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Open Science for Sustainable Development

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Introduction

Academic Librarians in Sri Lanka have been familiar with 'openness' for the last 25 years, since open-access publications entered the scholarly publishing industry. The National Science Foundation of Sri Lanka established its institutional repository in 2006, and from 2009 onward, universities and research institutions in Sri Lanka began establishing institutional repositories to support the trend of 'openness'. Through these repositories, librarians seek to showcase institutional and researchers' publications and make them openly available. We take advantage of openness to enhance the accessibility, visibility, and impact of research papers and to access scholarly information from various other open resources. However, the term 'openness' encompasses many paradigms that should be clearly defined, understood, and practiced.

Principles of openness vary according to context, including openness in scholarship, transparency, scientific norms, ethical obligations, freedom from cost, freedom of inquiry, authors' rights, users' rights, and openness in mindset. Openness in scholarship, knowledge production, and knowledge dissemination has been given much attention by knowledge workers, especially by librarians. As academic librarians in Sri Lanka, we aspire to open access because it reduces cost and access barriers and enhances the visibility of institutional research output. While broadly thinking about 'openness' over

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certain aspects, such as Open Scholarship and Open Science, we must be conscious of choices of some other aspects, too. Preliminary discussions with librarians indicated a lack of a common open science framework within Sri Lanka's higher education system.

Furthermore, Open Science and Sustainable Development are two different concepts that dominate the transformation of the world aspired to by the present and future generations. It is essential to conceptualize these two notions and to identify how they are interlaced. This paper describes these two concepts and the importance of their integration in the higher education sector. The dearth of literature relating these two concepts in Sri Lanka emphasizes the need for academic discourse at present. Therefore, this paper explores the principles, standards of practice, and policies regarding open access, open access publishing, open science, and open scholarship that have subtle differences, which seem a little challenging if they are not properly conceptualized. Through this oration, I aim to clarify various aspects of Open Science and sustainability and how academic libraries could contribute.

Objective

The objective of this study is to understand, conceptualize, and revisit the broader term Open Scholarship, and its successors, as Open Science and Open Access for sustainable development, in the context of policy formulation and standards of practice in academic libraries.

Specific Objectives

- Define and explain key terms and underpinning concepts associated with open scholarship/open science, open access, and sustainable development.
- Provide an overview of the most prominent models and initiatives that fall under the praxis of openness.
- Analyse how Open Science contributes to sustainable development in global and local scenarios.

- Identify the roles of academic librarians in implementing OS.

Methodology

This paper reviews the literature on 'Open Science' and 'Open Access' initiatives in Sri Lanka to evaluate the state of knowledge regarding the open access movement in the country. Furthermore, this paper reviewed the global-level research findings on 'Open Science ' and 'Sustainable Development' or 'Open Scholarship AND Sustainable Development' to investigate the effect of the relationship between these two domains. The results were used to map the development of this area in Sri Lanka over a decade and explore the global scenario regarding the necessity of open science for sustainable development.

Conceptual Review of Literature Open Scholarship

Open scholarship is an umbrella term that encompasses Open Science. According to Martin & Barbara (2022), "open scholarship includes open source software, open content licensing, open access to scholarly articles, open educational resources, open data, and citizen science".

Open Scholarship and Open Science are used interchangeably in much of the literature. Martin & Barbara (2022) have not differentiated the two concepts. They stated, "open scholarship is both a concept and a practice, and the assumptions about it vary depending on the context in which openness is discussed". Anyhow, Open scholarship and its underlying concepts are still a vague idea for many researchers. Hence, open scholarship is highly debatable for its complexity and multidimensionality. However, the philosophy behind this principle is mostly beneficial to the academic community. Open scholarship has become the new paradigm of scientific communication. The term refers to "teaching and research practices that espouse openness. This means "a collection of emergent scholarly practices that espouse openness and sharing, including open access, open publishing, and open education" (Veletsianos and Kimmons, 2012, p. 167).

Open Scholarship Practices (OSP) are defined as follows.

"OSPs refer to a broader movement to make both the process and output of scholarship more transparent and widely accessible (Dienlin et al., 2021; Lewis, 2019). Further, it was described as 'open scholarship is multifaceted and consists of a wide array of principles, values, and practices around procedural transparency and social inclusion in scholarship" (Rinke & Wuttke, 2021).

Open scholarship applies open principles to all academic disciplines, not just sciences, but including humanities, social sciences, arts, and education. Open scholarship is dynamic and ever-changing. It includes everything in open science, plus open educational resources (OER), open teaching materials, open pedagogy, public scholarship, digital humanities projects, community engagement, etc. The following section describes the Open Science principles and practices.

Open Science

According to Martin & Barbara (2022), "Open Science (OS) is a global movement that aims to make open scientific research and data". Open Science, open scholarship, or open research broadly refers to the movement to improve science's replicability, reliability, reproducibility, transparency, and robustness of science (Munafò et al., 2017; Nosek et al., 2015).

Open Science is defined as follows.

> An inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible, and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation, and communication to societal actors beyond the traditional scientific community.(UNESCO, 2021, p. 7)

Further, according to the UNESCO toolkit (2021), Open Science has four key pillars; they are open scientific knowledge, open science infrastructures, science communication, open engagement of societal actors, and open dialogue with

other knowledge systems. The phrase “open science” is the broadest term that encompasses related concepts, such as open data, open access publishing, open-source software, source code, open hardware, and open pedagogy. Open Science is the movement to make scientific research, data, and dissemination accessible to all levels of an inquiring society, amateur or professional. Similarly, open knowledge is knowledge that one is free to use, reuse, and redistribute without legal, social, or technological restriction. Openness in each and every perspective has created innovative approaches. Digital technologies and their rapid development in capacity are the key drivers of open science.

Open Science specifically promotes openness throughout the entire research process. This covers open access publications, open data, open code and software, open methodologies, open peer review, preprints, and reproducibility practices. Thus, open science is broader than open access.

UNESCO Recommendation on Open Science describes the associated benefits and challenges. It clearly shows the diverse path. Member States are encouraged to prioritise even areas in their implementation. It recommends the following to member states;

- Developing an enabling policy environment for open science
- Investing in infrastructure and services that contribute to open science
- Investing in training, education, digital literacy, and capacity-building to enable researchers and other stakeholders to participate in open science
- Fostering a culture of open science and aligning incentives for open science
- Promoting innovative approaches to open science at different stages of the scientific process
- Promoting international and multistakeholder cooperation in the context of open science with a view to reducing digital, technological, and knowledge gaps.

Open Science emphasizes that all research processes, from proposal,

methodology, data collection tools, analysis, findings, open review, and publishing in an open-access outlet, and the final product should be transparent and follow open access practices. So, equity, diversity, and inclusion are the core principles of open science. Open Science aims to open the creation, evaluation, and communication of scientific knowledge to marginalised scholars and societal actors beyond the traditional scientific community.

Many funding organizations require that the research findings resulting from the research grant be made publicly available. Rather than universal access, the open science emphasizes universal participation in developing and creating knowledge via practicing openness in each and every process. For instance, a traditional peer reviewing process is well known as 'blind peer review' in which the researchers and reviewers do not know each other, but in the review process under open science, they are mutually known. So, Open Science is a far more advanced practice than open access publishing. Indeed, it reduces the tension of researchers after sending the manuscript/s to the journal editors or after uploading the manuscript/s to the journal portal/home page. Generally, during a considerable time (may be several months), researchers are blind, and they don't know what's going on until they are rejected or get suggestions to revise or are accepted.

The distinction between Open Science and Open Scholarship remains ambiguous. A popular textbook on ' The Complete Guide to Open Scholarship' authored by Martin, Victoria, in 2022 has also not differentiated these two terms, and Walton (2023) mentioned in his review that they were developed concomitantly with a similar set of principles. It is observed that the author used these two terms interchangeably. The following section briefly describes the successors of Open Science, such as open access (OA) research, open educational resources (OER), and open data.

Open Access (OA)

The elements, norms, values, boundaries, and related scientific terms of open science have a broad scope, but open access is comparatively limited to certain perspectives only. OA is based on transparency, accessibility, usability, and reliability of scholarly outputs. OA mainly includes open access content in terms of open access research and open educational resources. The content areas are Open Access Journals, Open Repositories, Open Monographs, Open Education, and Open Publishing Resources.

The OA publishing model gained momentum in the early 2000s when three declarations, namely the Budapest Open Access Initiative, the Bethesda Statement on Open Access Publishing, and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, commonly known as the BBB declarations, transformed and shaped the publishing environment in successive decades. OA makes research publications openly available by removing unwarranted impediments such as subscription charges, as well as copyright permission to use, modify, and reproduce. Librarians must disseminate information for the widest community in this regard.

Open Access Models

There are three main strategies for attaining OA to scholarly literature. One is publishing in an OA journal (gold OA), the second is publishing in a hybrid journal (hybrid OA), and the last is self-archiving (green OA). The gold route to open access deals with publications in OA journals, which are peer-reviewed and are accessible through the internet without charges. The green route to open access is self-archiving. The published research paper or the manuscript before publishing is archived in an open-access online repository. However, many journals apply an embargo period to archive the papers. Hybrid journals follow two business models: publishing open access (openly available to readers) and the subscription-based model. Mostly, these types of journals allow paid access to the papers that don't have an open-access option. Some researchers hesitate to publish in open-access journals as they charge a certain amount of money.

Generally, most open-access journals do not earn money via subscription; hence they collect an Article Processing Charge (APC) from author/s. However, developing countries like Sri Lanka rarely support researchers in paying APCs for OA publications. Therefore, researchers in those countries struggle to enjoy the benefits of OA publishing and enhance the visibility of their publications. Institutions should support local researchers to select OA outlets and provide funding for publishing. The attitudes of many researchers, especially academics, are not good towards this movement, as they think open-access journals do not adhere to the peer review process and ethical guidelines. Academic Librarians must educate researchers and make them aware of the benefits of open access to individual researchers and institutions.

Legal Framework of Open Access

There is a misconception that open-content licensing undermines copyright law. To the contrary, it strengthens it, and works released under an open content licence are nevertheless copyrighted. The licensor must be the copyright holder to the work being licenced, and the grant of rights included in the licence must last for the duration of the work's copyright. In this context, it is important to note that researchers are often vexed by copyright law. The duty of academic librarians is to teach them regarding the legitimacy.

The legitimacy of OA publishing is bound up with Creative Commons copyright licences. Martin (2022) calls upon the "Five Rs" that govern Creative Commons licensing: the ability to Retain, Reuse, Revise, Remix, and Redistribute material. The legal framework of Creative Commons licensing is categorized into different criteria. The details of the criteria, based on the requirements of the content/ researcher/ institution, can apply for the licence by selecting a specific badge and obtaining it.

A research study (Pownall et al. (2021)) conducted among early-career PhD researchers of the psychology stream revealed that they have different opinions and limited knowledge and practices towards Open Science. This study recommends the necessity of integrating Open Science in training /educating

early career researchers to create a culture of Open Science practices among evolving/ developing researchers. This recommendation was supported by many previous studies, too. Pownall et al. (2021) stated, “teaching should include open science history and background; tools and practices, as well as critiques of open science”.

Open Educational Resources (OER)

OER have evolved based on the same principles and ideals of open scholarship. These principles are mainly freedom, collaboration, and sharing. OER aims to enhance the value of knowledge sharing by reducing the cost and access barriers for teaching and learning materials. OER is based on a philosophy that knowledge is a public good and the technology, the World Wide Web, supports the use, reuse, and sharing of knowledge. OER refers to learning content that can be freely and openly used and reused by anyone without the need to request permissions from copyright holders or to pay licence fees or royalties. Learning content can include any material designed for use in teaching and learning” (Martin 2022, p. 72). She further highlights three benefits of OER. They are as follows.

- lower cost to students,
- protection of the intellectual property rights of its creators, and thus
- removal of access barriers to copyrighted material.

OER should therefore be used to increase access to open science educational and research resources, improve learning outcomes, maximize the impact of public funding, and empower educators and learners to become co-creators of knowledge. It further emphasized that “education is about sharing knowledge; thus, openness is inherent in education”. Catherine Cronin (2017, p.16). Further, data sharing and knowledge sharing are two different concepts, but integrated. Let's see what open data is in the following section.

Open Data

Data that can be freely used, re-used, and redistributed by anyone; subject only, at most, to the requirement to attribute and ShareAlike (Open Data Handbook). Open data must be as follows.

1. legally open, i.e., available under an open content licence,
2. technically open, this is machine-readable, available in bulk, and provided in an open format

The Open Science Training Handbook defines open data as data that can be "freely accessed, reused, remixed and redistributed, for academic research and teaching purposes and beyond" and that "ideally, have no restrictions on reuse or redistribution, and are appropriately licenced as such" (Bezjak et al., 2018, p.19). Principles of Open data are mainly known as FAIR, which means Findability, Accessibility, Interoperability, and Reusability. The FAIR principle does not always make the data freely available, as data might be sensitive, proprietary, and private. It allows data sharing and reusability with legitimate concerns of confidentiality and intellectual property.

In addition to the FAIR principles, Panton Principles, and the Eight Principles of government data are essential to follow by the data repositories. The four Panton Principles can be summarized as follows:

- Data should be accompanied by a precise and irrevocable statement that clearly describes the terms and conditions for the data reuse and repurposing.
- Data should be licenced under a data-appropriate licence.
- Data should not be licenced under a licence that prohibits the commercial use of data or the creation of derivative works [emphasis added].
- Publicly funded data should be placed in the public domain.

In addition to these recommendations, the Panton Principles provide specific guidance for scientists on licensing their data and for placing their data in the public domain. Eight principles of government data have the attributes of Complete, Primary, Timely, Accessible, Machine Processable, Nondiscriminatory, Nonproprietary, and License-Free. Consequently, the National Research Council, the National Science Foundation of the UK, the National Institute of Health, and the Bill & Melinda Gates Foundation made it

mandatory that all research data should be made available for public access if the research is supported by public funds.

Journal editors also request that data related to a specific manuscript be uploaded, based on the guidelines given by the Transparency and Openness Promotion (TOP) committee. This is to get rid of the credibility catastrophe. TOP guidelines are included in the editorial policy of reputed journals such as 'Science', 'Nature', 'British Medical Journal', 'Lancet', 'Journal of the American Medical Association', 'Giga Science', and 'New England Journal of Medicine', etc. At present, publishers like Elsevier, Springer Nature, IEEE, and Taylor & Francis have also introduced data-sharing policies. Along with the review process, the data used for the specific research is being evaluated and archived by the publishers. This gives more reliability and trustworthiness to the research findings.

Open data repositories have tremendously grown across the globe; for instance, the Registry of Research Data Repositories in the world (https://www.re3data.org/). CODATA, GOSC, and country-wide data repositories are established and well underway in data sharing practices. Open data repositories are used for storing, finding, using, reusing, and sharing data. For this purpose, the legitimacy is considered by the '*Open Data Commons Attribution Licence '* and the "*Open Data Commons Open Database License"*.

Open Source Code

Generally, source code that shows the instructions on how to produce the specific software is hidden from public access. The reason behind this is purely commercial. Usually, vendors do not allow the source code to be freely available due to fear of their competitors and losing profits. Therefore, a closed-source system was practiced and based on licenced source code, which becomes accessible to a limited audience. This conservative approach was a great challenge to Computer Scientists, researchers, and students. This restricted software developers from further expanding or developing a specific project.

According to Martin (2022), the Free Software movement was pioneered

in the 1980s by Richard Stallman. In 1983, he announced his intention to create a new Unix-compatible software operating system and make it freely available to anyone who wanted to use it. Subsequently, the GNU and Linux operating systems were developed. The term 'open source' was coined by Christine Peterson in 1998. Then, Dr. Bruce Perens (1999), the leader of the Debian project (Linux), and Eric Raymond (1999), in Martin (2022), introduced open source code for the software developed by their projects. The policy behind this initiative is freedom and justice, as well as practical advancement.

"The development of free software and open source software is a community-driven dynamic production process where the boundaries between creators, users, and testers are blurred. This process presents powerful advantages compared to proprietary software", Martin (2022).

The advantages include flexibility, strong community culture, protection against third-party attackers, defense against malicious functionalities, freedom from vendor lock-in, and cost optimization. Open-source code is rapidly developing across the globe at present. Though it has many advantages as mentioned above, it still has some blurry challenges, such as code forking, issues in assuring quality, coordination, difficulty in use, licensing, and hardware compatibility.

Open source is usually a pragmatic focus. Free software and open source software (FOSS) are developed from an ethical perspective with a policy of freedom or liberty, but not always free of cost. Using proprietary software is seen as a restriction on human freedom to run, study, redistribute, and modify the software. FOSS has a great impact on the advancement of software development. Journal publishers, especially peer reviewers, actually check the code repository for a licence file. They also request source code similar to research data to evaluate their research findings, for instance, the Journal of Open Source Software (JOSS), SoftwareX (Elsevier), Geoscientific Model Development (GMD), and PLOS Biology, etc. The next section briefly describes Citizen Science, which has a direct impact on Openness.

Citizen Science

Citizen Science allows public participation in scientific research. Generally, research is carried out by scholars, and access to the processes is limited until the open science movement grew. Through open science, the research processes, findings, peer review process, and publications are kept open so that any interested citizen (even a non-scientist) can access them. It facilitates the general public to view and participate in the research process. Citizen Science encourages public participation in research activities and is closely associated with Open Science. Therefore, if science becomes a public good, it is possible through Open Science, as these two are interrelated. Anoma & Seneviratne (2026) found that libraries could support Citizen Science via open access to knowledge resources and establishing data repositories. In the emerging domain of citizen science, librarians play a pivotal role, acting as connectors, facilitators, educators, and data curators."

Chew et al. (2023) indicated the first general statement on Open Science as "the best practice of Science is OS. Science is primarily meant for the public good of SDGs, not for selfish gain". Let's see the basic ideas of SDGs in the following section.

Sustainable Development Goals

The United Nations (UN) adopted 17 Sustainable Development Goals (SDGs) at the United Nations Sustainable Development Summit in New York in September 2015. Altogether, the 17 goals include 169 targets. To evaluate the success, they have identified 244 indicators. SDGs have attracted immense attention from the whole world, as it is a universal agenda to transform the world. The 2030 Agenda frames sustainable development around five broad areas: people, planet, prosperity, peace, and partnership. The 193 countries that took part in the convention have included these 17 goals in their own developmental agendas. SDGs consider mainly three aspects, such as Economic, Social, and Environmental perspectives.

Open Science is increasingly recognized as an accelerator for the implementation of the SDGs. The interactions between open science and the SDGs are not sufficiently clear. However, the contribution of Open Science Principles and practices supports attaining the SDGs. Tennant et al. (2020) stated that "open science allows policymakers, researchers, innovators, and the general public to access and use scientific information without barriers, accelerating the achievement of the SDGs". This paper explores the means and ways in which libraries would contribute to transforming the world.

Research Gap

Even though a few studies have been carried out in Sri Lanka on 'Open access', they are limited to 'Open Scholarship' or 'Open Science'. So far, the participation and contributions of our researchers in Open Science practices other than open access publishing and archiving have not been studied. Therefore, there is a shortage of understanding in the literature regarding the Open Science Movement in Sri Lanka, the awareness level of academics, and especially academic librarians, and practical contributions related to establishing open data repositories, open research processes, open peer review, and the relationship to sustainable development. Open Science and sustainable development were rarely found in LIS literature in Sri Lanka, except for a published feature article (Mashroofa, 2023).

Furthermore, there is a dearth of literature relating to open science/ open scholarship and sustainable development. Even though a few papers discussed certain aspects of sustainability, for instance, Open Educational Resources (OER) and Sustainable development (Lane, 2017), OA platforms for Climate action and quality education (Johnstone, 2022), the whole aspects of sustainable development are not covered except in 'Statements on Open Science for Sustainable Development', Chew et al. (2024). Therefore, this discourse attempts to fill this gap in the literature, which primarily targets Open scholarship and its successors, such as Open Science, Open access, and their integration towards sustainable development.

Results and Discussions

Current landscape of Sri Lanka

The first paper published in Sri Lanka in this concept was on "Open access revolution: is it a paradigm shift of scholarly publishing practices", (Mashroofa, 2015) discussed the historical development of open access movement, open access business models and scholarly publishing trends, quality and technical characteristics of open access journals, repositories, mandates of funding agencies across the globe and concluded with a question of 'where is Sri Lanka in this movement ?'. Through another paper on Open access initiatives and institutional repositories: Sri Lankan scenario (Mashroofa & Seneviratne, 2016) explored DOAJ, OpenDOAR, and SLJOL and found that there were 60 locally published journals available online through SLJOL, but only 10 journals have been indexed in DOAJ. This study further identified that, though there are 23 institutional repositories in Sri Lanka, only seven repositories were registered in OpenDOAR.

While comparing the results in February 2026, after a decade, through a preliminary study by this researcher, SLJOL has 169 journals, and 31 journals are indexed in DOAJ. Considering the registered repositories, 09 is registered in OpenDOAR. It seems that over a decade, 109 journals and around 28 repositories were developed in Sri Lanka, but the ratio of indexing in DOAJ and registration at OpenDOAR remains slowly progressing. Ranasinghe & Chung (2019) have researched 'open access journal publishing in Sri Lanka' and explored the related issues in this venture.

Apart from the term 'open access', there are some other papers (Wanigasinghe, 2017; Seneviratne & Peiris, 2023) that discussed the success story and the state universities' contribution to the Sri Lanka Journals Online (SLJOL) platform, which was established with the intention of enhancing open access publications in Sri Lanka. Shiva Kumara (2025) studied trends and growth of open access research in Sri Lanka by analysing 2015-2024 data from SCOPUS and identified that "OA publications had significantly increased, from 686 in 2015 to 1,771 in 2024, and this growth underscored a growing commitment to

OA publishing" by Sri Lankan researchers. So far, the participation and contributions of the Sri Lankan researchers in Open Science practices other than open access publishing and archiving have not been studied.

Integration between OS and SDGs

Access to information is a basic requirement for all human beings, beyond the scientific community. Access to information may not always be part of the research/ scientific process, but rather this may be cultural, indigenous, or a local knowledge system. Citizen science has now expanded the concept of information to everyone. In this regard, Open Data, Open Source software, Open hardware, Data repositories, and knowledge repositories serve the general public as well as the Scientists. Research data repositories of the world do not include any research data repository of Sri Lanka (re3data.org (2026)).

Especially, data sharing is the global trend at present in achieving the SDGs. The National Aeronautics and Space Administration (NASA) has established a centre for Earth Science data https://www.earthdata.nasa.gov/technology/open-science. In this venture, the International Research Centre for Sustainable Development Goals, located at the Chinese Academy of Science, Beijing, China, has launched a satellite on 05 November, 2021, which sends data to the centre regarding the forest cover, crop cover, mangrove area, global temperature, water resource data, carbon emissions, land degradation, etc. The SDG indicators are progressing well under this project. They have created a platform for big data, which is available at https://sdg.casearth.cn.

Furthermore, the Committee on Big DATA (CODATA) has also taken this challenge to accelerate activities related to SDGs through the sharing of data. Global Open Access Cloud (GOSC) is another project undertaken by the Chinese Academy of Sciences in collaboration with CODATA. Many other developed and developing countries are marching forward in attaining SDGs through OS. India, Malaysia, and Africa have developed many open data repositories to archive and

showcase research data. Sri Lanka has shown little interest in this except for open-access publications. Discussions with a few academic librarians also showed that their interest was in publishing research papers in open-access outlets and archiving them at the institutional repository. University Librarians in Sri Lanka have to initiate actions to develop their data repository and a central repository for the country. This data repository must be registered at the global Registry of Research Data Repositories. A few members have been aware of the open peer review processes. However, the contributions of open science towards attaining SDGs are not very familiar to them.

Contribution of Open Science to Sustainable Development

All 17 Goals of the SDGs emphasize access to data, information, and knowledge from different perspectives. The UNESCO Recommendation on Open Science explicitly links these two concepts and argues that scientific progress is not only for those who can afford it but also for all human beings. Citizen Science emphasizes the involvement of the general public in scientific research activities. The Open Science Statement, Chew et al. (2024), has depicted clearly the two aspects.

Third International Forum on Big Data for Sustainable Development Goals (FBAS, 2023), hosted in Beijing, China, by the Chinese Academy of Sciences, the Committee on Open Data (CODATA), and others from August 28th to September 1st, 2023, discussed and recommended essential statements related to Open Science and SDGs. Participants of an International Training Workshop on 'Open Science for Sustainable Development Goals'-2023, organized by the Committee for Open Data (CODATA), CASEarth, UNESCO, and Global Open Science Cloud (GOSC) of the Chinese Academy of Sciences, published the recommendations as 'Statements of Open Science for Sustainable Development Goals' (Chew et al., 2024). This paper includes 20 statements that could apply to all 17 goals. (Refer to the annexure).

Altogether, to transform the world in 2030 according to the UN's agenda, the concept of 'openness' is essential as policy, practice, and legacy.

Conclusions and Recommendations

Based on the understanding of open scholarship, open science, open access publishing, archiving, open data, open source code, and OER, as they are all practiced to ensure equitable and inclusive access to the research process, scientific publications, data, educational resources, and knowledge, this study identified the necessity of open science towards sustainable development. Furthermore, Open Science empowers Citizen Science and timely supports evolving challenges related not only to scientific issues but also to social, economic, political, and climate issues. Open Science is tremendously contributing to all 17 goals of sustainable development. Therefore, the trend is highly embraced and practiced at the global level, but is limited at the national level. Even though open access publishing and archiving have considerably grown, the other aspects of the open scientific research process and open data seem limited.

This paper recommends that each institution should establish an open data repository, similar to an institutional repository. Further, this study recommends that academic librarians take action to develop such an institutional data repository and a national-level data repository. Furthermore, this study recommends educating the researchers of research institutions and universities regarding open science policies, the ethos of openness, and tools to motivate them to engage in open science practices for the betterment of the country. This study implies to formulate an Open Science framework, policy and standard practices that must be mandated to all higher education and research institutions of Sri Lanka.

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Annexure

Statements on Open Science (Chew et al.2024)
https://datascience.codata.org/articles/10.5334/dsj-2024-049

1. The best practice of science is OS. Science is primarily meant for the public good of SDGs, not for selfish gain.

2. When paired with equitable access to the benefits of OS and data reuse, OS can fulfil every human's fundamental right to science, scientific processes, knowledge, and related benefits.

3. OS encompasses data that are as open as possible and as closed as necessary to enable all stakeholders to benefit from the fair, ethical, and equitable reuse of data to address local and global problems in keeping with local and shared values.

4. OS does not mean indiscriminate openness or free of cost. Consent for data reuse, privacy-preserving approaches to the reuse of sensitive data, and licences that enable individuals and groups to retain their rights in data (i.e., intellectual property) must be considered to ensure the equitable distribution of rights derived from OS approaches.

5. Free research/scientific products for the SDGs advocate the use of copyright to force the openness of the products. Authors of free works should be treated equally to those of closed works.

6. The openness of OS must benefit and involve the needful community within every country, not just that of a specific gender, country, or region in the world, with an effect on the disadvantaged group in certain SDGs.

7. OS engages the public in scientific research to produce sound evidence and valuable data that progress towards SDGs.

8. Common sense must prevail over the scientific approach in quickly and safely mitigating urgent problems in certain SDGs.

9. Science should be applied to resolve problems that hamper SDGs in the most effective, efficient, acceptable, and sustainable ways.

10. Recognizing that science cannot solve all human problems in the SDGs, a more holistic approach might be needed.

11. To accelerate the achievement of SDGs, all research endeavours must be relevant to the SDGs, from problem identification to study designs, implementation, monitoring, and evaluation.

12. Science for SDGs must be conducted with utmost integrity throughout its whole process.

13. Useful scientific evidence for SDGs is only produced following rigorous methodology.

14. All scientific research must undergo an open and collective process, including using shared knowledge infrastructure to improve relevance and efficiency towards the SDGs.

15. All research products and findings must be freely available (UNESCO and CCUNESCO, 2022; Wilkinson et al., 2016) and made easily understood and useful to all by committed and continuous support, with due respect to proper acknowledgement to the owner, the local legal system, and intellectual property rights.

16. Science outputs for the SDG agenda must be timely and effectively communicated by all appropriate means to the target and research communities.

17. When available, scientific evidence must be translated into practice and implemented as soon as possible for the respective SDGs.

18. Outline and execute policy in a consistent investment, and manners at all levels to enable adequate OS infrastructures and human capacity for all SDGs.

19. Assess scientific contribution towards SGDs and career progression of researchers by rewarding good OS practices, research outputs including high-quality FAIR (Wilkinson et al., 2016) and metadata, well-documented and reusable software, protocols and workflows, machine-readable summaries of findings, teaching, outreach, and engagement of societal actors with qualitative evidence of research impact and knowledge exchange, influence on policy and/or community, and engaging in open innovation with partners beyond academia, rather than quantity of publications and journal impact factors, and/or the amount of funding.

20. Promote creative solutions and innovation towards SDGs by ensuring the security of living spaces, embracing digital technology, big data, and artificial intelligence, respecting personal intellectual property, and effective commercialization and business model.