many authors are not aware that it is unconscionable and exploitative for publishers to curtail authors' rights over preprints of articles, since they have made no contribution towards the same. Even if publishers do not claim copyright over preprints, many authors are not aware of their right to publish preprints in any repository or website of their choice. To clarify the rights in this regard inter se publishers and authors, copyright law could specifically mention that the original author(s) (or institution, as the case may be), retain all rights to preprint versions of papers.

POLICYMAKERS
- The fair dealing exception provision should be replaced with a broader fair use exception provision

- Add more enumerated exceptions, especially those enabling access for TDM, so that uncertainties can be reduced

- Broaden the scope of existing exceptions, e.g. persons and organisations that are permitted to use works to make them accessible for persons with disabilities

INSTITUTIONS
- Provide institutional support (may be through institutional IP policies) to researchers for their negotiations with publishers, so that exploitative provisions in publishing contracts can be avoided. For example, grant of non-exclusive rights to the university, as part of the copyright policy of the university, may help authors retain the right to share preprints

RESEARCHERS
- Be vigilant about publishers' copyright and open access policies

- During negotiations with publishers, try to avoid assignment of copyright. Licensing of specific rights is preferable

- Be aware of own rights over their works

b. Revisiting the National IPR Policy

In India, national policies may not have the force of law, but they definitely have a role to play in shaping subordinate policies and guidelines, and people's attitudes and practices. In this regard, the National IPR Policy, 2016 is reinforcing the singular focus on IP as a measure of innovation. Although the policy text starts with a mention of phrases like 'holistic, conducive ecosystem', 'knowledge economy', and 'benefit for all'; it does not expand on these aspects. Instead, it encourages awareness creation regarding the importance of IP, generation of IP as an end in itself. Further, it stresses on commercialisation of IP and strengthening of IPR enforcement mechanisms, without any counterbalancing measures. Instead of looking at IP as one of the many tools that can incentivise innovation, and also focusing on exceptions that are existing in the current IP law or those that need to be introduced, it equates strong IP laws with innovation and development. In this context, it might be useful to revisit this policy and introduce suitable changes.

THE INTELLECTUAL PROPERTY POLICY OF THE REPUBLIC OF SOUTH AFRICA is a good example as regards a balanced IP policy.

One of its strategies is to take a 'balanced and co-ordinated approach' to IPRs vis-a-vis the South African constitutions, which is known for its strong focus on human rights, especially socio-economic rights.[8]

It specifically refers to studies that have shown that there is no conclusive evidence on the role of patents in encouraging research and development or technology transfer, and its impact on economic development.[9]

It also discusses the need to evolve different IP systems for developing and developed countries, based on the relevant context, and states that it intends to coordinate the IP regime with international obligations, especially those pertaining to human rights.[10]

Further, it raises questions as to the relevance of a formal IP system in the informal innovation sector,[11] and provides some detail regarding how IP can be balanced with other concerns such as public health.

Adopting a balanced approach towards IP and its relationship with innovation and development in the National IPR Policy of India, may help bring a change in our rigid view of IPR to the exclusion of other relevant factors that are crucial for fostering creativity, innovation, and socio-economic growth in India.
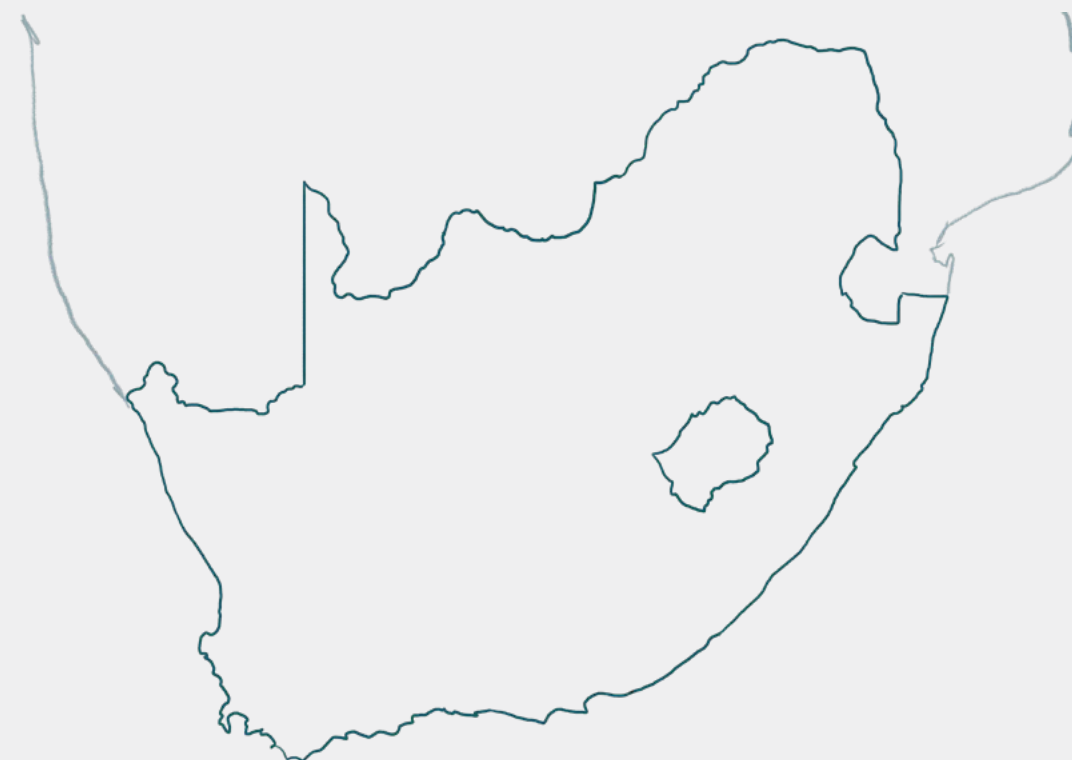
WHAT CAN YOU DO?

POLICYMAKERS
- Introduce counter-balancing provisions in the policy or through other policies

- Focus on more holistic analysis and policy making

IV

OPEN DATA POLICY

The current version of NDSAP is riddled with many problems. It must be amended to remove requirements of registration or payment, and there should be transparency in the components of and rationale for negative lists and sensitive data lists. Public should have a right to access and use government data, and to clarity on rationale of restriction if any. As long as identifying particulars (details which provide information about individuals) are removed from the data, there should be no other restriction for access to data generated or archived using public funds. Moreover, users should be given an accessible platform for providing feedback and seeking redressal in case they have complaints against quality or sufficiency of transparency.

Further, government data should be available in accessible and easily findable formats; and on a common platform- to avoid duplication of efforts in publishing same dataset(s) by more than one body, and in searching for data on multiple platforms.

WHAT CAN YOU DO?

LAWMAKERS
- Remove registration/ payment requirements

- Minimise the negative list and bring in more transparency with regard to negative list and sensitive data

- Remove usage restrictions

- Provide platform for feedback and redressal

- Make all ministry/ govt. body data accessible on common platform with optimal searchability

- Follow FAIR principles of data sharing

MINISTRIES AND GOVERNMENT BODIES

- Make government data available in accessible formats in a timely manner

- Make necessary elimination of identifying particulars

- Provide detailed rationale as to the non-publication of any dataset

The crisis in science is not solely due to problems at the level of institutions of higher education and research, but is a function of exclusions at various levels due to diverse socio-economic factors.

V

PRIVACY LAWS

To complement open access and open data policies, due attention must be given to privacy laws which ensure that personal or identifying data is not made accessible without stringent mechanisms to ensure removal of identifying particulars. Moreover, the exceptions in which such data can be shared or used by the State should be transparent and open to question.

WHAT CAN YOU DO?

LAWMAKERS
- Draft and enact sound privacy law based on thorough stakeholder engagement and respect for human rights

- Enforce mechanisms for adequate implementation

VI

BROADER REFORMS

As discussed previously, the crisis in science is not solely due to problems at the level of institutions of higher education and research, but is a function of exclusions at various levels due to diverse socio-economic factors.

Therefore, lawmakers and officials responsible for implementation of such laws must focus on laws such as the **Right to Education Act, 2009**, which seek to include socio-economically underprivileged persons within the formal education process.
The State should also continue working on other schemes, policies, and laws that can make education and science accessible across genders, geography, caste, language, class, etc.

ACCESSIBILITY

I

OPEN ACCESS AND OPEN DATA

Stringent open access and open data policies should be put in place by institutions and funding agencies. Ideally, these policies should not only apply to final research outputs, but also intermediate ones such as labnotes. Moreover, regardless of top-down policies, researchers themselves should understand the importance and benefits of openness, and implement open practices in their work. Increased awareness about open science, as discussed earlier in the chapter, can play a major role in this regard. One such benefit is increased visibility to publications/ data, through more diverse platforms. It is also important to provide more incentives for researchers to share data. **Currently most researchers may not have much incentives to share data. Lack of proper attribution, especially data citations, has not received sufficient emphasis**, thus discouraging many researchers from sharing their work.[12] Therefore, researchers must pay greater attention to proper citations when they refer to or rely upon someone else's work in their own, and institutions/ funding agencies need to create incentive mechanisms for better compliance in this regard.

WHAT CAN YOU DO?

INSTITUTIONS
- Institutional open access and open data policies

- Introduce reasonable embargo periods for researchers publishing on other non-open access platforms

- Prioritisation of such policies over commercial interests, in case of conflict

- Communication and awareness about such policies

- Provide due credits and recognition for data sharing

FUNDING AGENCIES

- Open access and open data policies should be made applicable to outputs of research funded

- Policy should be as clear and detailed as possible

- Provide due credits and recognition for data sharing, while considering applications

- Data/ publication sharing plans should be an integral part of funding application

- Ensure proper monitoring of open access/ open data policies and better compliance mechanisms

RESEARCHERS
- Adhere to applicable open access/ open data policies

- Practise open access/ open data regardless of existence of top-down mandates

- Proper and complete attribution, especially data citation

OPEN SOURCE AND OPEN HARDWARE

Open source software are being adopted by many large enterprises for reducing cost and acquiring latest technology at a faster pace. It is also hoped that such enterprises will contribute their own code to the open source community. Sharing of the code is helpful not only for the users of such code but also the company which has developed the code as the problems in the code can be identified at early stages due to exposure to diverse and larger numbers of users, and solved better by the collective brainpower of the open source community.

A survey on enterprises which use open source software suggests that 66% have contributed to open source projects and 48% were of the opinion that the number of contributors will increase.[15] However, some enterprises are not comfortable with sharing their source code as they are of the opinion that this is equivalent to releasing financially sensitive information. There is a need to educate enterprises about the benefit of contributing to open source projects. Data from open source code repository GitHub shows that Indian IT services companies are yet to embrace open source code culture.[16] More companies in India should encourage their employees to participate in the creation of open access software. Outward interaction for collaborative creation helps in awareness about latest developments and capacity-building on diverse skills, and adoption of open source software has been seen to increase speed and adaptability of organisations.

GITHUB, the world's biggest software development platform, has initiated 'Open Source Friday', a new program that encourages firms to set aside some time at the end of the week for participation in open source projects by employees.[17] According to GitHub, this initiative has been started to encourage "charity", but to also foster improvement of key business infrastructure.[18]

The program website has resources for employers as well as contributors to explain the importance of open source, but also ways of contributing through coding and creation and maintenance of documentation.[19]

NATIONAL DEFENSE AUTHORIZATION ACT for Fiscal Year 2018, a US federal law, has mandated the US Department of Defence to focus on adoption of open source software at the Pentagon.[13] Some of the supporters of this mandate argue that open source will reduce cost and waiting time through faster acquisition of new technology, and that it is more secure than proprietary software due to greater and continual scrutiny.[14] This can address some of the concerns about quality and risk of open source.

Similarly, open hardware practices should also be encouraged. It is impossible to practise a substantial part of science without hardware, access to which depends on available resources which many cannot avail or afford. This problem can be partially addressed by open hardware - by sharing designs, instructions for building, and protocols openly, for anyone to reuse.[20]

III

OPEN EDUCATIONAL RESOURCES

WHAT CAN YOU DO?

INSTITUTIONS/ WORKPLACES

- Encourage creation and development of open source software, at least during a portion of work hours

- Encourage open hardware for innovative or existing systems

- Adopt open source software for internal uses

PROFESSIONAL SOCIETIES

- Encourage and motivate the community to participate in the open source software/ open hardware movement

RESEARCHERS/ ENGINEERS OR OTHER PROFES- SIONALS

- Regardless of mandates, dedicate time and effort to these movements

In Chapter 2, various problems with currently available OER have been observed. More open educational resources, especially those available in accessible formats and diverse regional languages, available for use without restrictions, and on regularly updated and searchable platforms, are required.

Discipline-based, institutional, and other kinds of repositories should be set up for providing researchers platforms where they can deposit their works including data, to encourage mutual benefit and learning. Repositories are more useful than personal websites for producers and users of works since the former are cost-effective and easier to search and find resources from. Institutions should set up their own repositories where researchers could be mandated to deposit their project outputs. Even if the researchers choose to publish elsewhere, the papers and data should be deposited in the repository after a reasonable embargo period.

WHAT CAN YOU DO?

POLICYMAKERS
- Address problems with existing OER repositories and create new OER repositories

- Include more content with linguistic and other kinds of diversity

- Accessible formats

- Metadata

- Eliminate usage restrictions

- Efficient search function

- Sizing/ colour contrast options

INSTITUTIONS
- Encourage creation of and contribution to OER repositories

- Encourage content with linguistic and other kinds of diversity

- Accessible formats

- Metadata

- Eliminate usage restrictions

- Efficient search function

- Sizing/ colour contrast options

RESEARCHERS
- Contribute to OER repositories

PROFESSIONAL SOCIETIES
- Encourage creation of and contribution to OER repositories

- Encourage content with linguistic and other kinds of diversity

- Accessible formats

- Metadata

- Eliminate usage restrictions

- Efficient search function

- Sizing/ colour contrast options

IV

OPEN LICENCES

The kind of uses specifically allowed by an IP owner, particularly through a legal instrument like licence, can play a major role in determining the extent to which the IP would be utilised by users. For example, very often one can see copyright owners displaying the message "© ___ - All rights retained" on products such as books. Such reservation of all rights are often unnecessary and harmful for the society, as they prevent broader dissemination and utilisation of such works. Open licences can address this to a great extent by providing explicitly the rights granted to the users. Different kinds of open licences are available today and some of the most popular ones in the area of copyright are developed by Creative Commons, a non-profit organisation:[21]
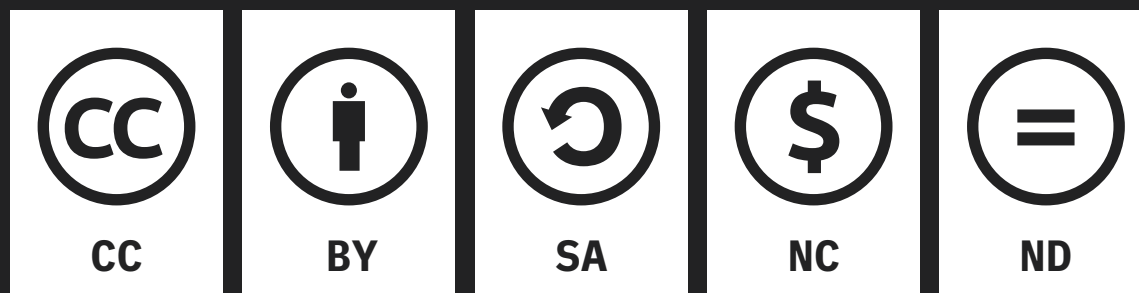
CC0
A Public Domain licence, which indicates that the copyright owner has not retained any right to the work and has dedicated it to the public domain, where it can be used- remixed, tweaked, built upon- for any purpose (including commercial purposes) without restriction.

CC BY (Attribution)
The work can be used for any purpose (including commercial purposes) without restriction, subject only to proper attribution (the manner of attribution can be specified by the copyright owner)

CC BY-SA
The work can be used- remixed, tweaked, built upon- for any purpose (including commercial purposes) without restriction, subject to proper attribution and the requirement that derivatives and new creations based on the work are also distributed under an identical licence.

CC BY-ND
Redistribution, commercial and non-commercial purposes are permitted, but making derivatives are not. The licence demands that work should be passed along unchanged and in whole, with proper attribution.
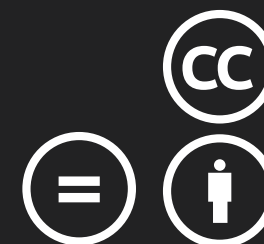
CC BY-NC
Only non-commercial uses (for example, remix) are permitted and proper attribution is necessary.

CC BY-NC-SA
Only non-commercial uses permitted. Attribution is necessary, and derivatives must be licensed under identical terms.

CC BY-NC-ND
Users are allowed non-commercial uses with proper attribution. Users are not allowed to create derivatives from the work. This is the most restrictive among all Creative Commons licences. But it needs to be noted here that even this licence is better than default position created by current copyright law – all rights reserved.
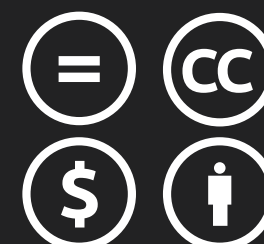
For enabling open science, it is important to use open licences like CC0 or CC BY while sharing works. It needs to be specifically added here that these two Creative Commons licenses have been mentioned here to merely illustrate the kinds of openness that need to be adopted, and one may also use other open licences like GNU General Public License, depending on the requirements and type of IP involved. What is important is to ensure that the open licence adopted is clear, identifiable, and comprehensible.

WHAT CAN YOU DO?

FUNDING AGENCIES
- Mandate sharing of outputs under an open licence (CC BY or equivalents)

INSTITUTIONS
- Mandate sharing of outputs under an open licence (CC BY or equivalents)

- Urge researchers to share their works under an open licence (CC BY or equivalents)

PUBLISHERS
- Share works under CC0/ CC BY licence or equivalents

RESEARCHERS
- Share works under CC0/ CC BY licence or equivalents

V

INFRASTRUCTURE

Apart from broad policies for creating shared infrastructure, it is important to ensure that institutional infrastructure including architecture, libraries, databases, and laboratories are accessible. The term, 'accessibility' has multiple dimensions-infrastructure and resources should be accessible to persons with various kinds of disabilities, through not just ramps and wheelchairs but also through Braille textbooks, audiobooks, flexible leave policies, etc. Moreover, they should also be open to the public at large, subject only to mechanisms to ensure security and safety of users. This will lead to optimum utilisation of scarce resources, especially those which are affordable only for few; and mutual benefit from interaction and diversity.

WHAT CAN YOU DO?

FUNDING AGENCIES
- Provide funding for meaningful accessibility of research outputs, including that for persons with disabilities

RESEARCHERS
- Advocate for increased accessibility within institution and of research outputs

- Make efforts to make research outputs accessible

INSTITUTIONS
- Provide public access to libraries, laboratories, etc.

- Conduct open days to make research within an institution accessible for the broader public

- Be part of library networks

- Ensure accessibility mechanisms such as ramps, wheelchairs, elevators, audiobooks, screen-reading software, Braille textbooks, flexible leave policies, etc.

"As a product of the Indian educational system, it's amazing to discover that the thinking of leading western universities on accessibility issues begins where the thinking of Indian universities ends."

Rahul Bajaj, Oxford University, Rhodes Scholar 2017
Twitter (May 23, 2018)

VI

LANGUAGE AND COMPLEXITY

Usage of unnecessary jargon or complicated and antiquated language is often considered necessary part of formal or academic writing. Without adding much value to the work, such usage actually makes writings inaccessible to most persons beyond the author's immediate peers. Authors should endeavour to use simpler, more contemporary language, which can help in better communication of science, while retaining the intended complexities and details of the subject matter.

Further, in order to enable greater access to their research, researchers should make concerted efforts to translate at least the primary findings and conclusions from their works in regional languages. This can be done on a personal capacity as well as with assistance from institutional facilities. Moreover, apart from publishing in academic journals which cater primarily to other academics in the same discipline, researchers should focus on ways in which laypersons and people from other disciplines can understand and participate in discussions surrounding their work. This can be done in the form of relatively simplified communication through blog posts, newspaper or magazine articles, etc. Such communication benefits the producers of research outputs by increasing visibility of research outputs/ findings and possibility of feedback from a larger and more diverse set of readers.

Οι ερευνητές πρέπει να μεταφράζουν τουλάχιστον τα κύρια ευρήματα και τα συμπεράσματα των έργων τους στις περιφερειακές γλώσσες. Επιπλέον, πρέπει να επικεντρωθούν στους τρόπους με τους οποίους οι μη ειδικοί καθώς και άτομα από διαφορετικούς κλάδους μπορούν να κατανοήσουν και να συμμετάσχουν σε συζητήσεις γύρω από το έργο τους.

*Researchers should translate at least the primary findings and conclusions from their works in regional languages.
Moreover, they should focus on ways in which laypersons and people from other disciplines can understand and participate in discussions surrounding their work.

Augmenting Writing Skills for Articulating Research

DST has started the AWSAR (Augmenting Writing Skills for Articulating Research) scheme to **encourage Ph.D. scholars and post-doctoral fellows to engage in 'popular science writing' through newspapers, magazines, blogs, social media, etc.[23]**

Incentives like monetary awards and certificates of appreciation for select entries are part of the scheme.[24] While it might be too early to predict whether the scheme has succeeded in its objectives, it is an admirable example of effort that could be taken by a government body to encourage crucial non-academic scientific communication.

WHAT CAN YOU DO?

POLICYMAKERS
- Recognise value and impact of scientific communication to non-academic audience

- Provide incentives to researchers for such communication to non-academic audience.

- Provide for translation on ministry-backed repositories

FUNDING AGENCIES
- Encourage and incentivise non-academic scientific communication

- Encourage and incentivise translations and derivations

INSTITUTIONS
- Encourage and incentivise non-academic scientific communication

- Encourage and incentivise translations and derivations

- Provide facilities for translation

RESEARCHERS
- Avoid unnecessary jargon and complex language in communicating science

- Publish simplified versions of research outputs (at least summarised versions through blog posts)

- Publish translation of at least summaries of findings in as many regional languages as possible

- Involve students in preparing summaries and translations. Provide appropriate credits to students

VII

USABILITY AND SEARCHABILITY

Research outputs should be made available in accessible formats. This is particularly important for ensuring more optimal utilisation of information through measures such as TDM. It is also important to ensure that persons with disabilities can access the same.

Moreover, sufficient focus should be put on findability of works, through comprehensive metadata and persistent identifiers. Repositories and other websites should have good searchability and accessibility features like font size and colour contrast change.

Further, to increase usability and interoperability, researchers should work towards adopting open standards for increasing the usability and interoperability of shared research outputs. This could pertain to the file formats, order, etc.

These efforts increase findability and visibility of research, and help build increased and more engaged readership. It is important to train undergraduate and postgraduate students on all these dimensions at an early stage, so that all aspects of open science, including data sharing and transparency measures, become an integral part of the research process.

WHAT CAN YOU DO?

FUNDING AGENCIES
- Ensure that outputs from all research they support meets accessibility requirements

- Funding support for making works accessible

- Provide funding support for training programmes

INSTITUTIONS
- Conduct training programmes, beginning at undergraduate/ postgraduate levels

- Make all research outputs from the institution accessible

MANAGERS OF REPOSITORIES
- Ensure proper metadata

- Provide technical support in making works available in accessible and machine-readable formats

- Use persistent identifiers

- Provide efficient search function

RESEARCHERS
- Ensure proper metadata

- Implement FAIR principles

- Adopt open standards for communication and sharing

VIII

INCLUSIVE ECOSYSTEM

As explained previously, open science is not just about sharing of knowledge outputs, but also making the research ecosystem more inclusive, so that socio-economic factors like gender, language, disability, geography, etc. do not hinder a person's participation in the same. In this context, institutions should put in place policies for maternity/ paternity leaves, flexible leave policies for persons with visible and invisible disabilities, and non-discriminatory promotion policies.

All stakeholders should make an effort to **increase awareness** and **sensitivity** about overlooked issues such as **language barriers, subliminal sexism/ casteism, mental health, invisible disabilities,** and other factors which restrict meaningful inclusion, in their respective institutions.

TRANSPARENCY,
REPRODUCIBILITY,
& PRIVACY

TRANSPARENCY

Disclosure of detailed methodology, data, negative results, errors/ limitations, and source of funding/ possible conflicts of interest pertaining to the research ensures that the veracity of the claims of the research can be tested. This would ensure that incorrect, misleading, or fraudulent research is arrested. Moreover, transparency can also lead to greater scope for feedback and replicability of research, thus also increasing the quality of research outputs. However, as one could see from the data in chapter 3, while many researchers are sharing research methodology (81.11%), not many share negative results (37.77%) or any errors in data they might have found (23.84%).[25] Substantial changes are required in this regard and there should be concerted efforts to increase

A recent study on publication of clinical trial findings in the field of Oncology has found substantial delays in sharing of clinical trial data.The study, conducted between 2011 and 2016, measured delays in notification and dissemination of phase 3 clinical trials in oncology by 8 large pharmaceutical companies. It was found that even for the most critical findings, the median publication delay was almost 1 year. Delays were longer for trials with negative data than those with positive data.[26] According to the authors, as compared to positive results, negative results took more than 4 months longer to be shared through ClinicalTrials.gov or published in a peer-reviewed medical journal. Moreover, among all the studies announcing negative results, only 70% published or posted results within two years.[27]

Knowledge of negative results is crucial for any scientific research, but especially so for fields in which imminent public interest like cancer treatment is involved. Studies like this illustrate the need for evolving more stringent measures for disclosure of results, particularly negative results.

WHAT CAN YOU DO?

POLICYMAKERS
- Mandates with regard to disclosure of source of funding and negative results

- Incentivise reporting of negative results

FUNDING AGENCIES
- Mandate disclosure of conflict of interest, detailed research methodology, research tools, negative results, errors, and limitations

- Incentivise reporting of negative results

INSTITUTIONS
- Mandate disclosure of conflict of interest statement, detailed research methodology, research tools, negative results, errors, and limitations

- Promote awareness

PUBLISHERS
- Mandate disclosure of conflict of interest, detailed research methodology, research tools, negative results, errors, and limitations

- Reduce inordinate focus on "cool" or exciting results which may motivate researchers to hide, modify, or misrepresent data

RESEARCHERS
- Even in the absence of mandates from publishers, disclose conflict of interest, detailed research methodology, research tools, negative results, errors, and limitations

II

FUNDING AGENCIES

- Encourage replication studies by allocating and providing more funding support for replication studies.

- Avoid excessive focus on novel studies while considering funding applications

INSTITUTIONS

- Encourage replication studies by giving them due recognition in performance evaluations

- Allocate funding support for replication studies

PUBLISHERS

- Encourage publication on diverse topics including replication studies which may not be "cool" at an international level

RESEARCHERS

- Constantly remind themselves (and peers) that reproducibility of results is an integral part of science and it is their duty as researchers to contribute in this aspect

- Report both positive as well as negative results with regard to replications

REPLICATION STUDIES

Replication studies may not be "cutting-edge" or completely novel. But they are extremely important for science and society, as they improve the veracity and reliability of science.[28] By doing this, not only will the quality of science and its social impact be improved, but researchers will in general be constrained from any data manipulation, as the probabilities of getting them detected by peers would become higher. Thus, veracity and reliability of the research and its producer(s) also increase.

III

WHAT CAN YOU DO?

FUNDING AGENCIES

- Encourage socially relevant studies by allocating and providing more funding support.

- Avoid excessive focus on novel studies while considering funding applications

INSTITUTIONS

- Encourage socially relevant studies by giving them due recognition in performance evaluations

- Allocate funding support for socially relevant studies

PUBLISHERS

- Encourage publication on diverse topics including socially relevant studies

RESEARCHERS

- Constantly remind themselves (and peers) that producing socially relevant research is an integral part of science and it is their duty as researchers to contribute in this aspect

SOCIALLY RELEVANT STUDIES

Similarly, socially relevant studies should be encouraged regardless of "exciting" or cutting-edge results from the same, or their appeal in the international scientific community.

IV

PRIVACY

Respecting privacy rights during any data collection and publication is of utmost importance. By establishing institutional measures for periodical ethical reviews, privacy violations can be prevented to a great extent.[29] Ethical reviews are intended to ensure adherence to research ethics and scrutiny of the research and data collection process. Although the process involved may be considered by some researchers and institutions as unnecessarily cumbersome, time-consuming and restrictive, it may in effect be also helping them to receive feedback and notice flaws/ scope for improvement in the project design at an early stage. It would also help in building trust with stakeholders/ participants, and preventing potential controversy at a later stage.

WHAT CAN YOU DO?

FUNDING AGENCIES
- Mandate privacy requirements

- Mandate ethical reviews

INSTITUTIONS
- Mandate privacy requirements

- Constitute ethical review boards

PUBLISHERS
- Ensure that publications and associated data do not violate privacy rights

RESEARCHERS
- Adhere to research ethics including those relating to privacy

- Encourage institutions to adopt ethical reviews

★ ★ ★ ★ ★ ★ ★ ★ ★ QUALITY ★ ★

I

PEER REVIEW

Peer review is considered one of the most important ways to ensure and increase quality of scientific publications. There are broadly three kinds of peer review: 1. open peer review- where the identities of the author(s) and the reviewer(s) are disclosed to one another; 2. single blind peer review- where the reviewer(s) remain(s) anonymous but not the author(s); and 3. double blind peer review- where the identities of neither the author(s) nor the reviewer(s) are disclosed to the other.

There are debates as to the ideal form of peer review. Single blind peer review is considered to foster honesty in reviews, but criticised for enabling unduly harsh and biased review - especially since only the reviewer(s) has knowledge of identity of the author(s), and not the other way round.[30] Single blind peer review may also result in bias towards scholars who are well known in a particular field. On the other hand, double blind peer review is considered to decrease chances of bias and fear on the reviewers' side, as the reviewer is not aware of the identity of the authors. However some studies show that double peer review hasn't improved research quality.[31] So some scholars argue in favour of open peer review.

According to them, open peer review makes biases easier to identify and encourages reviewers to be more responsible and less negligent. But a major criticism against this system is that reviewers may be overly critical to appear rigorous under scrutiny.[32]

Although there is no definite conclusion to this debate, it is important to ensure that peer review occurs in a meaningful and unbiased manner, such that quality and reliability of the research outputs are increased. Moreover, we must look beyond academic peer review and open doors for public consultation and debate, at least at the post-publication stage. **'Open and post-publication review'** is one of the ways to do that, whereby all the readers and not just the reviewers are able to review and comment.[33]

WHAT CAN YOU DO?

FUNDING AGENCIES

- Ensure thorough, unbiased reviews of outputs from research funded by them

- Provide post-publication review opportunities for research funded by them

- Ensure background research on reviewer(s) vis-a-vis author(s) to eliminate potential bias or conflict of interest

PUBLISHERS

- Ensure thorough, unbiased peer review of publications

- Provide post-publication review opportunities of publications.

- Ensure background research on reviewer(s) vis-a-vis author(s) to eliminate potential bias or conflict of interest

- Ensure transparency about the costs involved in the peer review process

RESEARCHERS

- Ensure thorough, unbiased review of article reviewed

- Actively participate in post-publication reviews

- Declare potential conflicts of interest clearly and promptly

II

OPEN LABNOTES

Researchers should be encouraged to publish labnotes as intermediate project outputs, in order to increase transparency and improve quality by inviting feedback and corrections at all stages of research, including the pre-publication stage. It may also reduce duplication of efforts. Open labnotes are likely to improve the quality of research owing to larger and more diverse scrutiny on its intermediate stages.

WHAT CAN YOU DO?

FUNDING AGENCIES

- Encourage sharing of labnotes in real time/ at intermediate stages of research

INSTITUTUIONS

- Encourage sharing of labnotes in real time/ at intermediate stages of research

RESEARCHERS

- Share labnotes in real time/ at intermediate stages of research, even in the absence of mandates from funding agencies/ institutions

III

PUBLIC CONSULTATION/ FEEDBACK

Drawing from the previous point, even if real-time labnotes are not made accessible, researchers should expose their research outputs to public scrutiny. Having a larger and more diverse set of reviewers through public consultation is likely to improve research quality through correction of errors and rigorous constructive feedback.

WHAT CAN YOU DO?

PUBLISHERS

- Enable open and post-publication review

- In case of delays in publication, make preprints available for public review

RESEARCHERS

- Make one's own research outputs accessible before and after publication

- Actively review the outputs of peers and provide constructive feedback
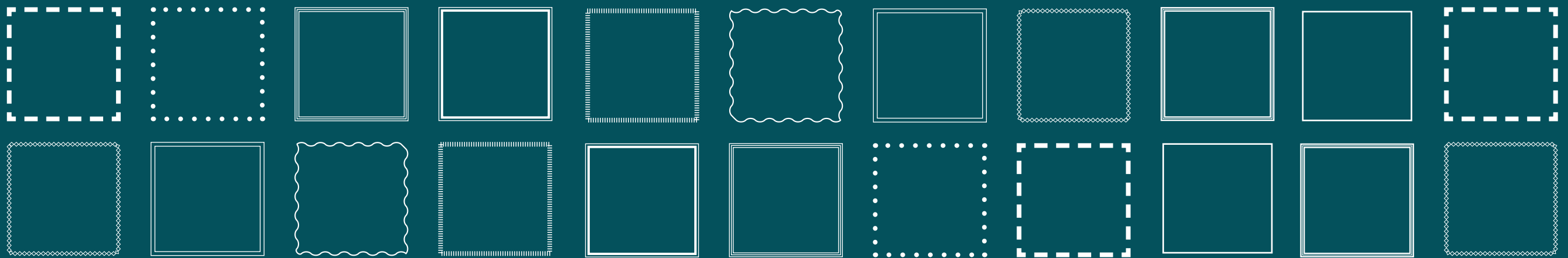
COLLABORATION

Collaboration within the same and across different institutions, disciplines, and parts of the world, should be encouraged to include diverse perspectives in research, and increase scrutiny and quality of research outputs. Collaborations have proven especially fruitful in international emergencies like the spread of Zika virus.[34] At an individual level, they help researchers learn from one another and increase their visibility through networking and exposure.

DURING THE PUBLIC HEALTH EMERGENCY CAUSED BY THE SPREAD OF ZIKA VIRUS in various parts of the globe, University of Wisconsin-Madison researchers working with Brazilian collaborators started sharing real-time data regarding virus dynamics on an open and collaborative platform.[35] This initiative of the Zika experimental science team (ZEST) was significant in the way open science principles of collaboration and real-time sharing were utilised during a global health emergency to assess the infectivity of the virus, measure concentration of the virus in bodily fluids/excreta, and determine whether the first Zika virus infection makes a person immune to re-infection.[36]

Other open source projects such as Nextstrain utilise similar open science principles to provide a continually-updated view of publicly available data with useful, interactive visuals which show pathogen evolution and epidemic spread.[37]
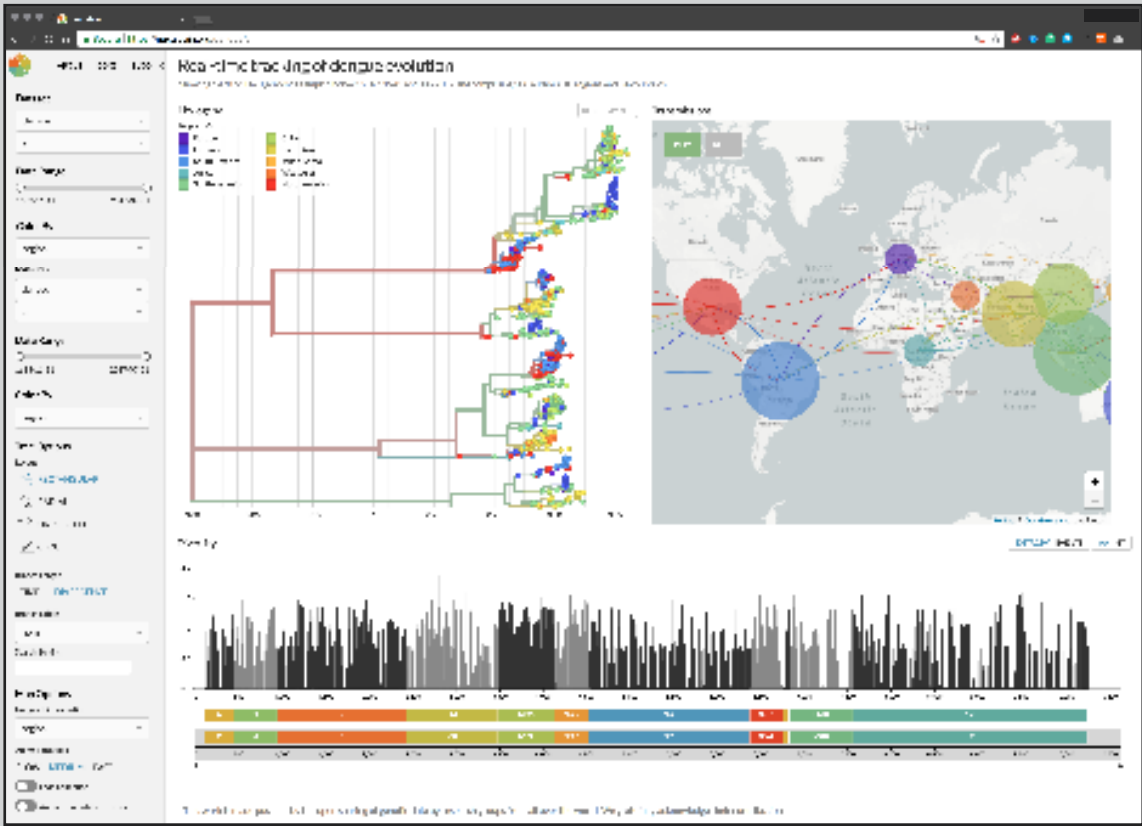
Currently, due to the inordinate focus on number of publications, collaboration is often seen as unnecessary expenditure of time and effort. In this context, policymakers, institutions, and funding agencies can play a major role in enabling collaborations within and across institutions, disciplines, and countries. Moreover, evaluation systems should change the current system wherein they give less and unequal scores for joint authors as opposed to single authors.[38]

The current crisis of trust between diverse stakeholders in research, especially the deficit of fairness and mutual respect present vis-a-vis researchers from the Global North and the Global South, can be mitigated to a large extent if funding agencies and institutions create platforms for equitable engagement, exchange, and collaboration.[39]

WHAT CAN YOU DO?

POLICYMAKERS

- Evaluation systems should shift some of the inordinate focus on numbers of publications to incentivising collaborations. Authors of collaborative research outputs should not be awarded lower and inexplicably different scores, as compared to single-author outputs

FUNDING AGENCIES

- Foster collaboration between researchers within and across institutions, disciplines, and countries

INSTITUTIONS

- Make institutional policies conducive to collaborations
- lessen bureaucratic hurdles and incentivise/encourage collaboration

RESEARCHERS

- Collaborate with other researchers within and across institutions, disciplines, and countries

COMMUNITY/CITIZEN SCIENCE

I

INTERACTION

Following from the previous point, researchers should engage with local communities for getting more insights on contemporary social and technological issues. Moreover, as illustrated in the citizen science discussion, local communities often have better insight into issues surrounding them, and their participation and feedback is crucial to meaningful understanding of the context. Diversity of perspectives, mutual learning, and trust-building with local communities while producing socially relevant research is a significant benefit.

Concerted efforts should also be made for other kinds of interaction and meaningful engagement with the local community.

Organisation of 'open days' where the public can ask questions and engage with researchers, public access to institutional events like talks and exhibitions, are some other avenues.

Moreover, more citizen science initiatives should be undertaken both by the government and institutions, particularly for projects that would greatly benefit from public participation, such as those dealing with **grassroots innovation, data collection on environmental issues, legal/ policy implementation, etc.**

> "Outputs of publicly funded research should be openly accessible... The high fees charged by publishers for allowing access to publicly funded research, and the simultaneous system of APCs, encouraged somewhat by the kind of metrics that we use to evaluate recruitment and promotion, is a problem."

Prof. K. VijayRaghavan, Principal Scientific Adviser to the Government of India 'Science, Technology and Innovation in Building a Knowledge Economy', Science, Technology and Innovation Policy Forum Lecture Series, Delhi (June 19, 2018)
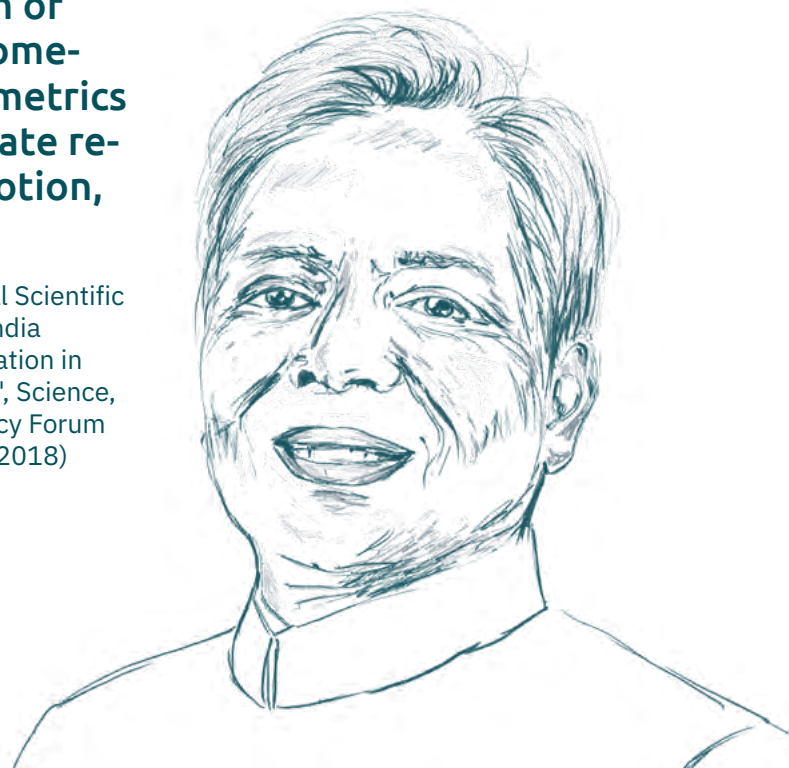
WHAT CAN YOU DO?

POLICYMAKERS

- Assess the value and impact of meaningful public engagement apart from academic talks/conferences

- Create incentives for public engagement

FUNDING AGENCIES

- Encourage public engagement and citizen science

- Be open to diverse grant applications, even from non-mainstream researchers

INSTITUTIONS

- Create mechanisms and incentives for public engagement

- Open day initiatives

- Allow public entry to talks, exhibitions, etc.

- Collaborate with local governments in creating science parks which are accessible to the public

PUBLISHERS

- Encourage public engagement and citizen science

- Be open to diverse entries, even from non-mainstream researchers

RESEARCHERS

- Meaningful and respectful public engagement, especially on local socially relevant issues

- Motivate peers to broaden their minds and delve into community interaction

II

CREDIT SHARING

Another crucial aspect of this interaction and engagement is fair sharing of credit and authorship over research outputs. This is an ethically sound practice and a necessary step in the direction of reducing exploitation involved in such collaborative relationships, and reduction of social gaps

WHAT CAN YOU DO?

FUNDING AGENCIES

- Mandate proper credit sharing for research outputs, with emphasis on often-neglected participants

INSTITUTIONS

- Mandate proper credit sharing for publications, with emphasis on often-neglected participants

PUBLISHERS

- Mandate proper credit sharing for publications, with emphasis on often-neglected participants

RESEARCHERS

- Share appropriate credit/ authorship with members of the local community as per nature and extent of contribution

"It is still not obligatory for social and natural science councils to acknowledge creative communities by their names and addresses, make them co-authors (though it is slowly beginning to change), and share the findings of their research back with them in their language… Another low is that many small companies replicate the ideas of children, but don't share the benefits with them or acknowledge them."

Prof. Anil K. Gupta
(https://bit.ly/2LL4NBo)

COMPLIANCE MECHANISMS ||||||||||||||||||||||

The discussions in both Chapter 2 and Chapter 3 of this report have illustrated the acute insufficiency of monitoring and compliance of existing open access policies. For example, data on the implementation of the DBT-DST Open Access Policies show that even formal communication of open access mandates is ignored, and mandated repositories are rarely updated. Our survey data also shows that many researchers are not aware of monitoring mechanisms, which illustrates the pressing lack of efforts to ensure compliance.

Therefore, for implementation of well-intentioned policies - for open access, open source software, open data, transparency; it is important to **create mechanisms** within the same that enable compliance. This pertains not just to **formal inclusion** of provisions for **regular monitoring**, but also **creating awareness** among those responsible for the **implementation** of such provisions. Therefore, a mixture of **top-down** and **bottom-up** approaches, and **positive and negative incentives**, are necessary in this regard.

WHAT CAN YOU DO?

LAWMAKERS

- Monitor compliance of legal mandates

- The text of laws must be made available in accessible formats (and not images or non-machine readable PDF formats)

- Awareness must be created about new laws

POLICYMAKERS

- Monitor compliance of policy mandates

- Policy should have sufficient details and certainty as to the process of monitoring and implementation

- Proper communication and awareness creation about openness mandates

- Timely monitoring and communication to researchers in the event of non-compliance

FUNDING AGENCIES

- Monitor compliance of mandates

- Policy should have sufficient details and certainty as to the process of monitoring and implementation

- Proper communication and awareness creation about openness mandates

- Timely monitoring

- Stringent sanctions for non-compliance, e.g. rejection of grant renewal proposal

INSTITUTIONS

- Monitor compliance of mandates

- Policy should have sufficient details and certainty as to the process of monitoring and implementation

- Proper communication and awareness creation about openness mandates

- Timely monitoring

- Stringent sanctions for non-compliance, e.g. denial of grant

RESEARCHERS

- Follow applicable legal/policy mandates

- Encourage peers to follow the same

UATION

REEVALUATING EVALU

The problems with the API system for evaluation of university teachers for recruitment and promotion have been discussed in Chapter 1. Recently, UGC has announced that the system is being considered to be removed.[40] However, apart from raising the educational qualifications required to enter the university faculty, no other change to the evaluation system has been announced.[41]

The results from our survey indicate that researchers have no incentive to adopt open science practices. In fact, the evaluation systems, by focusing heavily on the number of publications, impact factor of journals, and attendance at conferences, etc., disincentivises knowledge sharing and community interaction. Researchers start believing that sharing of their outputs may lead to "free riding" by other researchers for their own publications, and working on socially relevant issues is not worth their time if they intend on publishing in international journals to whom regional issues may not be of much interest. Moreover, in the race to increase the number of publications, more time-consuming aspects of empirical research, detailed data analysis, and collaboration are being neglected. As per the current system, not all authors in a collaborative work are given equal scores, which might discourage collaboration.[42] There is also high emphasis on the number of patents.

Most of the respondents in our survey even stated that they have received no benefits from data sharing. In contrast to 42.39%[43] who said that they received visibility from sharing publications through citations, only 17.47%[44] stated that they received this benefit from sharing data. Shouldn't API provide adequate incentives for data sharing?

This situation necessitates a serious change in the existing evaluation system. Scores should be allocated for sharing of publications, data, and complying with open access and open data policies. Apart from patents, open source initiatives should be awarded scores, and community interaction and collaboration should be acknowledged. This should be accompanied by mandates for data citations, since not much importance is given to the same currently.

Institutions and funding agencies should also depend on these alternative factors to evaluate applications for recruitment, promotion, and grants. Moreover, while evaluating applications for fresh grants or renewals, funding agencies must take into consideration researchers' sharing practices, and the extent to which researchers complied with previous open access/ data and transparency mandates- whether they were imposed by the institution, State, other funding agencies, or the funding agency in question. Involvement in replication studies can also be one such component in the evaluation process. Such systems of evaluation, if exercised by funding agencies, are likely to make researchers take such provisions seriously and make them realise the importance of openness in research.

WHAT CAN YOU DO?

POLICYMAKERS

- Recognise impact and value of sharing of publications/ data, adopting transparency measures, non-academic scientific communications, collaborations, engagement with local community

- Replace journal-based metrics with article-based metrics for assessment/ evaluation

FUNDING AGENCIES

- Factor past openness and compliance with openness mandates in the evaluation of grant applications (fresh/ renewal)

INSTITUTIONS

- Factor past openness and compliance with openness mandates in the evaluation of recruitment/ promotion applications

RESEARCHERS

- Provide appropriate citations wherever data/ publications of other researchers are used

- Sign the San Francisco Declaration on Research Assessment, which is a tool for advocating for important changes including elimination of journal-based metrics like Impact Factor, assessment of research on its own merits, and recognising the value and impact of datasets and software apart from research publication[45]

RETHINKING
PUBLICATION
MODELS

I

ENABLING OPEN ACCESS

The current publishing model followed by commercial publishers has been heavily criticised for being exploitative and completely replaceable by a more equitable one. Even for non-predatory journals, high costs charged for open access publishing or high access fees are being recognised as disproportionate to the costs incurred by the publishers for review, copy-editing, and publication.[46] This is especially so because in most cases, peer reviewers are not given monetary compensation for their contribution.[47] In some cases, 'hybrid journals', which have both open access and paid access content, have come under fire for profiting from both authors and readers.[48] Therefore, although publishers argue that the charges are meant to recover necessary expenses, it is clear that for many commercial publishers, huge profit margins are being maintained by charging both authors and readers.[49] Moreover, imposing unreasonable embargo periods often results in accessibility of research only long after findings are arrived at. This hinders timely availability of latest relevant developments before they become redundant, especially in fields where developments are fast-paced.

In this scenario, it is extremely important for publishers to re-evaluate their business models and make their costs more transparent and their charges proportionate to the necessary expenses. The embargo periods, if required, should also be as minimal as possible.

One may be curious as to what would incentivise commercial publishers to continue in the business without attractive profit margins.

Here, it is important to understand that institutions and professional societies can be self-sufficient as publishers due to developments in digital technologies and resulting ease of communication. The requirement of commercial publishers is fuelled primarily by the inordinate attention given to certain brand names. The services involved in publication- review, copy-editing, and dissemination, can be replicated by others, especially since peer review is anyway done by members of the academia/ professional society. Thus, if the focus is distributed to include quality and social relevance of publications, and transparency and sharing, the holistic change will also render profit-based publishers redundant.

Funding agencies should take initiative to support open access publishing through various models. Ideally, efforts should be made to render redundant exploitative publishing models which demand exorbitant amount of money in the form of APCs for

minimal contribution. This can be done by supporting publication by institutions and professional societies by covering administrative and transaction costs involved in peer-review, quality checks, publication, and dissemination.

However, although we strongly oppose the APC model, it is currently an undeniable reality in academic publishing. Many researchers all over the world, including many of the respondents of our survey (28.26%),[50] stated that APCs are unaffordable for them, thus disincentivising them from open access publishing. Therefore, until structural changes take place and publishing models are overhauled, funding agencies should allocate funds for APCs to enable open access.

Authors should make their publications accessible to the largest extent possible. Even if they are not in a position to make post-print versions available, they should at least provide access to preprints, preferably through repositories, since personal websites and access on demand increases transaction costs involved in locating and procuring the materials. This should not be limited to just articles, and researchers should also practise open data and open labnotes. Such practices will not only make the knowledge ecosystem more inclusive, but also increase researchers' visibility and the quality of their research through feedback from readers.

Efforts should be made to render redundant exploitative publishing models by supporting publication by institutions and professional societies by covering administrative and transaction costs involved in peer-review, quality checks, publication, and dissemination.

Until publishing models overhauled funding agencies should allocate funds for APCs to enable open access.

Publications accessible to the largest extent possible by providing access to preprints, through repositories if not post-print versions

WHAT CAN YOU DO?

POLICYMAKERS

- Recognise the value of diverse kinds of publications, especially open access publications of high quality, instead of attributing importance only to brand names of often exploitative publishers/journals

FUNDING AGENCIES

- Provide support for publication (in open access modes) without requiring commercial publishers (cover administrative and transaction costs)

INSTITUTIONS

- Support in-house publications which are openly accessible (technological and administrative facilitation)

PROFESSIONAL SOCIETIES

- Make joint efforts to come out with open access publications (with support from funding agencies if required), bypassing commercial publishers

RESEARCHERS

- Make publications (at least preprint versions) accessible

- Use the Scholarly Publishing and Academic Rights Coalition (SPARC) author addendum, which modifies the publishers' contract and helps authors retain their copyright over the work submitted.[51] It specifically mentions that its provisions will prevail over that of the publisher's contract in case of conflict; and allows the author to make and distribute copies of articles for teaching or research, and to post the article on personal/institutional websites and in other open access digital repositories[52]

II

The consortium model for collective bargaining with publishers has seen considerable success. Associations have been formed by libraries for advocating for fairer agreements with publishers. The Canadian Association of Research Libraries (CARL)[53] has released this brief as part of a larger discussion in response to rising journal subscription costs in Canada.[54] In this brief, CARL has discussed various ways in which libraries are trying to address this problem. **This includes diverting funds from other areas to libraries and forming consortia to negotiate prices and terms.[55] Some universities have conducted usage data and citation analyses which have helped them fix fair subscription prices.[56]**

In Germany, Projekt DEAL,[57] a consortium of 150 German libraries, universities, and research institutes, aims to develop an alternative model for open access academic publishing.[58] **They seek to enter into agreements with academic publishers to pay them a lump sum annual amount covering publication cost of papers whose first authors are at German institutions.[59] In lieu of this, these papers will be made freely available worldwide, and all online content of the publishers will be made accessible to German institutions.[60]** Publishers like Wiley and SpringerNature have come on board this arrangement.[61]

FORMING CONSORTIA - COLLECTIVE BARGAINING

Institutions, institutional libraries, and researchers must actively create or join consortia for negotiation with publishers to bridge the bargaining power gap vis-a-vis demands for fairer and more open terms.

WHAT CAN YOU DO?

INSTITUTIONS

- Institutions should form alliances with other institutions and/ or libraries, researchers, etc. for collective bargaining against commercial publishers to advocate for fair and open policies

LIBRARIES

- Institutional libraries should form alliances with other libraries and/ or institutions, researchers, etc. for collective bargaining against commercial publishers to advocate for fair and open policies

ACADEMIC OR PROFESSIONAL SOCIETIES/ RESEARCHERS

- Researchers and academic/ professional societies should form alliances with one another and or with institutions, etc. for collective bargaining against commercial publishers to advocate for fair and open policies

- They should also persuade such institutions to partake in the collective bargaining process
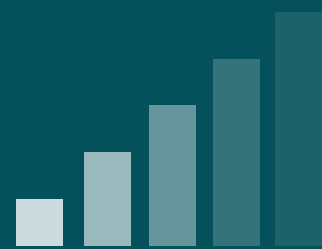
TAKING OPEN
SCIENCE OFFLINE

Most of the dominant, mainstream discussion on open science has initiated in the Global North, where access to the internet and the Web is presumed to exist for all persons. The negligible marginal cost, high speed and ease, and global scale of online communication and collaboration is generally taken for granted in such contexts, especially with the introduction of Web 2.0. Thus, some aspects of open science which are considered to be crucial but intangible are assumed to also be free of cost and operating across the world in real-time.

The Budapest Open Access Initiative defines open access in the following manner:

"...By 'open access' to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself..."[62]

Further, open science has been understood in the following way:

"Open science in its current form is based on digital technologies. Online tools provide scientists with the technical means to collaborate globally and to share knowledge on an unprecedented scale".[63]

ACCESS TO INTERNET AND THE WEB ID PRESUMED TO EXIST

for all

IN THE GLOBAL NORTH

IN THE CONTEXT OF THE GLOBAL SOUTH, ONLY

33.22%

OF THE INDIAN POPULATION HAS INTERNET SUBSCRIPTION

These excerpts show that open science and web technologies are often considered to be inalienable, and access to the web is presumed to be universal. However, in the context of the Global South, the situation is vastly different. For example, only 33.22% of the Indian population has internet subscription.[64]

Open science practices which can be implemented with negligible marginal cost in Global North countries cannot be implemented in the Global South context in the same manner.

This was highlighted by the Open and Collaborative Science Manifesto by OCSDNet, which resulted from participatory consultation with representatives from 26 countries in Latin America, Africa, the Middle East, and Asia.[65] The set of principles evolved by them call for a review of values at the core of open science, and focus on integration of "diverse scientific traditions and ways of knowing", the need to "address the role of power and inequality in knowledge production and sharing", and "design of inclusive infrastructures". While this effort is significant in the path to realisation of open science beyond the Global North, more efforts are required in this direction to clarify the steps necessary to implement the contents of the manifesto.

OCSDNet Open Science Manifesto proposes that Open and Collaborative Science[66]

#1 Enables a knowledge commons where every individual has the means to decide how their knowledge is governed and managed to address their needs

#2 It recognizes cognitive justice, the need for diverse understandings of knowledge making to co-exist in scientific production

#3 It practices situated openness by addressing the ways in which context, power and inequality condition scientific research

#4 It advocates for every individual's right to research and enables different forms of participation at all stages of the research process.

#5 It fosters equitable collaboration between scientists and social actors and cultivates co-creation and social innovation in society

#6 It incentivizes inclusive infrastructures that empower people of all abilities to make, and use accessible open-source technologies.

And finally, open and collaborative science:

#7 Strives to use knowledge as a pathway to sustainable development, equipping every individual to improve the well-being of our society and planet

Greater focus should be given to offline communication and collaboration to make open science more inclusive. Print media (newspapers and magazines) and networks of physical libraries should be utilised for communication and accessibility of science. Moreover, making libraries and events of educational and research institutions accessible to the public, and organising initiatives such as 'Open Day' and street plays, are extremely important in this regard. These avenues are especially important because they make interaction and communication possible in diverse local languages.

One of the important steps that could be taken in this regard is focusing on radio as a tool for science communication and discussion. Radio is accessible to a more diverse population as compared to text. It can reach diverse linguistic groups, those who are illiterate or do not have access to formal education, those who cannot read due to visual impairment, and those whose navigation is socially restricted- such as women (in many social contexts) and persons with locomotor disabilities. Our research shows that community radio stations- which were introduced for discussion and awareness-creation on local, socially-pertinent issues without the influence of the government or advertisement by private companies- are often used to discuss issues of health, hygiene, nutrition, environment, social empowerment, and news pertinent to local professions such as farming and fishing.[67]

OFFLINE COMMUNICATION

■ **Print Media**

■ **Libraries**

■ **Open Day**

■ **Street Plays**

■ **Radio**

Community radio has been seen to have led to change in community perceptions regarding participation and voice of women in areas such as science.

For example, women's control over content in community radio, has helped them have a voice in media and change perceptions regarding women's power and participation in areas which are not traditionally associated with women- including lower caste women- in many parts of India.[68]

However, the opportunities enabled by this medium of communication and engagement have not been optimally utilised because of bureaucratic hurdles in obtaining permits for instituting a community radio station. Restriction of permission requirement to only certain kinds of organisations while allowing single-window clearances only to educational institutions; lengthy, expensive, and painstaking procedural requirements which require travelling to offices in Delhi irrespective of the applicants' places of origin, and permission to air only All India Radio news, have significantly curtailed the power of community radio in India.[69]

Therefore, in the Global South context, apart from making efforts to increase meaningful web access, concerted efforts should be made to also take open science 'offline'.

WHAT CAN YOU DO?

POLICYMAKERS

- Reduce unreasonable restrictions on permits for community radio stations- allow organisations/ community groups apart from educational institutions and increase the scope of 'community-based organisations', reduce monetary burden, reduce bureaucratic hurdles

- Remove restriction on news other than AIR news

INSTITUTIONS

- Provide access to resources including infrastructure, libraries, laboratories

- Provide public access to events/ talks/ exhibitions; organise 'Open Day's/ science parks

LIBRARIES

- Form local library networks for mutual sharing of resources

MEDIA HOUSES

- Encourage pieces on science and local issues, with special focus on regional languages

LOCAL COMMUNITIES

- Set up community radios, local newspapers/ magazines for science communication

- Organise street plays and other creative avenues for science communication and interaction

RESEARCHERS

- Share simplified research findings through newspaper magazine articles, including regional print media

- Organise and participate in creative ways of communicating science (talks, open day, plays, etc.), with special focus on local issues and regional languages

It must be asserted that unless the problems with lack of openness are recognised and the status quo is challenged, it will not be possible to effect any meaningful, substantial change in science. In this respect, researchers, who are arguably the most important stakeholders in the knowledge creation process, must take proactive steps. Collective advocacy within the institution may also bring about positive changes to the status quo. As our data shows, a substantial percentage of the respondents were satisfied with existing institutional policies, and many of them stated that they have never felt the need to make any efforts for change. This apathy must be changed through greater awareness creation, and researchers should advocate for more openness within their institution.

This report has made an attempt to encourage readers to rethink and challenge existing systems in science and academia, and also recommended some measures that can be taken by different stakeholders. However, substantial change can only happen once stakeholders are truly convinced and committed to the cause of any movement. No amount of top-down impositions can make meaningful changes unless the same is associated with awareness creation and conviction. While critics may worry about increased expenditure and effort for putting open science into practice, it must be remembered that open science intends to decrease overall societal costs and duplication of effort.

If we want to work towards a future where science is accessible, socially relevant, better, and more reliable, we must adopt open science practices in our own capacities, and advocate for changes for a more equitable knowledge ecosystem.

Appendix 1

METHODOLOGY

This study uses the mixed methods approach in research, which generally refers to the use of both quantitative and qualitative data in a single study or series of studies analysing the same underlying phenomenon.[1] The research components whose methodology needs specific mention, and which are focused upon in major parts of this report, are:

I. Open science survey in India (primarily detailed in Chapter 3)**;**

II. Information on implementation of the DBT-DST Open Access Policy, 2014 and National Data Sharing and Accessibility Policy, 2012 through Right to Information (RTI) applications (primarily detailed in Chapter 2)**;**

III. Research on status of open movements in India (primarily detailed in Chapter 2)**; and**

IV. Personal interviews with experience or expertise in relevant areas (referred to in various parts of the report)**.**

The methodologies underlying each of these components have been mentioned below. Apart from these components, the research we conducted online on the context and components of open science, as well as specific examples cited to demonstrate the crisis in science and examples of solutions, was primarily done with the help of search engines such as Google, Bing, and Duckduckgo and databases like Jstor, WestLaw, LexisNexis, and HeinOnline.

OPEN SCIENCE SURVEY METHODOLOGY

The primary purpose of the survey was to gain more insights on attitudes and sharing practices of Indian researchers with respect to issues like open access, open science, transparency, reproducibility, and collaborations. It was conducted in two phases, the details of which are mentioned below. The survey questionnaire can be found in Appendix 2.

PHASE I

The first phase of the survey was conducted between January 21st, 2017 and June 21st, 2017. The survey instrument was a questionnaire containing 45 questions in English. It was divided into nine sections-

basic information, open access, open science, collaborations, transparency, accessibility, reproducibility, legal and policy measures, and institutional practices.

SAMPLING

The study uses purposive sampling and due to feasibility concerns, the sample was restricted to a limited number of disciplines and institutions. The fields of Economics, Law, Mechanical Engineering, Medicine, and Physics were selected in this regard to ensure diversity. Upon selection of these disciplines, the top three institutions in these fields, in terms of research outputs and quality of faculty, were identified. Since many of the existing ranking systems have methodological limitations, an alternative approach was adopted in this regard. Three researchers from every one of these fields were requested to rank top institutions in their area. In cases where uniformity was observed in the responses, the relevant institutions were selected. In cases where differences of opinion were observed among the researchers, more researchers were approached until a majority opinion was observed. However, for one discipline (Physics), despite these efforts, there was consensus only with regard to two institutions. The researchers working in the selected institutions were identified using the respective institutional websites, and their email addresses were collected from the websites.

An online link to the survey questionnaire was sent through an online platform (Survey Monkey) to the above identified sample. In cases of low responses, the institutional heads were contacted for permission to conduct the survey on campus. Student fellows/ researchers at CIIPC made personal visits to those campuses where permission was granted. During those visits, some respondents filled the physical copies of the questionnaire, while others preferred to complete the survey online due to environmental concerns or paucity of time. The total number of respondents in this phase was 251.

PHASE II

In Phase II of our survey the scope of the survey was expanded to include researchers from any discipline and any institution located in India. The sampling approach for Phase II is therefore different from that in Phase I; a single open web link was used for collecting responses. This link was sent to various Indian academic/ research institutions; and also shared on social media and through personal contacts. The survey link was open from July 21, 2017 to November 7, 2017. Although the survey instrument is essentially the same as the one used in Phase I, slight modifications were made to accommodate more disciplines and also to address some of the feedback we received during Phase I. Modification was made in questions on primary area of teaching/ research (Q.4 in Phase I/ Q.5 in Phase II); current academic position (Q.6 in Phase I/ Q.7 in Phase II); decision-maker in respondents' institutions with respect to taking up, conduct, and dissemination of research (Q.35 in Phase I/ Q.36 in Phase II); ownership rights over data (Q.42 in Phase I/ Q.43 in Phase II); and copyright ownership over articles (Q.43 in Phase I/Q.44 in Phase II). In order to ensure that participation in the survey is restricted only to those researchers who are working in any research/ academic institution located in India, a compulsory screening question was also added to confirm the same before the main survey.

A total of 410 people took the survey, but only 306 of them successfully qualified for the main questionnaire after the screening question. Among these 306 respondents, some did not answer any other question besides the screening question. To increase accuracy in the survey findings, such respondents were also removed from our data analysis. Therefore, in Phase II, responses from 230 respondents were analysed.

Since the questionnaire in both phases were largely the same, and the patterns of findings were comparable, the data analysis was done by consolidating both phases. In other words, responses from a total of 481 (251+230) respondents have been analysed. The survey data was analysed at disaggregated levels, where academic discipline as well as current academic position of the respondents were the parameters used for analyses. The sample has

116 respondents from medicine, 82 from law, 79 from engineering, 58 from physics, 46 from economics, and 97 respondents from other disciplines.[2] The respondents were classified into six categories based on their current academic position. The sample has 135 assistant professors, 55 associate professors, 53 professors, 122 Ph. D. fellows, 30 research fellows, and 83 'others'.[3] As some of the institutions, particularly the institutions under the Council of Scientific and Industrial Research (CSIR), use nomenclatures for research/ academic positions which are very different from the ones generally seen in central and state universities, we had to take certain additional steps to merge them with the appropriate categories in the sample.[4] Two variables used in this classification process were: (i) educational qualification and (ii) mean age (as a proxy for years of experience). A postgraduate degree is generally the basic qualification required at entry level for most academic positions in India, so we used masters degree as the first reference. We then used the mean age of the respondents to identify the approximate years of experience, and included those respondents within the assistant professor, associate professor, and professor categories according to the minimum experience levels required for those positions.

STUDY ON IMPLEMENTATION OF THE DBT-DST OPEN ACCESS POLICY, 2014 AND NATIONAL DATA SHARING AND ACCESSIBILITY POLICY, 2012

In order to better understand the extent of implementation of the DBT-DST Open Access Policy, 2014 as well extent of compliance of various ministries with select provisions of National Data Sharing and Accessibility Policy (NDSAP), 2012, different applications were filed under the Right to Information Act, 2005 before the relevant authorities.

DBT-DST OPEN ACCESS POLICY, 2014

With regard to the implementation of the DBT-DST Open Access Policy, 2014, an RTI application was initially sent to the Department of Science and Technology (DST) requesting for a list of researchers and institutions whose research projects they fund. Their response provided a list of researchers whose projects are funded under DST's Clean Energy Research and Water Technology initiatives. Following this, a total of 203 RTI applications were sent to the institutions mentioned in the list to seek information on the communication of the policy/ mandate by DST to the researchers to whom project grants were sanctioned, compliance to open access mandates, monitoring of compliance, and sanctions imposed. This was completed in two rounds, as we had to revise some of the questions based on the kind of responses we received from some institutions in Round 1. The primary reason for modifying those questions was the response from some institutions that some of the questions were subjective in nature and hence they do not have to respond to them under Right to Information Act.

The questions included in Round 1 were -

1. Are you aware of the DST open access policy?

2. With regard to the grant you have received from DST for your project titled "X" have you taken any specific measures for compliance with the DST Open Access Policy?

3. At the time of signing of your grant agreement, did DST communicate to you about your obligations under the open access policy?

4. Did DST communicate to you about the open access policy at any point of time?

5. If the answer to Q 4 is YES, then what was the mode of such communication?

6. Please mention the number of publications that you have made from this project grant.

7. Please mention the number of patents you have been able to file under the grant received under the project.

8. If you have managed to produce publication under this grant, please mention the details of your best (most cited) publication from this project.

9. If you have managed to file patent applications using the funds received under this grant, please provide the patent application numbers.

10. What other research outputs have you produced as a part of this project?

11. As per the terms and conditions of the DST grant agreement are you required to submits any annual report regarding the status of your research?

12. As per the terms and conditions of the DST grant agreement are you required to submit any annual report regarding access to research outputs from your projects?

13. As per the terms and conditions of the DST grant agreement are you required to submit any annual report regarding compliance with the DST policy?

14. If you have not complied with the DST Open access policy so far, has DST imposed any penalties or sanctions for violation of the policy?

15. If the answer to Q.14 is yes, what penalty was imposed?

16. If the answer to Q.14 is YES, do you think it will affect your possibilities getting grants in the future?

The questions included in Round 2 were -

1. With regard to the grant you have received from DST for your project titled "X" please provide details of any specific measures undertaken for compliance with the DST Open Access Policy.

2. Please provide details of communication by DST about your obligations under the open access policy at the time of signing of your grant agreement or any other time.
Please provide details of regarding the mode of communication of the Open Access Policy.

3. Please mention the number of publications that you have made from this project grant.

4. Please mention the number of patents you have been able to file under the grant received under this project.

5. Please mention the details of your best (most cited) publication from this project.

6. Please provide the patent application numbers of patents filed from this project.

7. Please provide details of other research outputs you have produced as a part of this project.

8. As per the terms and conditions of the DST grant agreement, are you required to submit any annual report regarding the status of your research?

9. As per the terms and conditions of the DST grant agreement are you required to submit any annual report regarding access to research outputs from your projects?

10. As per the terms and conditions of the DST grant agreement are you required to submits any annual report regarding compliance with the DST policy?

11. Please provide details of penalties or sanctions imposed by DST for non-compliance of the DST Open Access Policy.

12. Please provide details regarding effects of non compliance with open access policy on future grants.

Among the 203 RTI applications sent, a total of 138 replies with relevant information were received. 3 responses claimed that the project mentioned by DST did not exist in their institution. Among those who did not respond to the RTI applications, 37 were private institutions and 25 were public institutions. We appealed against rejections from private institutions who claimed that the RTI Act did not apply to them, on the ground that information relating to public funding would be within the scope of the Act even for private institutions. Central Information Commission, the authorised appellate body under the RTI Act, rejected our appeals in two cases, following which we did not appeal against non-response by the other private institutions. Among the 25 public institutions which did not reply, 7 responded to reminders and objects but did not respond to the questions, and first appeals were filed against 18 institutions which did not respond to our reminders at all. Those appeals too did not yield responses to the RTI questions.

NDSAP, 2012

An RTI application was sent to DST, the nodal department responsible for the implementation of this policy. Information regarding compliance by ministries/ departments to the policy by submission of negative lists that may not be accessed by the public as per the policy, was sought through the application. The questions included in this application are -

You are required to furnish the following information as per section 6(1) of the Right to Information Act:

1. Whether the below-mentioned central ministries/departments have submitted negative lists as per the National Data Sharing and Accessibility Policy (NDSAP), 2012:

Ministry of Agriculture
Department of Agriculture and Co-operation
Department of Agricultural Research and Education
Department of Animal Husbandry, Dairying & Fisheries
Indian Council of Agricultural Research (ICAR)
Ministry of Chemical and Fertilizers
Department of Chemicals and Petrochemicals
Department of Fertilizers
Ministry of Coal
Ministry of Commerce and Industry
Department of Commerce
Department of Industrial Policy and Promotion
Ministry of Corporate Affairs
Ministry of Consumer Affairs, Food and Public Distribution
Ministry of Culture
Ministry of Defence
Ministry of Earth Sciences (MoES)
Ministry of Environment & Forests (MoEF)
Ministry of External Affairs
Ministry of Finance
Ministry of Food Processing Industries (MOFPI)
Ministry of Health & Family Welfare
Ministry of Heavy Industries & Public Enterprises
Department of Heavy Industry (DHI)
Department of Public Enterprises

Ministry of Home Affairs (MHA)
Ministry of Human Resource Development (MHRD)
Ministry of Information and Broadcasting
Directorate of Advertising and Visual Publicity (DAVP)
Directorate of Field Publicity
Ministry of Labour
Ministry of Law and Justice
Ministry of Mines
Ministry of Minority Affairs
Ministry of Development of North Eastern Region
Ministry of Overseas Indian Affairs
Ministry of Parliamentary Affairs
Ministry of Personnel, Public Grievances and Pension
Ministry of Petroleum and Natural Gas
Ministry of Power
Ministry of Railways
Ministry of Rural Development
Ministry of Science and Technology
Department of Bio-Technology (DBT)
Department of Science and Technology (DST)
Department of Scientific and Industrial Research (DSIR)
Ministry of Shipping, Road Transport and Highways
Ministry of Road Transport & Highways
Ministry of Shipping
Ministry of Social Justice and Empowerment
Ministry of Statistics and Programme Implementation
Ministry of Steel
Ministry of Textiles
Ministry of Tourism
Ministry of Tribal Affairs
Ministry of Urban Development
Ministry of Water Resources

2. If the answer to question 1 is in the affirmative, kindly provide such lists submitted by the mentioned central ministries/ departments.

However, no response was received by us from DST in this case.

STATUS OF IMPLEMENTATION OF OPEN MOVEMENTS

Research on implementation of open movements was done on the internet using the following search engines- Google, Yahoo, Bing, and Duckduckgo. The last date on which the search results were updated and verified was June 24, 2018.

PERSONAL INTERVIEWS

In addition to the above, personal interviews were conducted with diverse stakeholders including various leaders of open initiatives and citizen science movements; eminent scholars who have worked on IP, innovation, people's science, and knowledge sharing; persons working on disability inclusion, as well as persons who have experienced exclusion in the research ecosystem.

These interviews were conducted in order to gain deeper insights on the crisis in science as well as the diverse challenges for open science movement in India, which would been difficult to gain merely through desktop research. The interviews played a major role in broadening our own perspectives on the subject matter, and have guided the evolution of various recommendations mentioned in this report.

LIMITATIONS OF THE STUDY

Apart from the data collected through field work, the study had to rely extensively on information available on the internet. We consider this as a limitation, particularly for topics like citizen science/ people's science, where a large part of the discourse take place offline.

Further, this report does not claim to provide exhaustive accounts of the crisis in science, open movements or their implementation status, and other details. It only intends to provide an overview of findings on which further analysis is desirable. In this context, we encourage enthusiasts and experts in all related fields to research and comment further on relevant issues referred to or arising from this report.

Appendix 2

QUESTIONNAIRE

I. WELCOME TO THE OPEN SCIENCE SURVEY!

We are conducting this survey as part of a study conducted by theCentre for Innovation, Intellectual Property and Competition at National Law University, Delhi (www.ciipc.org). The broader goal of our study is to identify the factors that promote/ hinder open movements in India. As researchers are the most important stakeholders in this area, we consider it extremely important to include perspectives of researchers like you. Through this short survey, we aim to identify the different sharing practices in your discipline, factors that promote/ dissuade openness in research in your field, and legal/ policy conditions that may foster more openness in research.

This survey will take only around 15- 20 minutes to complete, and your participation in this survey is extremely valuable for us.

CONFIDENTIALITY GUARANTEE
We assure you that all the information you provide will be treated with full confidentiality. We also assure you that only the aggregated results of the survey will be published or disseminated.

AMAZON GIFT VOUCHER
As a token of our gratitude for all those who fill in the questionnaire completely, we offer an opportunity to take part in a lucky draw for winning an Amazon Gift Voucher of ₹5000/-. You will find the details of the lucky draw on the last page of this questionnaire.

QUESTIONS REGARDING THE STUDY
If you have any questions regarding this study, please feel free to send them in. We will also be happy to share a summary of the findings of this study, if you are interested. The contact details are mentioned below.

On behalf of the entire Open Science research team at CIIPC, I thank you for sharing your valuable time with us, and welcome you to this survey.

Best regards,
Dr Arul George Scaria
Co-Director -Centre for Innovation, Intellectual Property and Competition (CIIPC) National Law University,
Delhi, Sector 14 Dwarka,
New Delhi 110078, India
arul.scaria@nludelhi.ac.in
Project details: http://ciipc.org/projects/open-science-for-an-innovative-india/

* 1. Are you a researcher working in any research/ academic institution located in India?
○ Yes
○ No

II. BASIC INFORMATION

2. Year of birth: _____

3. Gender
○ Male
○ Female
○ Other

4. Education
○ Undergraduate degree
○ Masters degree
○ Ph.D.
○ Post doctoral research
○ Other (please specify): _____

5. What is your primary area of teaching/ research?
○ Physics
○ Engineering
○ Law
○ Economics
○ Medicine
○ Chemistry
○ History
○ Political Science
○ Linguistics Sociology
○ Other (please specify): _____

6. Years of research experience (including your time for doctoral research): _____

7. Which of the following best describes your current position?
(Options are ordered alphabetically)
○ Assistant Professor
○ Associate Professor
○ Attending Physician
○ Consultant
○ Distinguished Scientist
○ Head of Department
○ Lecturer
○ Lab Director
○ Medical Professional/ Doctor
○ Ph.D. Student
○ Principal Investigator
○ Professor
○ Professor Emeritus
○ Research Assistant

○ Research Director
○ Research Fellow
○ Research Scientist
○ Senior Scientist
○ Scientist B
○ Scientist C
○ Scientist D
○ Scientist E
○ Scientist F
○ Scientist G
○ Scientist H
○ Staff Scientist
○ Student
○ Teaching Assistant
○ Other (please specify): _____

8. Which of the following factors influenced your decision to become a researcher/ scientist?
(You may choose more than one option)
☐ Physics
☐ Engineering
☐ Law
☐ Economics
☐ Medicine
☐ Chemistry
☐ History
☐ Political Science
☐ Linguistics Sociology
☐ Other (please specify): _____

III. OPEN ACCESS

If you do not have any publications or data from your research so far, you may move to question number 15.

NOTE 1:
For the purpose of this section, the term 'open access' means access without payment by any person or institution.

NOTE 2:
For the purpose of this section, 'data' means facts and statistics collected together for reference or analysis.

9. Do you have any publications (journal articles/ books/ book chapters/ working papers/ research report/ policy document/ blog posts)?
○ Yes
○ No

10. How many publications do you have?

	Total number of publications	Number of single authored publications	Number of publications which can be accessed by anyone without paying any fees
Journal articles Books	_____	_____	_____
Book chapters	_____	_____	_____
Research report/ policy document/ project deliverable	_____	_____	_____
Working papers	_____	_____	_____
Blog post	_____	_____	_____

11. Which of the following best characterises the way you share publications and data?
(You may choose more than one option)

	Publications	Data *(For the purpose of this question, data means facts and statistics collected together for reference or analysis)*
I actively share with researchers working in my team (e.g. sending out hard copy/digital copy/links)	☐	☐
I actively share with any researcher working in my institution	☐	☐
I actively share with close friends or trusted acquaintances	☐	☐
I share with anyone who asks for them	☐	☐
I share through an open access repository (for e.g., SSRN, ArXiv, Research Gate)	☐	☐
Majority can be accessed by anyone through my personal website, with no restrictions	☐	☐
I don't generally share with anyone	☐	☐

If you have any other sharing practices with regard to publications/ data, please specify: _____

12. How often do you track the access of your shared publications/ data? (For example, information regarding who accessed your articles/ data)

	Publications	Data
Never	○	○
Occasionally	○	○
Always	○	○

13. Which of the following factors havediscouraged you from publishing through open access modes?
(You may choose more than one option)
☐ I did not think it was important
☐ I wanted to improve the quality of the work before sharing it openly
☐ I fear that people may plagiarise my publications
☐ I fear that people may use my publications for their professional benefits (for example, producing a better product or research using my publication)
☐ I was not aware of any options for publishing through open access modes
☐ I am not willing to pay money to the publisher to publish an article (Article Processing Charges/ APC)
☐ I was unable to fund the article processing charges (APC)
☐ There are no reputed open access journals in my field
☐ Open access was not an option available for the journal(s) where I wanted to publish
☐ If there are any other factors, please specify: _____

14. Which of the following factors havediscouraged you from sharing data openly?
(You may choose more than one option)
☐ I don't consider data sharing as important
☐ I can share data openly only when all research and publications based on those data are completed
☐ I can share data only after proper curation (for example, putting it in a format that is understandable to and useable by others)
☐ I was not confident with the quality of my data to share it openly
☐ I fear people may use my data for their professional purposes (for example, producing a better product or research using my data)
☐ Lack of time to upload data to the data repositories
☐ Lack of adequate resources to upload the data to the data repositories (for example, reliable internet connection, software, etc.)
☐ Data has commercial value for my organisation (for example, my organisation sells services relating to data or data analysis expertise)
☐ My funding agency does not mandate sharing of data
☐ My institution does not mandate sharing of data
☐ There are no reputed open data repositories in my field
☐ If there are any other factors, please specify: _____

15. If you have shared your publications/ data openly, have you ever received the following benefits?
(You may choose more than one option)

	Publications	Data
I have not received any benefits	☐	☐
A new professional contact	☐	☐
More visibility (e.g., more citations)	☐	☐
Quality improvement through feedback from people who accessed them	☐	☐
nvitations for collaborations from people who have accessed my work	☐	☐
Personal financial benefits	☐	☐
More funding for research	☐	☐

If you have received any other benefits, please specify: _____

16. How important are the following factors when publishing your research outputs in a journal/ book chapter/ book?

Impact factor of the journal
○Not at all important ○Slightly Important ○Moderately important ○Important ○Very important

Reputation of the journal/ publisher
○Not at all important ○Slightly Important ○Moderately important ○Important ○Very important

The focus area of the journal/ publisher
○Not at all important ○Slightly Important ○Moderately important ○Important ○Very important

Quality of peer review adopted by the journal/ publisher
○Not at all important ○Slightly Important ○Moderately important ○Important ○Very important

Open access policy of the journal/ publisher
○Not at all important ○Slightly Important ○Moderately important ○Important ○Very important

Copyright ownership policy of the journal/ publisher
○Not at all important ○Slightly Important ○Moderately important ○Important ○Very important

Payment to be made to the journal/ publisher for the publication
○Not at all important   ○Slightly Important   ○Moderately important   ○Important   ○Very important

The likelihood of acceptance by the journal/ publisher
○Not at all important   ○Slightly Important   ○Moderately important   ○Important   ○Very important

Average time taken for publication by the journal/ publisher
○Not at all important   ○Slightly Important   ○Moderately important   ○Important   ○Very important

If you consider any other factor as important, please specify: _____

17. Do you agree or disagree with the following statements?

Openness is a core value of science
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

All publicly funded research should be openly available
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

Open access will improve research
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

Open access provides for more equitable distribution of information
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

Open access ensures more reproducible research
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

Open access will reduce the quality of research
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

Open access will lead to free riding on research
○Strongly disagree   ○Disagree   ○Neither agree nor disagree   ○Agree   ○Strongly agree

18. Are there reputed open access journals in your field?
○ Yes
○ No
○ I don't know

19. For your research, have you ever used any publications/ data available openly on the internet?

	Publications	Data
Yes	○	○
No	○	○
I don't know	○	○

IV. OPEN SCIENCE

20. Are you familiar with the concept of 'open science'?
○ Yes
○ No

21. In your opinion, what are the key characteristics of open science?: _____

22. Do you believe that open science is important for research?
○ Yes
○ No
○ I don't know

23. Should other researchers be allowed to make commercial uses of your research outputs?
○ Yes, if I get a share of monetary benefits
○ Yes, if I get a share of non-monetary benefits
○ Yes, if I get a share of both monetary and non-monetary benefits
○ Yes, even if I do not recieve any monetary and/ or non-monetary benefits
○ No
○ Other (please specify): _____

24. Do you publish a simplified version of your research findings for a layperson?
○ Never
○ Rarely
○ Occasionally
○ Frequently
○ Always

25. Do you publish a translated version of your research findings in any of the regional languages in India?
○ Never
○ Rarely
○ Occasionally
○ Frequently
○ Always

V. COLLABORATIONS

26. Have you ever engaged in collaborative research projects? (For the purpose of this question, 'collaboration' means working with other researchers who actively contribute to the core research and play a role in the decision making process.)
○ Yes
○ No

VI. TRANSPARENCY

27. Which of the following do you routinely share as a part of your research publications?
(You may choose more than one option)
☐ Detailed research methodology
☐ Research tools (e.g., software necessary for data analysis)
☐ Negative results (e.g., results against your findings)
☐ Errors in your research
☐ Errors in your data
☐ Any other limitations with regard to your research
☐ Source of funding
☐ None of the above
☐ Other (please specify): _____

28. Do researchers working in your institution routinely share any of the following as a part of their research publications?

Research methodology
○Yes   ○No   ○I don't know

Research tools (e.g., software necessary for data analysis)
○Yes   ○No   ○I don't know

Negative results (e.g., results against their findings)
○Yes   ○No   ○I don't know

Errors in research
○Yes   ○No   ○I don't know

Errors in data
○Yes   ○No   ○I don't know

Any other limitations with regard to research
○Yes   ○No   ○I don't know

Source of funding
○Yes   ○No   ○I don't know

29. Does your funding agency/ institution mandate sharing any of the following in your most important project (the project in which you have devoted the most time in the past two years?)

Research methodology
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

Research tools (e.g., software necessary for data analysis)
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

Negative results (e.g., results against their findings)
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

Errors in research
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

Errors in data
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

Any other limitations with regard to research
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

Source of funding
○I don't know   ○Funding Agency   ○Institution   ○Both   ○Neither

VII. ACCESSIBILITY

30. Are there are any researchers with physical disabilities working in your research institution?
○ Yes
○ No
○ I don't know

31. Which of the following facilities are available in your institution for researchers with a physical disability? *(You may choose more than one option)*
☐ Ramp facilities
☐ Wheelchair facilities
☐ Restrooms for persons with disability
☐ Audiobooks
☐ Braille textbooks
☐ Disabled friendly lab
☐ Flexible leave policy
☐ None of the above
☐ Other (please specify): _____

32. Are there any steps taken for persons with disability by your institution to ensure ease of access to the research produced in your institution? (For example, providing research outputs in disabled friendly formats)
○ No
○ I don't know
○ Yes (please specify): _____

VIII. REPRODUCIBILITY

NOTE :
For the purposes of this section, 'reproducibility' means the ability to replicate the results of a particular study or an experiment, using the same methodology and/or the same datasets.

If this is not applicable to your field please move to question number 35.

33. Have you ever tried to reproduce someone else's published research?
○ Yes
○ No

34. Do you agree or disagree that the failure to reproduce scientific studies is a major problem in your field?
○ Strongly disagree
○ Disagree
○ Neither agree nor disagree
○ Agree
○ Strongly agree

35. In your opinion, how relevant are the following factors in the failure to reproduce results?

Fraud (fabricated or falsified results)
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Pressure to publish for career advancement
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Insufficient oversight/ mentoring by principal investigator/ supervisor
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Insufficient peer review of research
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Selective reporting of results
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Original findings not robust enough because not replicated enough in the lab publishing the work
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Original findings obtained with low statistical/ poor statistical analysis
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Mistakes or inadequate expertise in reproduction efforts
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Raw data not available from original lab
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Protocols, computer code or reagent information insufficient or not available from original lab
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Methods need 'green' fingers - particular technical expertise that is difficult for others to reproduce
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Variability of standard reagents
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Poor experimental design
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Bad luck
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Lack of funds
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

Lack of sufficient incentives
○Not at all relevant ○Somewhat relevant ○Relevant ○I don't know

IX. LEGAL AND POLICY MEASURES

36. In general, who is the decision maker in your institution with regard to the following?

	What research is taken up	How research is conducted	How research is disseminated
Case by case decision by researchers	☐	☐	☐
Institutional head/ head of department	☐	☐	☐
The governing body of the institution	☐	☐	☐
Funding agency	☐	☐	☐
Government	☐	☐	☐
Other	☐	☐	☐

If you have chosen "Other" for any of the options, please provide the details): _____

37. In general, who is the decision maker in your institution with regard to the following?

	What research is taken up	How research is conducted	How research is disseminated
No rules/ procedures	☐	☐	☐
Informal rules/ procedures	☐	☐	☐
Some formal rules/ procedures	☐	☐	☐
Format (written) rules/ procedures	☐	☐	☐

38. As a researcher, how often have you tried to change the rules/ practices in your institution with regard to the following?

What research is taken up
○Never ○Occasionally ○Frequently ○I have never felt the need to try to change the rules/ practices

How research is conducted
○Never ○Occasionally ○Frequently ○I have never felt the need to try to change the rules/ practices

How research is disseminated
○Never ○Occasionally ○Frequently ○I have never felt the need to try to change the rules/ practices

39. Is your institution receptive to suggestions by researchers regarding changes in rules/ practices with regard to the following?

What research is taken up
○Never ○Occasionally ○Frequently ○Always ○I don't know

How research is conducted
○Never ○Occasionally ○Frequently ○Always ○I don't know

How research is disseminated
○Never ○Occasionally ○Frequently ○Always ○I don't know

40. Are you aware of any specific policies by the institution/ funding agency/ government with regard to the following? *(You may choose more than one option. You may leave the columns blank if none of them are applicable.)*

Intellectual Property Rights over your research outputs like articles and data
☐Institutional policy ☐Funding Agency ☐Government policy

Ownership rights over data generated by you
☐Institutional policy ☐Funding Agency ☐Government policy

Data sharing
☐Institutional policy ☐Funding Agency ☐Government policy

Open access to publications
☐Institutional policy ☐Funding Agency ☐Government policy

Open access to data
☐Institutional policy ☐Funding Agency ☐Government policy

Publication and use of research outputs
☐Institutional policy ☐Funding Agency ☐Government policy

Collaborations
☐Institutional policy ☐Funding Agency ☐Government policy

Other (please specify): _____

41. Does your funding agency take any measures to monitor the compliance with the above mentioned policies?
○ Yes
○ No
○ I don't know
○ Not applicable
○ Other (please specify): _____

42. How satisfied are you with the rules in your institution with regard to the following?
(Answer only those applicable)

Intellectual Property Rights over your research outputs like articles and data
○Extremely dissatisfied ○Dissatisfied ○Neither satisfied nor dissatisfied ○Satisfied ○Extremely satisfied ○Policy doesn't exist in my institution

Ownership rights over data generated by you
○Extremely dissatisfied ○Dissatisfied ○Neither satisfied nor dissatisfied ○Satisfied ○Extremely satisfied ○Policy doesn't exist in my institution

Data sharing
○Extremely dissatisfied ○Dissatisfied ○Neither satisfied nor dissatisfied ○Satisfied ○Extremely satisfied ○Policy doesn't exist in my institution

Open access to publications
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

Open access to data
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

Publication and use of research outputs
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

Collaborations
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

How research is taken up
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

How research is conducted
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

How research is disseminated
◯Extremely dissatisfied ◯Dissatisfied ◯Neither satisfied nor dissatisfied ◯Satisfied ◯Extremely satisfied ◯Policy doesn't exist in my institution

43. Who has ownership rights over data from your project?
☐ Myself
☐ The lead researcher
☐ The entire team
☐ The institution
☐ Funding agency (private/ government)
☐ None
☐ I don't know
☐ Other (please specify): _____

44. Who has copyright over your articles? *(You may choose more than one option)*
☐ Myself
☐ The lead researcher
☐ The entire team
☐ The institution
☐ Funding agency (private/ government) Journal/ publisher
☐ I don't know
☐ Other (please specify): _____

45. Have you applied for patents?
◯ Not applicable for my field of research
◯ No
◯ If yes, how many: _____

X. PRACTICES IN YOUR INSTITUTION

46. Do you agree or disagree with the following statements?

Researchers within my institution share their research publications amongst one another
◯Strongly disagree ◯Disagree ◯Neither agree nor disagree ◯Agree ◯Strongly agree

Researchers within my institution share their research data amongst one another
◯Strongly disagree ◯Disagree ◯Neither agree nor disagree ◯Agree ◯Strongly agree

There are practices in place to ensure reproducibility of research in my institution
◯Strongly disagree ◯Disagree ◯Neither agree nor disagree ◯Agree ◯Strongly agree

There is frequent collaboration amongst the researchers in my institution
◯Strongly disagree ◯Disagree ◯Neither agree nor disagree ◯Agree ◯Strongly agree

There is a high level of trust amongst the researchers in my institution
◯Strongly disagree ◯Disagree ◯Neither agree nor disagree ◯Agree ◯Strongly agree

XI. THANK YOU!

Thank you for sharing your valuable time with us. As a token of our gratitude for participating in this survey, we would like to offer you two things:
1. A digital copy of the summary of the findings from this study, and
2. An opportunity to take part in a lucky draw for winning an Amazon Gift Voucher of ₹5000/-.

If you would like to receive the summary of the findings, you just have to enter your email address in the box provided below. If you are interested in participating in the lucky draw, you just have to enter your email address in the box provided below for the same. If you are not interested in them, you may just leave the fields blank. Please note that the email address you are providing here will not be used in any manner to identify the responses you gave for this survey and all the responses you have given here will be treated with full confidentiality.

Thank you once again for participating in this survey!

47. If you are interested in receiving a digital copy of the summary of findings from this study, please provide your email address here: _____

48. If you are interested in participating in the lucky draw for the Amazon Gift Voucher of ₹5000, please provide your email address here: _____

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55. 26.08% respondents stated that their project is at a premature stage and they do not have project outputs yet. Therefore, they believe that the project is not yet at a stage at which open access obligations have arisen. Interestingly, one respondent stated that they have been trying to upload their project outputs on the central repository, but have not been able to access the same due to registration/ login requirements.

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03

7. N= 373, 122 females, 247 males

8. N= 373, 123 females, 246 males

9. N= 368, 122 females, 242 males

10. N= 369, 122 females, 243 males

11. N= 361

12. N= 321

13. N= 372

14. N= 478.

15. N= 288

16. N= 226

17. N= 226

18. N= 355

19. N= 288

20. Law- 49, Engineering- 49

21. N= 288

22. N= 226

23. N= 226

24. N= 35

25. N= 21

26. N= 300

27. N= 297

28. N= 243, 76 females, 164 males

29. N= 243, 76 females, 164 males (44.74% females, 42.07% males)

30. N= 166, 52 females, 112 males (61.54% females, 60.71% males)

31. N= 166, 52 females, 112 males

32. N= 276

33. N= 276, 85 females, 187 males [Desire to improve quality- 22.35 females, 21.39 males; fear of plagiarism- 11.76% females, 17.11% males; fear of use by others for professional benefits- 3.53% females, 11.76% males; lack of awareness of OA options- 18.82% females, 10.16% males]

34. N= 276, 85 females, 187 males [No reputed OA journals in their field- 2.35% females, 12.3% males; OA option unavailable where they wanted to publish- 18.82% females, 24.06% males]

35. N= 276, 85 females, 187 males (14.12% females, and 9.63% males)

36. N= 267, 86 females, 177 males

37. N= 267, 86 females, 177 males

38. N= 376

39. N= 361

40. N= 361

41. N= 354

42. N= 357

43. N= 360

1. N= 378, 123 females, 251 males

2. Engineering- 68, Economics- 36

3. N= 195, 55 females, 137 males

4. N= 373, 122 females, 247 males

5. Law- 30, Medicine- 37, Physics- 27, Engineering- 43, Economics- 11, Others- 47

6. N= 373, 122 females, 247 males

44. N= 363

45. N= 362

46. N= 358

47. N= 360

48. N= 323

49. N= 318

50. N= 312

51. N= 306

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55. N= 275

56. N= 267

57. N= 256

58. N= 256

59. N= 252

60. N= 290

61. N= 301

62. N= 328

63. N= 481

64. N= 287

65. N= 287

66. N= 280

67. N= 250

68. N= 236

69. N= 232

70. N= 246

71. N=238

72. N= 237

73. N= 250

74. N= 256

75. N= 246

76. N= 294

77. N= 293

78. N= 290

79. N= 294

80. N= 293

81. N= 290

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OPEN SCIENCE INDIA REPORT

This draft report summarises the major findings and recommendations from the open science project conducted at the Centre for Innovation, Intellectual Property and Competition; National Law University, Delhi.

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