University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818

Open Science Knowledge and Practices among Tanzanian Scholars

[*]Aneth David
Department of Molecular Biology and Biotechnology,
University of Dar es Salaam
Email: anethdavid367@gmail.com

Mohamed Zahir
Department of Biochemistry,
Muhimbili University of Health and Allied Sciences
Email: mzahir89@gmail.com

Grantina Modern
Department of Biomedical Engineering,
Nelson Mandela African Institution of Science and Technology
Email: grantinamodern@gmail.com

Obadia Buhomoli
Directorate of Library Services, University of Dodoma, Tanzania
Email: obadiashadrack16@gmail.com

Paul Muneja
Information Studies Unit, University of Dar es Salaam
Email: pmuneja@gmail.com

Abstract

The Open Science (OS) movement is rapidly expanding globally, enhancing access to scientific knowledge. However, awareness and practices of OS among researchers in Tanzania remain unclear. This study aimed to assess OS awareness and practices among Tanzanian scholars and to identify the challenges they encounter. A digital survey was conducted among academicians, researchers, students, librarians, and science communicators in Tanzania, using a Google Form shared via social media and institutional mailing lists. Analysis was performed using Microsoft Excel and SPSS. Results indicated that 84 per cent of respondents (n = 144) were aware of OS, primarily through peers and online platforms. Open access (OA) publishing emerged as the most prevalent OS practice, underscoring the need for greater awareness of other OS activities. Respondents reported several barriers to OS adoption, including insufficient knowledge, lack of institutional support, and concerns over data security. The study underscores the significance of peer learning and online resources in promoting OS awareness and advocates for supportive institutional policies, infrastructure development, and guidelines to encourage OS practices among Tanzanian scholars.

Keywords: Open Science, OS, Open Science Tanzania, Open Access, Scholarly Communication

https://dx.doi.org/10.4314/udslj.v20i2.5

[*] Corresponding Author

University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818

Introduction

Open science refers to the movement that aims to make the scientific process openly available, accessible, and reusable for everyone. (UNESCO, 2021). The Organisation for Economic Cooperation and Development (OECD) defines Open Science (OS) as "efforts by researchers, governments, research funding agencies or the scientific community to make the primary outputs of publicly funded research results publicly accessible in a digital format with minimal or no restriction as a means for accelerating research; these efforts are in the interest of enhancing transparency, collaboration and fostering innovation" (OECD, 2015).

The OS movement aims at making the research process more open and participatory for all relevant actors, within and beyond the scholarly community (Dai et al., 2018). It encourages openness and transparency in research through collaboration as well as an interactive relationship between researchers and citizens (Knack, 2017). The movement seeks to extend principles of openness to the entire research process, from idea generation, data collection, data analysis, and findings communication, to drive systemic change in science and research conduct.

The OS movement has succeeded in increasing access to information and transparency in science globally, although uptake has been slow in African countries, particularly in Sub-Saharan Africa, due to various socio-economic factors and low research funding (Mwelwa et al., 2020; Okafor et al., 2022). Because research knowledge is a public good generated from research that is funded by public monies, it follows that everyone should be able to access and make use of that knowledge at no additional cost, thus generating higher social returns (OECD, 2015). OS makes it possible for the general public to access the scientific knowledge and processes by advocating for and providing the infrastructure to share scientific methods, output, data and research infrastructure (European Commission. Directorate General for Research and Innovation., 2018; Fecher & Friesike, 2013; Nosek et al., 2015). The rapid spread of the OS movement has been made possible through the advent of Information and Communication Technologies (ICT), which are increasingly integrating into everyday life (Knack, 2017). The internet and web applications have created new ways of generating knowledge, publishing and disseminating research output and making them immediately available to the research and academic communities and the general public (OECD, 2015).

OS is a relatively new avenue in the research landscape of Tanzania, with reported practices placing a heavy focus on open access (OA) (Buhomoli & Muneja, 2022; Dulle et al., 2010; Mgonzo & Yonah, 2014a). OS adoption in Tanzania has been slow despite several initiatives aimed at promoting the movement (Fossner, 2021; Kaijage, 2017); P. S. Muneja & Ndenje-Sichalwe, 2016; Personal. The slow trend may be due to low awareness of the OS practices among research and academic institutions. Misconceptions and concerns about the misuse of data, such as the loss of patent rights, data theft, and manipulation in open repositories, may hold back researchers from practising OS (Buhomoli & Muneja, 2022). Elsewhere in Africa, a lack of clear institutional policies to guide the application of OS principles has also been a hindrance, and this may be the case for Tanzania as well (Mwelwa et al., 2020; Okafor et al., 2022). Additionally, poor institutional support and incentives to promote OS adoption among

researchers, and the unavailability of platforms for researchers to practise OS, may contribute to the slow growth. To date, no comprehensive study on OS awareness and practices among scholars in Tanzania has been conducted. Several studies have focused on a aspects of OS, particularly OA and institutional repositories (Dulle & Minishi-Majanja, 2009; Mbughuni et al., 2022; Nunda & Elia, 2019a) but not the entire movement. This study, therefore, aimed to establish the level of awareness and practices regarding OS among academicians and researchers in Tanzania. The specific objectives were

i. To assess awareness of OS principles among Tanzanian researchers and scholars
ii. To determine practices of OS among Tanzanian researchers and scholars
iii. To uncover the perceived benefits of OS among Tanzanian researchers and scholars who are aware of and/or practice OS
iv. To determine the challenges that Tanzanian researchers and scholars face regarding OS practice

Literature review

The term Open Science (OS) describes practices that promote transparency, accessibility and collaboration across all stages of the research process, from data collection and analysis to publication of findings and dissemination. Its key pillars include open access, open data, open peer review, open-source software and inclusive public engagement in the research process through citizen science (Chiware & Lockhart, 2025; UNESCO, 2021). OS is increasingly recognized as a transformative approach to research that enhances public trust in science and, in turn, the impact of science. Practices such as OA increase the visibility of research and support the validation and replication of scientific findings, the latter being crucial for maintaining the integrity of research processes. They also foster a more inclusive and efficient scholarly communication ecosystem, benefiting researchers, practitioners, policymakers and the wider public, particularly in low-income nations such as Tanzania (Harle & Warne, 2020; Tennant et al., 2016).

Open access

Among the most common OS practices that scholars and researchers engage in is open access (OA). OA refers to the principles and a set of practices in scholarly communication that aim to make research outputs such as publications accessible by removing financial, legal and technical barriers (Harle & Warne, 2020; P. Muneja, 2023; Tennant et al., 2016). Under the OA, scholarly artefacts such as research publications, datasets, methodology, software and other relevant materials are made freely available online to all users, allowing anyone to read, download, copy, distribute, print, search and use the content for lawful purposes without restriction, provided appropriate attribution is given to the original authors (Beall, 2019). This stands in contrast to traditional subscription-based publishing, where access to research findings and related artefacts is limited to individuals or institutions willing to pay costly journal subscriptions or one-time access fees. The principles of open access are articulated in key international declarations, such as the Budapest Open Access Initiative (BOAI, 2002) and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, 2003), which emphasize not only free access but also the right to reuse and redistribute scholarly works.

University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818

OA encompasses several types defined by how and when research outputs are made freely available as well as by their funding models. The most widely recognized categories are gold, green, and diamond/platinum open access. In gold OA, research articles are made immediately and permanently accessible to everyone without subscription barriers. Authors or their institutions typically pay article processing charges (APCs) to cover the manuscript handling and production costs (Beall, 2019; Rowley et al., 2017) For Green OA, articles are published behind a paywall, and authors do not pay APCs; instead, they may self-archive a version of their work, typically the accepted manuscript after peer review but before final publisher formatting, in an institutional or subject repository. This allows authors to make their research freely accessible despite the journal's paywall restrictions. However, publishers usually impose an embargo period before the accepted manuscript can be publicly shared, typically 6 to 24 months, depending on the publisher's policies (Laakso, 2014; Rowley et al., 2017). Diamond or Platinum OA journals provide free access to readers and do not charge authors any publication or processing fees. Academic institutions, scholarly societies, government funding or philanthropic sources typically support these journals. Although often smaller and community-driven, diamond OA journals contribute significantly to equitable access by removing financial barriers for both authors and readers (Beall, 2019).

Status of open science globally, Africa and in Tanzania

The adoption of OS practices globally has been accelerating, driven by growing recognition of their potential to democratize knowledge, enhance research transparency, and foster innovation. This momentum is also fueled by technological advancements that allow rapid dissemination of research components and publications, as well as policy mandates aimed at increasing the impact and reproducibility of research (P. Muneja, 2023). The spread of the OS movement is motivated by the understanding that publicly funded research should be accessible to public actors, maximizing the dissemination and impact of knowledge while promoting equity and transparency in academia.

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), the number of countries with open science policies has increased significantly, nearly double the original number since the adoption of the Recommendation on Open Science in 2021, with eleven countries introducing new frameworks to support open science practices (UNESCO, 2023). Globally, open science initiatives have led to greater accessibility of research outputs, improved reproducibility and more inclusive collaboration across disciplines and borders. The adoption of OS has been promoted by various stakeholders, including funders, academic institutions, and international bodies, seeking to improve the reproducibility, equity, and societal relevance of science. Some of these include the OECD (Paic, 2021), the US National Institutes of Health NIH) (Corscadden, 2024) and the European Commission (European Commission, n.d.-a, n.d.-b; European Commission. Directorate General for Research and Innovation., 2018). These policies and initiatives signal institutional commitment to open science and set a precedent for institutions and individuals in their geographical areas or those they support to follow suit.

In Africa, however, the adoption of OS remains limited, with low awareness and uneven implementation of its principles. This is due to several factors, chief among them being

systemic challenges such as limited funding, weak research infrastructure and low general prioritization of science and technology (Okafor et al., 2022). From a wider picture, Africa contributes about 2% of the global knowledge (Thondhlana & Garwe, 2021), reflecting both underinvestment and structural barriers. This is also reflected in the low OS adoption rate across the continent, especially in Sub-Saharan Africa.

Despite these challenges, significant strides are being made through continent-wide and regional initiatives. The African Open Science Platform (AOSP) project was launched to coordinate OS efforts by fostering policy development, infrastructure enhancement, and capacity building tailored to African contexts (CODATA, 2018; Motshegwa, 2025; Participants of African Open Science Platform Stakeholder Workshop et al., 2018a). Similarly, the East African Community's inclusion of OS in its Science, Technology and Innovation policy marks a pioneering regional commitment to unlocking scientific potential for sustainable development (EAC, 2024; EASTECO, n.d.). Across individual countries, studies show that South Africa, Ghana, and Kenya lead in OS adoption on the continent (Mwelwa et al., 2020; Okafor et al., 2022; Steinhart et al., 2042), although the rates remain low compared to other regions worldwide.

In Tanzania, as in other Sub-Saharan African countries, the adoption of OS is gradually emerging, partly in response to the global movement towards equitable and accessible knowledge sharing. While some progress has been made, it remains limited to OA publishing and the establishment and use of institutional repositories. Promotion of OA in Tanzania can be traced to the late 2000s, with a primary focus on sensitization and establishing guiding policies, particularly for repositories (EIFL, n.d.; Muneja, Paul, 2023). The highest number of repositories recorded in Tanzania is 17, with sources reporting varying numbers between 5 and 17 over the years (EIFL, n.d.; Mgonzo & Yonah, 2014b; Mwalubanda, 2021). Most of the repositories are institutional, having been established in higher learning institutions and research institutions (Mwalubanda, 2021). Since then, studies have investigated various aspects of repositories, including their use, adoption and role in facilitating scholarly communication (Gideon & Samzugi, 2024; Nunda & Elia, 2019b, 2019a) as well as challenges and opportunities (P. S. Muneja & Ndenje-Sichalwe, 2016). Although the number of repositories has been growing steadily, studies report a slow pace of growth and uptake (Kakai et al., 2018; Mwilongo & Kachota, 2023; Nunda & Elia, 2019b).

Open data is an emerging field of OS in Tanzania, although studies also show a consistently low rate of adoption due to factors such as low or lack of skills and awareness among researchers and decision-makers, inadequate infrastructure and a lack of supportive institutional strategies (Buhomoli & Muneja, 2022; E. Msonde et al., 2024; Kayungi et al., 2021). Concerns about data ownership, security and the potential for data misinterpretation or misuse, sometimes referred to as "parasitic" use, also discourage researchers from sharing their data openly (E. Msonde et al., 2024; Mosha & Ngulube, 2023).

Much of the discussion and growth of OS in Tanzania has been spurred by international OS initiatives such as UNESCO's 2021 Recommendation on Open Science and the AOSP. The leading players have been international organizations supporting local initiatives, such as the Electronic Information for Libraries (EIFL) and the International Network for Advancing

Science and Policy (INASP), with the Consortium of Tanzania University and Research Libraries (COTUL) being a key local player. Further, emerging local organizations such as the Open Research Community of Tanzania (ORCT) signal emerging grassroots advocacy.

Research on the OS landscape in Tanzania has focused on individual pillars such as OA and open data. Studies assessing the current level of knowledge and actual practices across the entire OS field among Tanzanian scholars remain lacking. This gap indicates the need to investigate how Tanzanian researchers understand and engage with OS. By exploring both knowledge and practices, this study seeks to contribute to evidence-based interventions that support capacity building, policy development and the strategic promotion of OS in Tanzania.

Materials and Methods

A digital survey of academicians, researchers, students, librarians and science communicators in Tanzania was done to assess their level of understanding and practice of OS. A semi-structured questionnaire was used to capture demographic data and information on OS practice in Tanzania. The questionnaire was disseminated via a Google Form (Appendix 1), social media platforms (Instagram, Twitter, Facebook, LinkedIn, and WhatsApp), institutional mailing lists, and to key individuals within institutions who could share it in their circles. Reminders were sent every 4 weeks, and responses were collected over 3 months, from December 2021 to February 2022.

A total of 144 responses were collected, exported to Google Sheets, and then imported into Microsoft Excel for preliminary analysis. Further analysis was done in SPSS version 22.

Results

Demographics

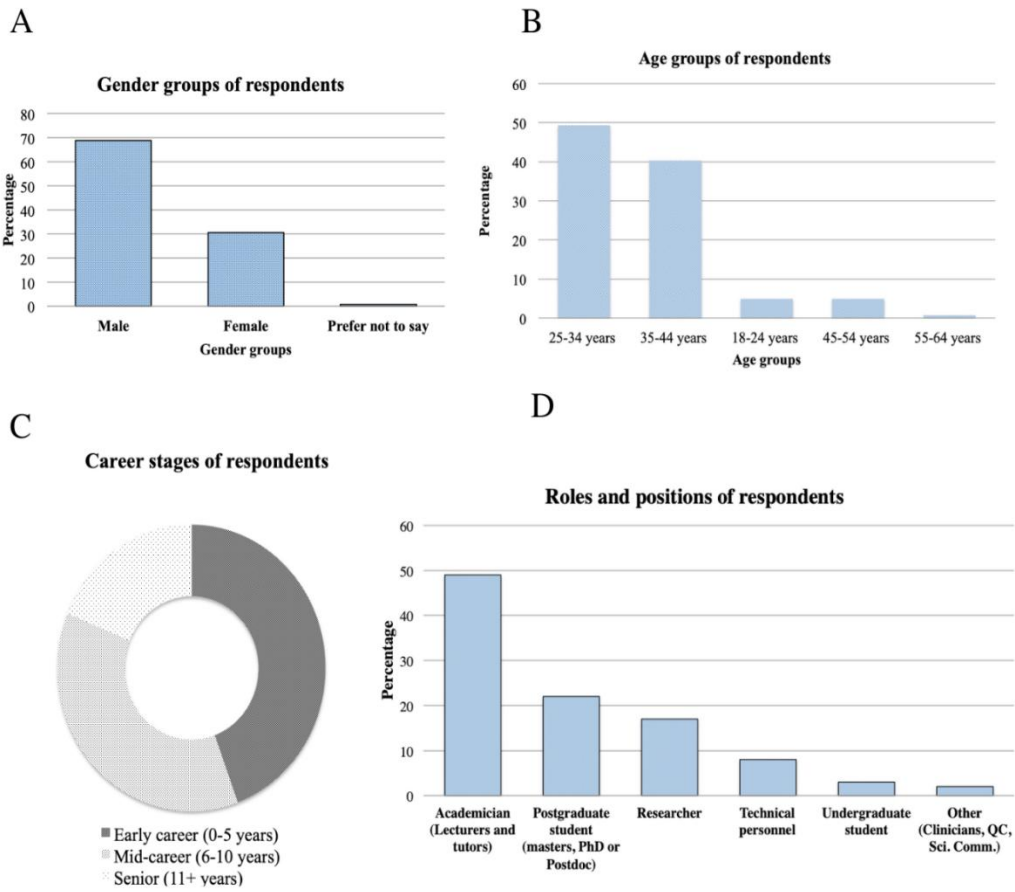
The goal of this study was to assess OS awareness and practices among Tanzanian scholars. The target audience was academics, researchers, students, librarians, and science communicators, as these groups were more likely to practise open science.

A total of 144 responses were collected via a digital survey, of which 68.8% were male, and 30.6% were female. About 1% of respondents preferred gender anonymity (Fig. 1A). In addition, 49.3% were aged 25-34 (Fig. 1B).

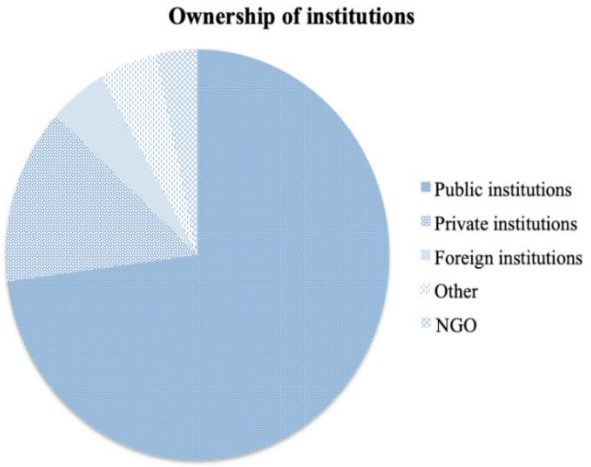
Early-career respondents with 0-5 years of experience comprised majority of the respondents (44.4%), while respondents in mid- and senior career stages comprised 36.8% and 18.8%, respectively (Fig. 1C). Position-wise, academicians, postgraduate students, and researchers comprised 48.6%, 22.2 and 16.7%, respectively. Less than 3% of the respondents were undergraduate students, communicators, clinicians and quality control officers (Fig. 1D).

Most respondents (72.9%), were affiliated with public institutions and were mainly from the University of Dar es Salaam and University of Dodoma (Fig. 1E). Nevertheless, there were respondents from other academic and research institutions, public offices, regulatory bodies, science communication companies and non-governmental organisations (Supplementary Table 1).

University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818



E



F

Major institutions	Percentage
UDSM	26
Other	24
UDOM	17
Research institutions	8
Foreign	5
SUA	3
MUHAS	3
DIT	3
NM-AIST	3
MUST	2
SAUT	2
KCMU	2
MoCU	2

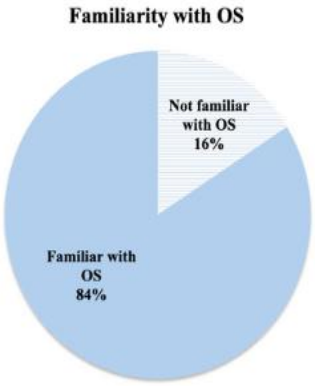
Fig. 1: Demographics of the respondents, including gender distribution (A), age group (B), career stage (C), career roles (D) and institutional affiliations (E and F)

OS Awareness and Perceived Benefits

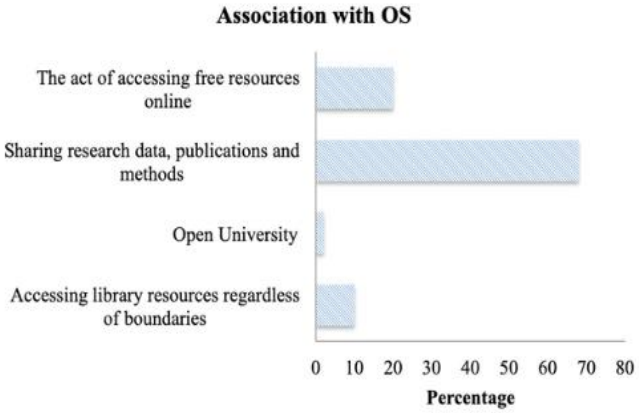
Regarding awareness of the term "Open Science", 84% of the respondents said they were familiar with the term (Fig. 2A), with the majority associating it with sharing data, publications and methods (Fig. 2B). This is an indication that most of them have been exposed to OS practices and were the right target for the survey.

More than 50% of respondents who were familiar with OS became aware of the term and/or practice mainly from their colleagues, social media, or online sources. About 19% of respondents learned about OS through the publishing process, 11.2% during their studies, and 8.8% through other self-initiatives. Only 2.4% of the respondents had learned about OS from their institutional libraries (Fig. 2D). Respondents also cited several benefits of engaging in OS in their research activities. The most common benefits were related to access and the publication process. Responses citing improved access to publications, research methodologies, and lower knowledge access costs were 60% and 11.8%, respectively (Fig. 2C). Respondents recognised that free access to others' works or publications had positively contributed to their research and provided them with needed information. They also said it helped them share information with a larger audience and improved their visibility. It allowed accessibility to hundreds of research materials that would otherwise be difficult to obtain.

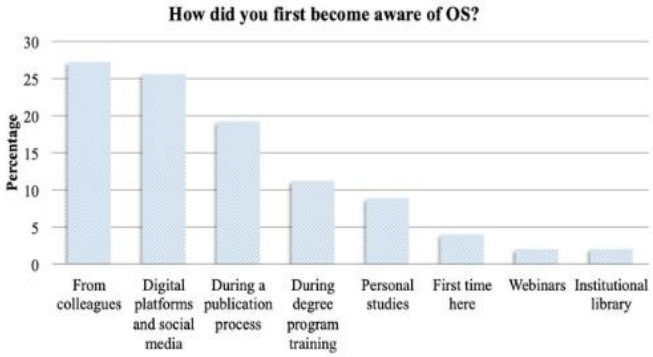
A



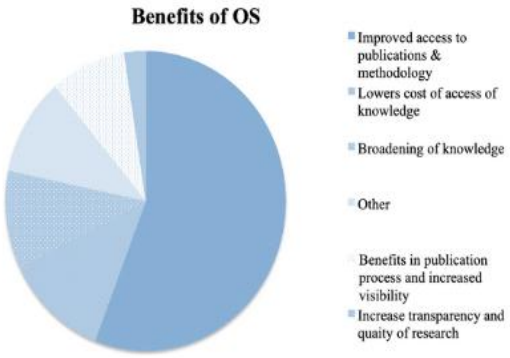
B



C



D



University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818

Fig. 2: Respondents' awareness of open science (A) as well as what they associate it with. (C) shows how respondents first became aware of open science, and (D) shows the reported benefits of open science by respondents' knowledge

OS Practices

Further analysis of the data showed that 72% of respondents who were aware of OS had practised at least one form, with 63.2% through OA publishing, 34.9% through open source activities, and 31.1% through open data (OD). Others had practised OS via open notebooks and blogging (Fig. 3A). The remaining respondents either had not engaged with any form of OS (15.3%) or were unsure whether they had (12.5%). When asked about their recent OS activity, participants mainly reported OA publishing and OD activities. A handful of respondents used open notebooks and blogged about OS (Fig. 3B).

Further, OA publishing and sharing, and access to articles and online information were reported as the most common OS activities among the respondents. Other everyday activities reported included OD and methodology-sharing activities. A minority used institutional repositories and engaged in OS training and outreach activities (Fig. 3C).

This study, therefore, consistently shows that OA publishing and free access to scientific literature are the most common OS practices among the surveyed researchers and scholars (Fig. 3A, Fig. B and Fig. C).

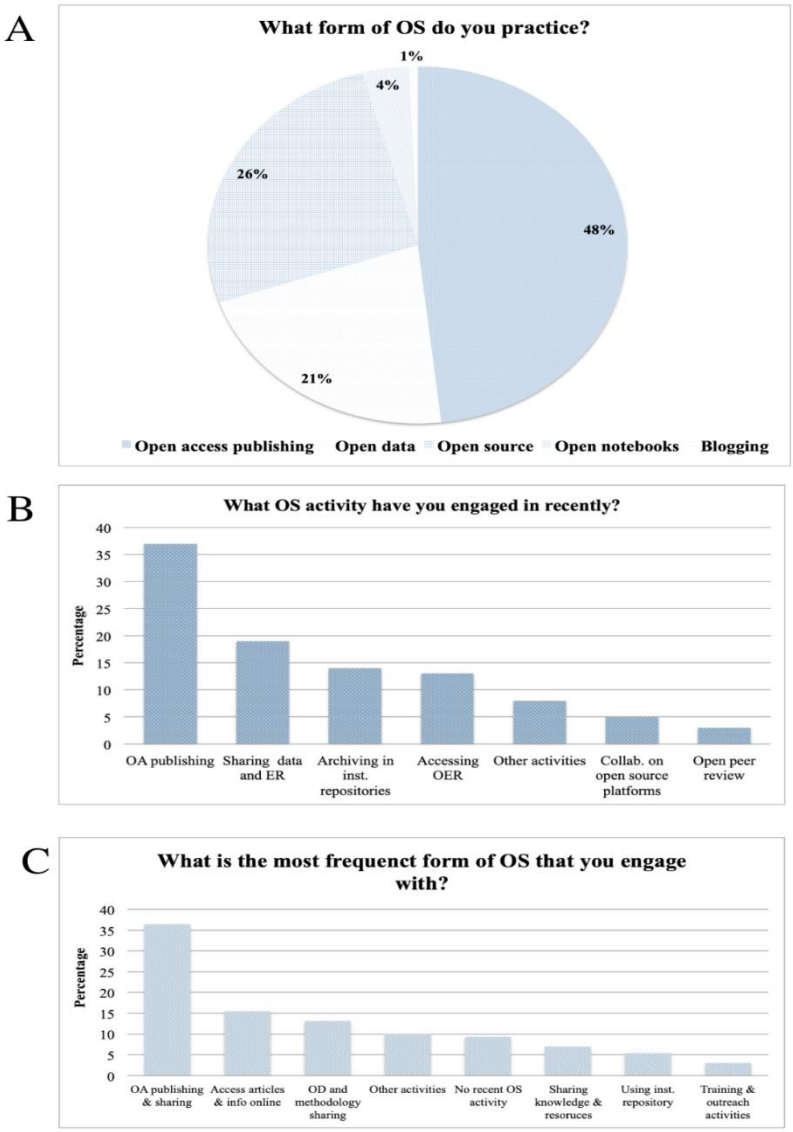


Fig. 3: Various activities practised by the respondents who were aware of open science (A), most recent open science activities they had engaged with (B), and most common open science activities that respondents perform

Barries of Practicing OS

When respondents were asked to name the biggest barriers to practising OS, the most frequently reported challenges were related to a lack of awareness, knowledge, and skills to engage with OS activities (41%, Fig. 4). Respondents noted that many scholars were not aware of OS practices and/or their benefits. They also said that scholars may lack the necessary skills to adopt OS, as some practices may require knowledge of information technologies (IT). Closely related to a lack of awareness were negative perceptions and the persistence of myths about OS, such as those regarding the quality of OA publications.

University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818

Another set of challenges was related to poor institutional support and unclear OS policies and guidelines (17%, Fig. 4). Here, respondents mentioned limited will to support OS at the institutional level and collaborating partners, lack of resources allocated to support OS, rigid institutional culture and lack of legal and ethical frameworks to support OS. The lack of OS policies at institutions was also noted, and when available, they were not known to the majority. It was noted that some academic institutions do not recognise academic works published in OA journals that charge Article Processing Charges (APCs) for academic promotion. This tended to discourage academics from publishing in such journals. At the national level, Tanzania's data-sharing policy was reported as a problem, but no further details were provided to explain why.

Technical challenges and infrastructural barriers were also not far off (13% of responses each; Fig. 4), with poor ICT knowledge and poor internet services common themes. Other, lesser-reported barriers included financial limitations (6%; Fig. 4). Under financial limitations, respondents frequently mentioned a lack of funds to pay for APCs as one of the barriers to practising OS. Further, a shortage of funds to install OS infrastructure for students and scholars was also reported. Other challenges were related to copyright, legal, and trust issues, including concerns about not owning the copyright to the data, poor legal and regulatory frameworks, fear of losing data, data ownership, and the perception of OS.

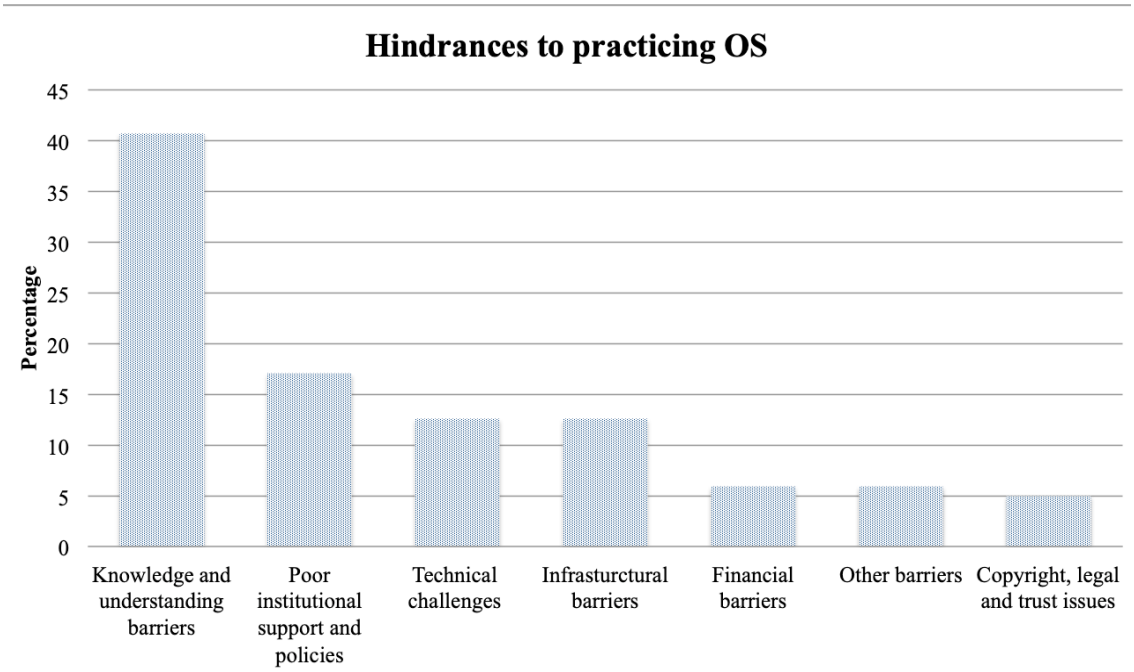


Fig. 4: Factors that act as barriers to practising open science in Tanzania

Discussion

This study aimed at understanding the level of knowledge and practice of OS among scholars and researchers in Tanzania. This is the first study of its kind, as opposed to earlier studies that only focused on OA, institutional repositories and OD (Buhomoli & Muneja, 2020, 2022; Kayungi et al., 2021; Mbughuni et al., 2022; Mgonzo & Yonah, 2014b; Mwalubanda, 2021; Nunda & Elia, 2019b; Samzugi, 2017). The results of this study are discussed below.

Demographics

A large part of the respondents were early career researchers (ECRs) of 25-34 years old, probably reflecting the relatively recent emergence of the OS movement (Christensen et al., 2020) fuelled by the rise of ICTs (Mwelwa et al., 2020). The respondents were mainly academicians, postgraduate students, and researchers affiliated with public academic institutions, our target groups. A study by Buhomoli & Muneja (2020) investigating awareness of OD among researchers at public universities in Tanzania observed similar demographics, with the majority being male and in early career stages. However, the majority of the respondents in that study were in the age group 36 - 45 years old. The reason may be that the study focused on academic staff and did not include participants such as postgraduate students and other ECRs. An earlier survey study on OA scholarly output in Tanzanian universities found that the majority of respondents were over 41 years old (Dulle et al., 2010). The study, however, purposely excluded junior academic staff and postgraduate students.

OS Awareness

The majority of respondents were aware of OS and correctly associated it with sharing data, publication, and methods. Interestingly, respondents familiar with OS first became aware of the term or practice mainly from colleagues, social media, and other online sources. These routes indicate their potential as effective channels for raising awareness and encouraging OS adoption by capitalising on network effects. Other studies have reported the importance of both peer-to-peer learning and social media in advancing open science practices (Farrow et al., 2020; Voytek, 2017; Zečević et al., 2020). They have highlighted that social media platforms such as Twitter and Facebook inform and create trends in open science and related fields such as data science. This observation may also explain the popularity of OS among ECRs, since they are more likely to use social media for professional purposes (Jamali et al., 2020; Nicholas et al., 2017).

From our findings, it seems that majority of the respondents gained awareness of OS through personal initiatives rather than institutional ones such as initiatives under libraries or during their studies as part of the curriculum. A sizable portion learned about OS during the publication process, such as during payment of article processing charges (APCs), which is still a personal initiative. Although best suited for the role, this is an indication that institutions and their libraries are missing an important opportunity to promote and facilitate OS practices. Given that awareness is an important first step in the adoption of new technologies and practices (Ali et al., 2022), our findings set a precedent for promoting the adoption of OS practices in Tanzania. Further studies could explore which media, social media platforms and forms of peer-to-peer learning are most effective. Integration of peer-to-peer learning and social media in institutional initiatives may be a good strategy for spreading OS awareness and its advantages to scientists and society at large. This could be coupled with other academic

University of Dar es Salaam Library Journal
Vol 20, No 2 (2025), pp 56 - 78
ISSN: 0856-1818

and scholarly gatherings such as conferences and workshops that are regular avenues for scholarly communication. Such initiatives will equip scholars and researchers with hands-on skills in applying OS principles as well as enabling exchange of experiences and best practices in an environment that is already conducive for dissemination of such knowledge. Similarly, in their publication on awareness of OD among researchers in Tanzania, Buhomoli & Muneja (2020) recommended commemorating the World Open Data Day and Open Access Week as means to raise OS awareness and encourage adoption of open data and open access practices. There is also a need to integrate OS knowledge and practice into undergraduate and postgraduate curricula so that researchers acquire relevant knowledge and skills early on (Hagger, 2022). In addition, clear institutional guidelines, policies, and frameworks for practising and incentivising OS will propel the trend and scale its impact, compared to individual and small-network effects.

OS Practices

The majority of OS activities reported by respondents were related to OA and publishing, including journal selection, APC payment, and self-archiving in institutional repositories. OA publishing was reported as both the most frequently practised and the most recent OS activity that the respondents and colleagues engaged with. Respondents also engaged in activities related to OD, open source, and open notebooks, but at a much lower level than OA publishing and free access to knowledge and information. As noted above, OA is the dominant form of OS practised and researched in Tanzania, most likely due to the direct connection to promotion and career advancement of academics and researchers. Other studies, such as that by Louderback et al. (2022) have also found OA to be the most common OS practice. There needs to be efforts to further awareness of other OS practices beyond OA. These other practices should be linked to the research process and clear incentives for uptake.

Perceived Benefits of OS

Someone's knowledge of OS benefits can influence their eagerness to adopt the practices. A large proportion of respondents cited easier and free access to information (scientific publications, methodologies, datasets) and OA publishing as key benefits, commending how they have positively impacted their research. They cited that OS, especially OA, led to lower research costs due to free access to information, which is a challenge for researchers and scholars in developing countries like Tanzania (Mwelwa et al., 2020; Okafor et al., 2022). Participants also mentioned other benefits of OS practices, including increased visibility and greater opportunities for collaboration. The popularity of OA publishing and free access to information is linked to their direct incentives, such as increased visibility and career advancement of researchers and academics (Mwelwa et al., 2020; Swan & Brown, 2004; Tennant et al., 2016).

Challenges Facing OS in Tanzania

Individual and institutional challenges that hinder practising OS were observed. At the individual level, respondents' lack of awareness, knowledge, and skills to engage with OS activities was the most common challenge. The lack of knowledge may have left room for the perpetuation of fears about data ownership and copyright infringement, which respondents also reported as barriers. In their study of authors' perception of OA, Swan & Brown (2004)

also noted that a lack of awareness and misperceptions about OA journals were the main reasons authors did not publish in OA journals. Therefore, efforts to increase awareness of not only OA but also OS as a whole are needed.

On the institutional side, poor institutional support, unclear OS policies and guidelines, infrastructural barriers such as poor ICT capability, lack of internet access and financial barriers were cited. These barriers indicate that OS is not part of the research culture and is not prioritised in the institutions to which the respondents are affiliated. The reported institutional challenges are not unique to Tanzania. In a review on institutionalising open science in Africa, Okafor et al. (2022) mention insufficient funding, poor infrastructure, the lack of deliberate policies, and low OS awareness as the major roadblocks to advancing the movement in Africa. There is a need to strengthen human and technical institutional capacity to support OS practices across academic cadres and to create an enabling environment for the promotion of OS.

Institutional support for OS in terms of comprehensive policies, guidelines, and operating frameworks would help set the tone for how other supporting organs, such as libraries, support OS practices. Institutions should also set aside resources needed to complement individual efforts in applying OS principles and incentives to make them impactful. In the end, OS practices benefit not only individuals but also boost the ranking of institutions (Mwelwa et al., 2020). Globally, OS advocacy has been growing with support from governments and major regional bodies. For example, the US government has mandated all agencies in the country to openly and freely publish all publicly-funded research by 2026 (Tollefson & Van Noorden, n.d.) The OECD and the EU, on the other hand, have elaborate instruments for guiding open science frameworks and practices in member states (EOSC Portal, 2022; European Commission, 2022; OECD, 2015). Further, the United Nations Educational, Scientific and Cultural Organization (UNESCO) adopted "Recommendation on Open Science" in 2021 to define shared values and principles for OS, identify concrete measures towards OS and provide an international framework for OS policy and practice (UNESCO, 2021). Several regional and country-specific initiatives are changing the OS landscape in Africa, including the African Open Science Platform (AOSP) (International Science Council, 2022; Participants of African Open Science Platform Stakeholder Workshop et al., 2018b), Electronic Information for Libraries (EIFL) (EIFL, n.d., 2022) and Library Support for Embedded NREN Services and E-infrastructure (LIBSENSE) (LIBSENSE, 2022). Tanzania is a member of some of these. In addition, several African countries have national OS policies or are in the process of adopting them, including Ethiopia, Congo, South Africa, Côte d'Ivoire, Nigeria, and Uganda (Hey, 2022; Oaiya, 2022; Tamrat, 2021). However, there are no clear policies and guidelines governing OS and related practices in Tanzania. Nor are we aware of any national level initiative to develop a national OS policy in Tanzania. It is high time for Tanzania and its institutions to actively participate in the OS movement, the appropriate staring point being establishment of policy frameworks to guide and promote the practices building on existing individual efforts. This will enable the country to reap its rewards and contribute to the global scientific research agenda effectively.

Conclusions and Recommendations

This study investigated the level of awareness and practices of open science (OS) among researchers and scholars in Tanzania. Open Science initiatives in Tanzania are fragmented and rely on individual drivers due to a lack of policy frameworks that guide the OS implementation. This makes it challenging to have an effective and sustainable impact, as well as to change the research culture across the country. As a consequence, OS and related initiatives are left in the hands of individuals, limiting widespread adoption and measurable impact of OS. Despite these shortfalls, the findings of this study indicate a promising level of awareness of OS among scholars and academics in the country, mainly spread through peer networks and social media. It also uncovered the perceived benefits of OS, which are closely linked to personal career growth and incentives. We recommend harnessing the power of peer-to-peer learning and social media platforms in addition to existing platforms to enhance OS awareness and practices. In addition, clear institutional support, the provision of resources, incentives, and frameworks will build on existing individual efforts to create a greater impact for both researchers and institutions.

AUTHOR CONTRIBUTIONS

All authors took part in designing the study, data collection, and analysis. ABD and PM prepared the first draft, and all authors contributed to refining it. All authors approved the final version of the manuscript for publication.

ACKNOWLEDGEMENT

We thank the respondents for their generosity by filling the survey. We are especially grateful to Dr. Vincent Rwehumbiza for reviewing the manuscript prior to submission.

DECLARATIONS OF INTEREST

None

References

Ali, O., Shrestha, A., Jaradat, A., & Al-Ahmad, A. (2022). An Evaluation of Key Adoption Factors towards Using the Fog Technology. *Big Data and Cognitive Computing*, *6*(3), 81. https://doi.org/10.3390/bdcc6030081

Beall, J. (2019). Scholarly Open-Access Publishing. *A Guide to the Scientific Career*. https://api.semanticscholar.org/CorpusID:211324497

Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. (2003, October 22). Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. *Open Access Initiatives of the Max Planck*. https://openaccess.mpg.de/Berlin-Declaration

BOAI. (2002). *The Budapest Open Access Initiative Declaration*. https://www.budapestopenaccessinitiative.org/read/

Buhomoli, O. S., & Muneja, P. S. (2020). Awareness of open data among researchers in selected public universities in Tanzania. *University of Dar Es Salaam Library Journal*, *15*(1), 173–185.

Buhomoli, O. S., & Muneja, P. S. (2022). Factors that determine open data readiness among scholars: Experience from selected universities in Tanzania. *Information Discovery and Delivery*. https://doi.org/10.1108/IDD-10-2021-0111

Chiware, E. R. T., & Lockhart, J. (2025). Open Science. In *Encyclopedia of Libraries, Librarianship, and Information Science* (pp. 440–446). Elsevier. https://doi.org/10.1016/B978-0-323-95689-5.00061-4

Christensen, G., Wang, Z., Paluck, E. L., Swanson, N., Birke, D., Miguel, E., & Littman, R. (2020). Open Science Practices are on the Rise: The State of Social Science (3S) Survey. *UC Berkeley: Centre for Effective Global Action*. https://escholarship.org/uc/item/0hx0207r

CODATA. (2018, December 12). *The Future of Science and Science of the Future: Vision and Strategy for the African Open Science Platform*. https://codata.org/initiatives/decadal-programme2/global-open-science-cloud/african-open-science/

Corscadden, L. (2024, May 1). NIH Public Access Policy Announcement "The NIH's 2025 Open Access Mandate: A Systemic Shift in Scientific Publishing." *CONDUCTSCIENCE*. https://research.conductscience.org/the-nihs-2025-open-access-mandate-a-systemic-shift-in-scientific-publishing/

Dai, Q., Shin, E., & Smith, C. (2018). *Open and inclusive collaboration in science*. https://doi.org/10.1787/2dbff737-en

Dulle, F. W., & Minishi-Majanja, M. K. (2009). Researchers' perspectives on open access scholarly communication in Tanzanian public universities. *SA Journal of Information Management*, *11*(4), 1–14. https://doi.org/10.4102/sajim.v11i4.413

Dulle, F. W., Minish-Majanja, M. K., & Cloete, L. M. (2010, May 29). *Factors influencing the adoption of open access scholarly communication in Tanzanian public universities*. World Library and Information Congress: 76th IFLA General Conference and Assembly, Gothenburg, Sweden. http://www.ifla.org/en/ifla76

E. Msonde, S., Mariki, B. O., & Kanyuma, L. S. (2024). Faculty Adoption of Open Science and Their Practices Towards Data Sharing in Tanzanian Health Universities. *The International Information & Library Review*, *56*(4), 366–383. https://doi.org/10.1080/10572317.2024.2409600

EAC. (2024, April 29). A Big Win for East Africa with the Inclusion of Open Science in the EAC STI Policy. *East African Community (EAC)*.

EASTECO. (n.d.). *EAC Regional policy for Science, Technology and Innovation 2022—2033*. Retrieved June 23, 2025, from https://easteco.org/policy_strategy/eac-regional-policy-for-science-technology-and-innovation/

EIFL. (n.d.). Open access and open science in Tanzania. *EIFL*. Retrieved June 20, 2025, from https://www.eifl.net/eifl-in-action/open-access-and-open-science-tanzania

EIFL. (2022, September 22). First open science policy adopted in Congo. *Electronic Information for Libraries*. https://www.eifl.net/news/first-open-science-policy-adopted-congo

EOSC Portal. (2022). European Open Science Cloud Portal. *European Open Science Cloud Portal*. https://eosc-portal.eu

European Commission. (n.d.-a). European Open Science Cloud (EOSC). *European Commission*. https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/our-digital-future/open-science/european-open-science-cloud-eosc_en

European Commission. (n.d.-b). Open science in Horizon Europe. *European Commission*. Retrieved June 23, 2025, from https://rea.ec.europa.eu/open-science_en

European Commission. (2022, June 7). A European Strategy for Data. *European Commission*. https://digital-strategy.ec.europa.eu/en/policies/strategy-data

European Commission. Directorate General for Research and Innovation. (2018). *OSPP-REC: Open Science Policy Platform Recommendations.* Publications Office. https://data.europa.eu/doi/10.2777/958647

Farrow, R., Pitt, R., & Weller, M. (2020). Open Textbooks as an innovation route for open science pedagogy. *Education for Information*, *36*(3), 227–245. https://doi.org/10.3233/EFI-190260

Fecher, B., & Friesike, S. (2013). Open Science: One Term, Five Schools of Thought. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2272036

Fossner, A. (2021, July 29). Open Science Hardware Accelerates Innovation, Democratizes Science. *Drexel University College of Arts and Sciences*. https://drexel.edu/coas/news-events/news/2021/July/open-science-hardware-accelerates-innovation-democratizes-science/

Gideon, H., & Samzugi, A. S. (2024). The Role of Institutional Repositories in Facilitating Scholarly Communication at the Open University of Tanzania and University of Dar es Salaam. *University of Dar Es Salaam Library Journal*, *19*(1), 85–105.

Hagger, M. S. (2022). Developing an open science 'mindset.' *Health Psychology and Behavioral Medicine*, *10*(1), 1–21. https://doi.org/10.1080/21642850.2021.2012474

Harle, J., & Warne, V. (2020). *Open Access: Challenges and opportunities for Low- and Middle-Income Countries and the potential impact of UK policy* (p. 67). International Network for Advancing Science and Policy (INASP). https://assets.publishing.service.gov.uk/media/5f85aa45e90e0732a2448113/20-10-05_DFID_OA_in_LMICs_-_final_report.pdf

Hey, T. (2022). Open science and Big Data in South Africa. *Frontiers in Research Metrics and Analytics*, *7*, 982435. https://doi.org/10.3389/frma.2022.982435

International Science Council. (2022, March 28). The African Open Science Platform begins to take shape. *International Science Council*. https://council.science/current/blog/african-open-science-platform-takes-shape/

Jamali, H. R., Nicholas, D., Herman, E., Boukacem-Zeghmouri, C., Abrizah, A., Rodríguez-Bravo, B., Xu, J., Świgon', M., Polezhaeva, T., & Watkinson, A. (2020). National comparisons of early-career researchers' attitudes and behaviours towards scholarly communication. *Learned Publishing*, *33*(4), 370–384. https://doi.org/10.1002/leap.1313

Kaijage, Z. (2017, October). *Open data and open access landscape in Tanzania*. Africa Open Science Platform. https://www.slideshare.net/AfricanOpenSciencePl/open-data-and-open-access-landscape-in-tanzania

Kakai, M., Musoke, M. G. N., & Okello-Obura, C. (2018). Open-access institutional repositories at universities in East Africa. *Information and Learning Science*, *119*(11), 667–681. https://doi.org/10.1108/ILS-07-2018-0066

Kayungi, P. N., Ndenje-Sichalwe, E., & Manda, P. A. (2021). Academic Staff Awareness of Institutional Repositories (IRs) in Tanzania Universities. *University of Dar Es Salaam Library Journal*, *16*(1). https://www.ajol.info/index.php/udslj/article/view/215755

Knack, A. (2017). *Open science: The citizen's role in and contribution to research*. RAND Corporation. https://doi.org/10.7249/CF375

Laakso, M. (2014). Green open access policies of scholarly journal publishers: A study of what, when, and where self-archiving is allowed. *Scientometrics*, *99*(2), 475–494. https://doi.org/10.1007/s11192-013-1205-3

LIBSENSE. (2022). The LIBSENSE Initiative: Strengthening open access and open science in Africa. *Library Support for Embedded NREN Services and E-Infrastructure*. https://libsense.ren.africa/en/about-us/#about-initiative

Louderback, E. R., Gainsbury, S. M., Heirene, R. M., Amichia, K., Grossman, A., Bernhard, B. J., & LaPlante, D. A. (2022). Open Science Practices in Gambling Research Publications (2016–2019): A Scoping Review. *Journal of Gambling Studies*. https://doi.org/10.1007/s10899-022-10120-y

Mbughuni, A. S., Mtega, W. P., & Malekani, A. W. (2022). Exploring academic staff engagement in depositing locally produced research content in open-access

institutional repositories in Tanzania. *IFLA Journal*, *48*(4), 523–537. https://doi.org/10.1177/03400352211069157

Mgonzo, W. J., & Yonah, Z. O. (2014a). *A Review of Open Access Publication in Tanzania*. *8159*, 8159–8165.

Mgonzo, W. J., & Yonah, Z. O. (2014b). A Review of Open Access Publication in Tanzania. *International Journal of Engineering and Computer Science*, *3*(9), 8159–8165.

Mosha, N. F., & Ngulube, P. (2023). The utilisation of open research data repositories for storing and sharing research data in higher learning institutions in Tanzania. *Library Management*, *44*(8/9), 566–580. https://doi.org/10.1108/LM-05-2023-0042

Motshegwa, T. (2025). The African Open Science Platform: Implementing the African Open Science Vision. *Open Conference Proceedings*, *5*. https://doi.org/10.52825/ocp.v5i.1427

Muneja, P. (2023). Open Science and Policy Interface: The Tanzania Perspective. *East African Journal of Science, Technology and Innovation*, *4*. https://doi.org/10.37425/eajsti.v4i3.771

Muneja, P. S., & Ndenje-Sichalwe, E. (2016). Institutional Repository Initiatives in Tanzania: Opportunities and Challenges. *University of Dar Es Salaam Library Journal*, *11*(2).

Muneja, Paul. (2023, October 25). Tanzania: OA repositories & policies making impact. *EIFL*. https://www.eifl.net/blogs/tanzania-oa-repositories-policies-making-impact

Mwalubanda, J. (2021). The development of institutional repositories in East African countries: A comparative analysis of Tanzania, Kenya, and Uganda. *IASSIST Quarterly*, *45*(3–4). https://doi.org/10.29173/iq1012

Mwelwa, J., Boulton, G., Wafula, J. M., & Loucoubar, C. (2020). Developing Open Science in Africa: Barriers, Solutions and Opportunities. *Data Science Journal*, *19*(1), 31. https://doi.org/10.5334/dsj-2020-031

Mwilongo, K. J., & Kachota, B. (2023). The Role of Tanzanian Academic Libraries in Promoting Scholarly Communication through Open Access: A Literature Review. In University of Johannesburg & M. Frahm-Arp, *Academic Libraries in Africa* (1st ed., pp. 43–56). UJ Press. https://doi.org/10.36615/9781776460533-003

Nicholas, D., Boukacem-Zeghmouri, C., Rodríguez-Bravo, B., Xu, J., Watkinson, A., Abrizah, A., Herman, E., & Świgoń, M. (2017). Where and how early career researchers find scholarly information: How ECRs find scholarly information. *Learned Publishing*, *30*(1), 19–29. https://doi.org/10.1002/leap.1087

Nosek, B. A., Alter, G., Banks, G. C., Borsboom, D., Bowman, S. D., Breckler, S. J., Buck, S., Chambers, C. D., Chin, G., Christensen, G., Contestabile, M., Dafoe, A., Eich, E., Freese, J., Glennerster, R., Goroff, D., Green, D. P., Hesse, B., Humphreys, M., …

Yarkoni, T. (2015). Promoting an open research culture. *Science*, *348*(6242), 1422–1425. https://doi.org/10.1126/science.aab2374

Nunda, I. M., & Elia, E. F. (2019a). Institutional Repositories Adoption and Use in Selected Tanzanian Higher Learning Institutions. *International Journal of Education and Development Using Information and Communication Technology*, *15*, 164.

Nunda, I. M., & Elia, E. F. (2019b). Institutional Repositories Adoption and Use in Selected Tanzanian Higher Learning Institutions. *International Journal of Education and Development Using Information and Communication Technology*, *15*, 164.

Oaiya, O. (2022, May). *National open science policies in Africa*. UNESCO. https://www.unesco.org/sites/default/files/medias/fichiers/2022/05/National_and_Institutional_OS_Policies.pdf?TSPD_101_R0=080713870fab20005a9ba6ba3352144cb804f2b3cc007594f49fef1011a232276bab0c6dc19c0697087696887f143000cc3090d40a2aea2e4258328cf30326754cbaf75733e14666052ba91ea0926dd9860fd9092f0cf634db33b67250dec353

OECD. (2015). *Making Open Science a Reality* (OECD Science, Technology and Industry Policy Papers No. 25; OECD Science, Technology and Industry Policy Papers, Vol. 25). https://doi.org/10.1787/5jrs2f963zs1-en

Okafor, I. A., Mbagwu, S. I., Chia, T., Hasim, Z., Udokanma, E. E., & Chandran, K. (2022). Institutionalising Open Science in Africa: Limitations and Prospects. *Frontiers in Research Metrics and Analytics*, *7*, 855198. https://doi.org/10.3389/frma.2022.855198

Paic, A. (2021). *Open science—Enabling discovery in the digital age* (Going Digital Toolkit Notes No. 13; Going (Digital Toolkit Notes, Vol. 13). https://doi.org/10.1787/81a9dcf0-en

Participants of African Open Science Platform Stakeholder Workshop, S. 2018, Participants of African Open Science Platform Strategy Workshop, M. 2018, Advisory Council, A. O. S. P. P., Technical Advisory Board, A. O. S. P., Boulton, G., Hodson, S., Serageldin, I., Qhobela, M., Mokhele, K., Dakora, F., Veldsman, S., & Wafula, J. (2018a). *The Future of Science and Science of the Future: Vision and Strategy for the African Open Science Platform (v02)*. https://doi.org/10.5281/ZENODO.2222417

Participants of African Open Science Platform Stakeholder Workshop, S. 2018, Participants of African Open Science Platform Strategy Workshop, M. 2018, Advisory Council, A. O. S. P. P., Technical Advisory Board, A. O. S. P., Boulton, G., Hodson, S., Serageldin, I., Qhobela, M., Mokhele, K., Dakora, F., Veldsman, S., & Wafula, J. (2018b). *The Future of Science and Science of the Future: Vision and Strategy for the African Open Science Platform (v02)*. https://doi.org/10.5281/ZENODO.2222418

Personal communication. (2022, August). *1st Open Science Hardware in Tanzania* [Personal communication].

Rowley, J., Johnson, F., Sbaffi, L., Frass, W., & Devine, E. (2017). Academics' behaviors and attitudes towards open access publishing in scholarly journals. *Journal of the Association for Information Science and Technology*, *68*(5), 1201–1211. https://doi.org/10.1002/asi.23710

Samzugi, A. (2017). The role of institutional repositories in promoting grey literature in academic libraries in Tanzania. *University of Dar Es Salaam Library Journal*, *12*(2). https://www.ajol.info/index.php/udslj/article/view/184574

Siyao, P. O., Whong, F. M., Martin-Yeboah, E., & Namamonde, A. (2017). Academic libraries in four Sub-Saharan Africa countries and their role in propagating open science. *IFLA Journal*, *43*(3), 242–255. https://doi.org/10.1177/0340035217712263

Steinhart, G., Collister, L., Huang, C.-K. (Karl), Lippincott, S., Neylon, C., Riordan, D., Sellanga, J., Skinner, K., Thaney, K., & Tsang, E. (2042). *2024 State of Open Infrastructure: Trends in characteristics, funding, governance, adoption, and policy*. Invest in Open Infrastructure. https://doi.org/10.5281/ZENODO.10934089

Swan, A., & Brown, S. (2004). Authors and open access publishing. *Learned Publishing*, *17*(3), 219–224. https://doi.org/10.1087/095315104323159649

Tamrat, W. (2021, June 10). Open science's riches are still largely unexploited. *University World News*. https://www.universityworldnews.com/post.php?story=20210608060835101

TCC Africa. (2022, July 20). Advancing Open Science in Africa – three organizations collaborate to increase education and awareness with African Higher Education institutional Leadership. *The Training Centre in Communication (TCC Africa)*. https://www.tcc-africa.org/advancing-open-science-in-africa-three-organizations-collaborate-to-increase-education-and-awareness-with-african-higher-education-institutional-leadership/

Tennant, J. P., Waldner, F., Jacques, D. C., Masuzzo, P., Collister, L. B., & Hartgerink, Chris. H. J. (2016). The academic, economic and societal impacts of Open Access: An evidence-based review. *F1000Research*, *5*, 632. https://doi.org/10.12688/f1000research.8460.3

Thondhlana, J., & Garwe, E. C. (2021). Repositioning of Africa in knowledge production: Shaking off historical stigmas introduction. *Journal of the British Academy*, *9s1*, 1–17. https://doi.org/10.5871/jba/009s1.001

Tollefson, J., & Van Noorden, R. (n.d.). US government reveals big changes to open-access policy. *Nature Briefings*. Retrieved December 16, 2022, from https://www.nature.com/articles/d41586-022-02351-1

UNESCO. (2021). *UNESCO Recommendation on Open Science*. https://unesdoc.unesco.org/ark:/48223/pf0000379949.locale=en

UNESCO. (2023, December). Number of countries with open science policies has almost doubled since adoption of UNESCO Recommendation. *UNESCO*. https://www.unesco.org/en/articles/number-countries-open-science-policies-has-almost-doubled-adoption-unesco-recommendation

Voytek, B. (2017). Social Media, Open Science, and Data Science Are Inextricably Linked. *Neuron*, *96*(6), 1219–1222. https://doi.org/10.1016/j.neuron.2017.11.015

Zečević, K., Houghton, C., Noone, C., Lee, H., Matvienko-Sikar, K., & Toomey, E. (2020). Exploring factors that influence the practice of Open Science by early career health researchers: A mixed methods study. *HRB Open Research*, *3*, 56. https://doi.org/10.12688/hrbopenres.13119.1