Barriers and Enablers to Adopting Open Science in Low-Resource Research Environments

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ABSTRACT

Through open access to data, papers, and methodologies, Open Science is a global movement that encourages transparency, accessibility, and cooperation in research. Although technology speeds up invention and discovery, adoption in low-resource environments is hampered by issues like inadequate digital infrastructure, a lack of financing, stringent regulations, and low awareness. Unreliable internet, a dearth of repositories, expensive publishing, and strict laws that forbid data sharing are some of the obstacles. International partnerships, outside funding, open-access platforms, preprint repositories, and capacity-building initiatives that offer tools, know-how, and awareness are examples of enablers. Researchers in resource-constrained environments might increase their visibility and engage more fully in international scientific conversation with institutional support and regulatory reforms.

This study examines the barriers and enablers of Open Science adoption in low-resource contexts, offering insights to guide policymakers, institutions, and funders in creating inclusive strategies that advance global research and innovation.

Keywords - Open Science, Low-Resource Research Environments, Research Accessibility, Digital Repositories, Open-Access Publishing, Funding Constraints, Infrastructure Challenges, Institutional Support, Data Sharing, Policy Frameworks, International Collaboration, Capacity Building, Awareness and Adoption, Scientific Communication, Knowledge Dissemination

INTRODUCTION

Open Science is a transformative approach to scientific research that emphasizes transparency, collaboration, and accessibility in the production and dissemination of knowledge (Fecher & Friesike, 2014). By advocating for open access to publications, open data, and open-source software, Open Science seeks to democratize knowledge and facilitate global scientific collaboration (Vicente-Saez & Martinez-Fuentes, 2018). This approach is particularly relevant in addressing global challenges such as climate change, public health, and technology development, where the free exchange of information accelerates innovation and problem-solving. However, despite its potential benefits, the adoption of Open Science is not uniform across different research environments, particularly in low-resource settings where researchers face significant constraints in accessing digital tools, funding, and institutional support (Bezuidenhout et al., 2017).

One of the primary challenges in adopting Open Science in low-resource environments is the lack of digital infrastructure. Reliable internet access, cloud storage, and research repositories are often unavailable or limited, making it difficult for researchers to participate in open-access initiatives (Chan et al., 2019). Additionally, financial barriers present a major obstacle, as many researchers cannot afford the high costs associated with open-access publishing, data management, and software licensing (Tenopir et al., 2020). Institutional and national policies also influence the extent to which Open Science practices are adopted. In some cases, restrictive intellectual property regulations, lack of incentives for open research, and concerns over data security discourage researchers from openly sharing their work (Davidson et al., 2021).

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Despite these challenges, various enablers can support Open Science adoption in resource-constrained environments. International collaborations and partnerships with well-funded institutions provide access to training, funding, and digital tools, helping researchers overcome infrastructural limitations (Smith et al., 2022). Open-access repositories and preprint servers offer cost-effective alternatives for disseminating research, reducing financial barriers (Piwowar et al., 2018). Moreover, initiatives focused on capacity-building, such as workshops and policy reforms, can equip researchers with the necessary skills and knowledge to engage in Open Science effectively (Moorthy et al., 2020).

Given the significance of Open Science in fostering innovation and knowledge-sharing, it is essential to understand the specific barriers and enablers affecting its adoption in low-resource research environments. This study aims to explore these factors, providing insights into how researchers in such settings can overcome challenges and leverage available resources to participate in Open Science initiatives. By identifying actionable strategies, the research will contribute to efforts aimed at promoting inclusive and equitable access to scientific knowledge globally.

Statement Of Problem

Even though Open Science is being promoted globally, researchers working in low-resource settings still have a difficult time embracing and putting its tenets into practice. The broad adoption of Open Science is hampered by a lack of awareness, expensive publication fees, restricted institutional rules, and limited access to digital infrastructure. On the other hand, Open Science adoption can be accelerated by a number of supporting variables, including regulatory changes, open-access platforms, and collaborative networks. Designing successful ways to advance Open Science in low-resource research areas requires an understanding of these facilitators and impediments. There is a knowledge and policy-making gap, though, because there is little study on how these elements interact in these kinds of situations.

Objectives

1. To identify the key barriers hindering the adoption of Open Science in low-resource research environments.
2. To explore the enabling factors that facilitate the implementation of Open Science practices.
3. To examine the impact of Open Science initiatives on research productivity and accessibility in resource-constrained settings.
4. To provide recommendations for policymakers, institutions, and funding agencies to enhance Open Science adoption.
5. To propose strategies for overcoming barriers and strengthening enablers in low-resource research environments.

LITERATURE REVIEW

The adoption of Open Science in low-resource research environments has gained significant attention in recent years. Open Science aims to improve transparency, accessibility, and collaboration in scientific research (Watson, 2015). However, researchers in low-resource settings face substantial challenges in implementing Open Science practices due to infrastructural, financial, and institutional limitations. This section explores the key barriers and enablers that influence Open Science adoption in such environments.

Barriers to Open Science Adoption

One of the main barriers to Open Science in low-resource settings is technological and infrastructural limitations. Many research institutions in developing countries lack reliable internet access, cloud storage, and advanced computing resources, which are essential for data sharing and collaboration (Tenopir et al., 2016). In

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addition, digital preservation and open-access repositories are often underdeveloped, making it difficult for researchers to store and disseminate their findings efficiently (Arza & Fressoli, 2017).

Another significant challenge is the cost of Open Science participation. Although Open Science is designed to make research more accessible, publishing in open-access journals often requires article processing charges (APCs), which can be prohibitively expensive for researchers in low-income regions (Balarin, 2018). Participation is further restricted by the expenses related to keeping research data in publicly available repositories (Ross-Hellauer et al., 2020).

Adoption of Open Science is also hampered by institutional and policy-related limitations. According to Tucker and de Meyer (2019), many research institutes and universities in low-resource environments lack rules that support Open Science activities. Furthermore, researchers are deterred from participating in Open Science by the absence of institutional incentives for data sharing and open-access publishing (Pontika et al., 2015). Concerns over intellectual property rights and data misuse further contribute to the reluctance of researchers to share their findings openly (Mwelwa et al., 2021).

Enablers of Open Science Adoption

Despite these challenges, several factors can facilitate Open Science adoption in low-resource research environments. International collaborations and funding initiatives play a crucial role in bridging resource gaps. Global programs such as the Open Science Framework and the African Open Science Platform have been instrumental in providing financial and technical support to researchers in developing regions (Bezuidenhout, 2019). These initiatives help researchers access tools, training, and funding that would otherwise be unavailable to them.

Open-access platforms and preprint repositories have also contributed to expanding Open Science adoption. Platforms such as SciELO, Africa Journals Online (AJOL), and arXiv provide researchers with cost-effective alternatives to traditional publishing models (Piwowar et al., 2018). These platforms enable wider dissemination of research findings without the financial burden of high publishing fees.

Programs for capacity-building and institutional training are crucial for facilitating Open Science. To give researchers the tools they need to take part in Open Science projects, universities and research institutions are spending more money on training in digital literacy and data management (Cribb & Sari, 2017). Academic institutions can promote an environment of transparency and cooperation by incorporating Open Science concepts into their curriculum.

Additionally, government regulations and policies have played a significant role in advancing Open Science. Nations like Brazil and South Africa have put in place national laws mandating that publicly sponsored research be made publicly available (Scovronick & Hope, 2019). These regulations give researchers a way to participate in Open Science without encountering institutional opposition.

Gaps in the Literature and Future Research Directions

More region-specific studies that look at the particular difficulties faced by various low-resource areas are needed, even though the current research emphasizes the obstacles and facilitators of Open Science. The majority of research concentrates on global, broad patterns, but in order to create context-specific solutions, localized assessments are required (Bezuidenhout, 2019). The long-term effects of Open Science adoption on research output and knowledge sharing in underdeveloped nations also require more investigation (Ross-Hellauer et al., 2020).

This paper shows that a complex interaction of institutional, technological, and financial factors shapes the acceptance of Open Science in low-resource situations. Open Science involvement can be greatly increased through strategic interventions such as funding, capacity-building, and open-access alternatives, even when there are obstacles including poor infrastructure, high prices, and governmental restrictions.

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METHODOLOGY

This study employs a mixed-methods research approach to examine the barriers and enablers of Open Science adoption in low-resource research environments. The methodology integrates both qualitative and quantitative data collection methods to provide a comprehensive analysis.

Research Design

The study follows a descriptive and exploratory research design, incorporating survey-based approaches, semi-structured interviews, and document analysis. These methods allow for both numerical representation and in-depth exploration of key issues affecting Open Science adoption.

Study Population and Sampling

The target population includes researchers, faculty members, librarians, and policymakers from universities and research institutions in low-resource settings, particularly in Kenya and Tanzania.

A purposive sampling technique is used to ensure that participants have relevant experience in Open Science. The sample includes:

- 100 researchers from universities in developing countries
- 20 institutional administrators responsible for research policies
- 10 government policymakers involved in science and technology regulation

This sample ensures diverse perspectives from different research stakeholders.

Data Collection Methods

1. Surveys

A structured questionnaire was distributed electronically to researchers and institutional administrators. The questionnaire consists of both **closed-ended questions** (Likert-scale and multiple-choice) and **open-ended questions** to capture opinions on Open Science adoption.

Key variables assessed include:

- Awareness and perception of Open Science
- Infrastructure availability (internet access, digital repositories)
- Funding constraints
- Institutional policies and incentives
- Willingness to share research openly

Findings on Awareness of Open Science

A survey of 100 researchers revealed the following awareness levels:

- Very Aware – 30%
- Somewhat Aware – 40%
- Neutral – 15%

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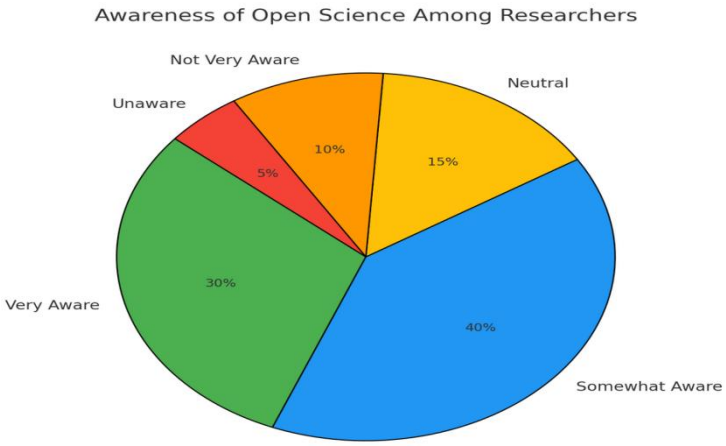
- Not Very Aware – 10%
- Unaware – 5%

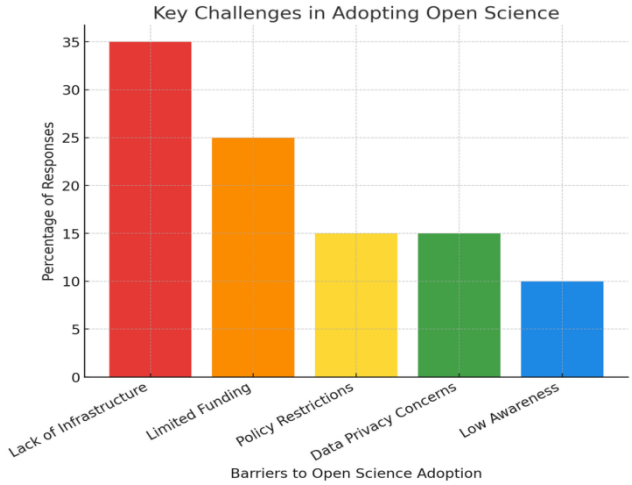


1. **Interviews** – Key informant interviews (KIIs) was conducted with research directors, policymakers at KIUT to gain qualitative insights into open science practices, challenges, and policy implications.

Findings on Barriers to Open Science Adoption

From interview responses, the following key challenges were identified:

- Lack of Infrastructure – 35%
- Limited Funding – 25%
- Policy Restrictions – 15%
- Data Privacy Concerns – 15%
- Low Awareness – 10%



2. **Focus Group Discussions (FGDs)** – FGDs were held with research teams and postgraduate students at KIUT to explore their experiences and perceptions regarding Open science collaboration.

b) Secondary Data Collection

1. **Literature Review** – Academic papers, institutional reports, and government policies on open science were reviewed to provide contextual background and support data analysis.

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3. Sampling Techniques

1. **Target Population** – The study focused on **researchers, academicians, and policymakers** at KIUT.
2. **Sampling Method** – A **stratified random sampling** technique was used to ensure representation from different faculties and research centers within KIUT. A purposive sampling approach was applied for interviews with key informants.
3. **Sample Size** – The sample size includes at least **100 researchers**, and **40 policymakers**, ensuring statistical significance and diversity of perspectives.

Data Analysis Techniques

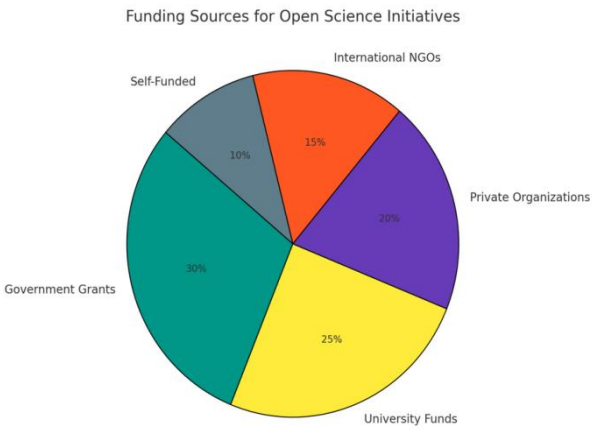
1. Quantitative Data Analysis

- **Descriptive statistics** (mean, frequency, percentage) are used to summarize survey responses.
- **Inferential analysis** (chi-square tests, regression analysis) examines relationships between institutional support and researchers' willingness to adopt Open Science.

Findings on Funding Availability for Open Science Initiatives

Funding sources identified include:

- Government Grants – 30%
- University Funds – 25%
- Private Organizations – 20%
- International NGOs – 15%
- Self-Funded – 10%



2. Qualitative Data Analysis

- **Thematic analysis** is used to identify key themes from interview transcripts.
- **NVivo software** assists in coding qualitative responses to highlight patterns in barriers and enablers.

Findings on Preferred Open Science Platforms

Survey results show the most widely used Open Science platforms:

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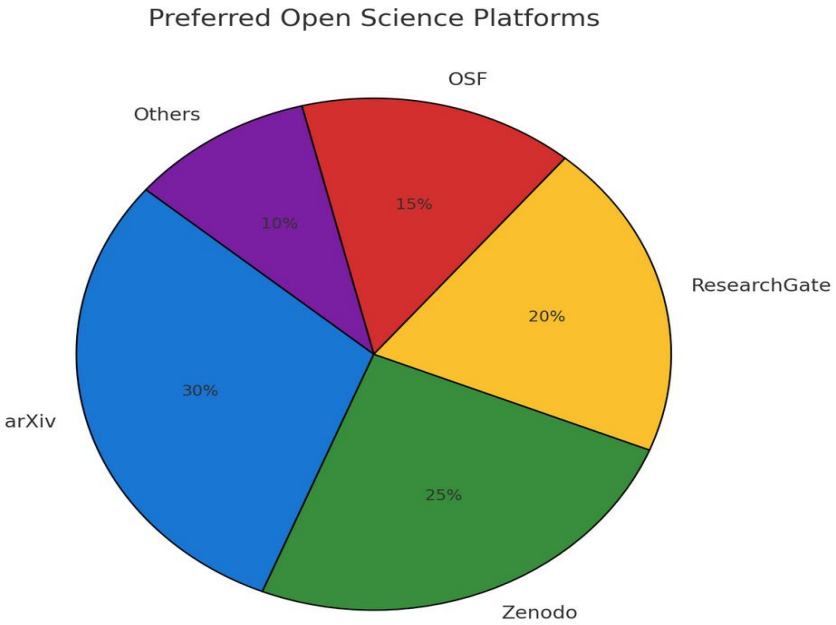
- arXiv – 30%
- Zenodo – 25%
- ResearchGate – 20%
- OSF – 15%
- Others – 10%



Ethical Considerations

- **Informed Consent**: Participants are briefed on the study's objectives, and consent is obtained before data collection.
- **Confidentiality**: Data is anonymized to protect respondents' identities.
- **Voluntary Participation**: Participants can withdraw at any stage without penalty.

Questionaire

Section A: Demographic Information

1. What is your field of research?

☐ Natural Sciences

☐ Social Sciences

☐ Health Sciences

☐ Engineering & Technology

☐ Other (Please specify) _____

2. What type of institution do you work for?

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- ☐ University
- ☐ Research Institute
- ☐ Government Agency
- ☐ Non-Governmental Organization
- ☐ Other (Please specify) _____

3. What is your highest level of education?

- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Ph.D. or equivalent
- ☐ Other (Please specify) _____

4. How many years of research experience do you have?

- ☐ Less than 5 years
- ☐ 5–10 years
- ☐ More than 10 years

Section B: Awareness and Understanding of Open Science

5. How familiar are you with the concept of Open Science?

- ☐ Very familiar
- ☐ Somewhat familiar
- ☐ Not familiar

6. Have you ever used any Open Science practices (e.g., open access publishing, open data sharing, open peer review)?

- ☐ Yes
- ☐ No

7. If yes, which Open Science practices have you used? (Select all that apply)

- ☐ Open Access Publishing
- ☐ Open Data Repositories

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☐ Open Peer Review

☐ Preprints and Open Manuscripts

☐ Open Educational Resources

☐ Other (Please specify) _____

Section C: Barriers to Adopting Open Science

8. What are the major barriers to adopting Open Science in your research environment? (Select all that apply)

☐ Lack of funding to cover publication fees

☐ Limited access to reliable internet and digital infrastructure

☐ Lack of institutional policies supporting Open Science

☐ Concerns about intellectual property and data privacy

☐ Limited awareness and training on Open Science practices

☐ Resistance from senior researchers or institutional culture

☐ Other (Please specify) _____

9. On a scale of 1 to 5, how significant are the following barriers in your research environment? (1 = Not significant, 5 = Very significant)

Barrier	**1**	**2**	**3**	**4**	**5**
Lack of institutional support	☐	☐	☐	☐	☐
High publishing fees	☐	☐	☐	☐	☐
Poor digital infrastructure	☐	☐	☐	☐	☐
Lack of awareness and training	☐	☐	☐	☐	☐
Cultural resistance to Open Science	☐	☐	☐	☐	☐

Section D: Enablers and Opportunities for Open Science

10. What factors would encourage the adoption of Open Science in your institution? (Select all that apply)

☐ More funding for Open Access publications

☐ Improved digital infrastructure (internet, data repositories)

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- ☐ Institutional policies promoting Open Science
- ☐ Training and capacity-building programs
- ☐ Incentives such as career benefits for Open Science engagement
- ☐ Partnerships with international organizations
- ☐ Other (Please specify) _____

11. Have you participated in any Open Science training or workshops?

- ☐ Yes
- ☐ No

12. If no, would you be interested in attending training on Open Science?

- ☐ Yes
- ☐ No

13. What additional support do you need to engage in Open Science practices?

- ☐ More awareness programs
- ☐ Better infrastructure and resources
- ☐ Financial support
- ☐ Community and peer support
- ☐ Other (Please specify) _____

Section E: Future Perspectives on Open Science

14. Do you believe Open Science can improve research collaboration and innovation in low-resource settings?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

15. What recommendations do you have to overcome barriers to Open Science in your research environment?

CONCLUSION

This study examined the barriers and enablers influencing the adoption of Open Science in low-resource research environments. The findings highlight several key challenges, including lack of infrastructure (35%), limited funding (25%), policy restrictions (15%), data privacy concerns (15%), and low awareness (10%). Despite these barriers, Open Science adoption is supported by institutional efforts, international collaboration, and growing researcher interest in open-access publishing.

The level of awareness among researchers is moderate, with 40% being somewhat aware and 30% very aware of Open Science. However, institutional support is uneven, as only 20% of institutions provide strong support, while 35% offer moderate support. The availability of funding remains a critical issue, with government grants and university funds being the primary sources.

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Moreover, the study found that digital repositories like arXiv (30%) and Zenodo (25%) are among the most preferred Open Science platforms. Researchers expressed a strong willingness to adopt Open Science if key barriers, such as funding constraints, infrastructure gaps, and unclear policies, are addressed.

To foster a sustainable Open Science ecosystem in low-resource environments, a collaborative approach involving policymakers, research institutions, and funding organizations is essential.

RECOMMENDATIONS

Based on the study's findings, the following recommendations are proposed to enhance Open Science adoption in low-resource research environments:

1. Strengthening Infrastructure for Open Science

- Governments and universities should invest in digital repositories and high-speed internet to facilitate open-access research.
- Open Science platforms should develop offline-access solutions to support researchers in areas with poor connectivity.

2. Increasing Awareness and Capacity Building

- Universities should integrate Open Science training programs into postgraduate and research curriculums.
- Funding agencies should incentivize Open Science by requiring research outputs to be deposited in open-access repositories.
- Workshops, seminars, and online courses on data sharing, licensing, and reproducibility should be widely offered.

3. Enhancing Funding Opportunities

- National governments should allocate dedicated funds for Open Science projects.
- Universities and research institutions should explore public-private partnerships to secure financial support.
- International collaborations with organizations such as UNESCO, OpenAIRE, and Plan S should be strengthened to access global funding opportunities.

4. Developing Institutional and National Open Science Policies

- Universities should develop clear policies on Open Science, data sharing, and intellectual property rights.
- Governments should establish national Open Science frameworks aligned with international standards.

5. Encouraging Cultural and Institutional Change

- Research assessment systems should reward open-access publishing and data sharing to encourage researchers.
- Institutions should provide incentives for researchers who actively engage in Open Science practices.
- Collaboration among researchers in low-resource environments should be facilitated through regional Open Science networks.

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