



# OPEN SCIENCE IN CHINA: AN OPEN OR CLOSED CASE

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China's place in the global system of science has become increasingly prominent. In 2016, China published the highest number of scientific articles and in 2022 it was home to the most cited papers.<sup>1</sup> However, whether the world's population can access and benefit from these scientific outputs largely depends on them being openly available. Academic and governmental institutions, as well as the public, connect the open science (OS) movement with two main practices, the publishing of open access (OA) research articles and sharing open data. Since the early 1990s, OS has been an umbrella term used to refer to all the different technology-enabled initiatives to strengthen openness, one core ethos of science.<sup>2</sup>

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The development of China's OS (开放科学) impacts both China, and the rest of the world. The fact of whether scientific articles and research data from China are published as OA, will affect first, whether a major part of scientific knowledge will be open to the world and second whether through open data, research done in China will become increasingly transparent. These instances make a difference on a global level as China is one of the leading countries in science, research, and article publications. For instance, in the cases of the COVID-19 pandemic or the triple planetary crisis, e.g., pollution, the climate crisis, and biodiversity loss, global access to the most up-to-date scientific knowledge and data remains an essential instrumental first step for collective mitigation efforts.<sup>3</sup>

Governments, institutions, and individual scholars see a number of benefits from OS, for instance, the democratization of knowledge production and steps to make scientific research more transparent and reproducible.<sup>4</sup> As nations recognize these benefits, the EU and US strongly foster OS practices, while China's OS development appears modest. Although China has several decades of national OS initiatives and widespread support behind it, the outcomes of OS appear low. The Chinese government's attitude towards OA publishing and open data can be seen as contradictory. Even though the government appears to be motivated to make research accessible to the public, it also views OA research as a national security risk.<sup>5</sup>

This Observations paper will focus on the past two decades of OA publishing and open data in China. By doing so, the paper will demonstrate China's ambitions and progress in participating in the large-scale movement of OS currently emerging in global academic systems around the world.

## A Brief History of Open Science Around the World

The early moments of the OS movement can be traced back to the early 1990s Anglo-American private sector, as the first preprint archive, arXiv was established in the US in 1991, and the first OA publisher, BioMed Central, in the UK in 1999. Individual companies used to be the frontrunners of OS, but nowadays that role has shifted to the public sector. One of the most significant reasons for this shift was that governments wanted publicly funded research results to be available to taxpayers. Initially the UK and the US paved the way for OS but from the 2010s on, as a result of a long-term policy development, the EU took the lead and launched its Plan S in 2018, an initiative that ensures all publicly funded research articles from 2021 are published OA.<sup>6</sup> In a similar move in August 2022, the White House Office of Science and Technology Policy (OSTP) determined that the results of publicly funded research should also be made immediately available to US citizens.<sup>7</sup> In China the OS movement has been enjoying gradual institutional support since the early 2000s led by academic libraries and the Chinese Academy of Sciences (CAS)<sup>8</sup>. After UNESCO published The Recommendation on Open Science (2021), an international standard-setting instrument on OS, many governments, including China, signaled the importance of putting OS on their policy agenda.<sup>9</sup>

The recommendation can be considered a historical milestone for OS, giving it global legitimacy. It resulted from "a regionally balanced, multistakeholder, inclusive and transparent consultation process," in which China was also included. In 2021, UNESCO Member States adopted the recommendation, a normative, globally shared, modern code of conduct and ethics framework of

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high-quality science that aims to foster human rights and global equality.<sup>10</sup> China's involvement in the creation of the recommendation as well as several smaller governmental initiatives indicate that OS is taken seriously on a governmental level.

## An Optimistic Decade for China's Open Access and Open Data Development

Around 2010, several scholars (e.g. Zhang 2014; Ren and Montgomery 2015; Montgomery and Ren 2018) deemed China's open data led OS development as promising.<sup>11</sup> China joined the World Data Center in 1984 and the World Data System in 1988, earth sciences' global joint data center.<sup>12</sup> Large-scale OS development in China, however, first began in 2001, with the launch of a national Scientific Data Sharing Project. This started the construction of scientific data sharing centers, that initially shared data from meteorology, forestry, and agriculture.<sup>13</sup> Another significant governmental open data milestone was The Outline of the National Medium- and Long-Term Science and Technology Development Plan (2006–2020) that mentioned establishing an open mechanism for sharing scientific data and resources.<sup>14</sup> Also, the launch of the regulation Measures for the Management of Scientific Data (MMSD) in 2018 was significant as it stated that government funded research data should be shared and “used in accordance with the principle of openness” while “following hierarchical management, safety and control.”<sup>15</sup> Although these government level initiatives fostering open data are impressive, policy implementation still remains in its infancy.<sup>16</sup>

In 2013, CAS and the Natural Science Foundation of China (NSFC) endorsed the Global Research Council's Action Plan toward Open Access to Publications. In his article, Dr. Zhang from the National Science Library of CAS stated that “MoST, CAS, NSFC, are all currently working on detailed OA policies, and it is expected that high-level policies with far reaching impact could come into force soon,” expressing strong optimism about the development of OA.<sup>17</sup> In 2016 the Confederation of China Academic Institutional Repository (CHAIR) was founded and CAS established ChinaXiv—a repository for preprint articles—and expressed strong optimism about the OA development.<sup>18</sup> Since then, scientific institutions have made some developments, for instance in 2018 a number of significant libraries e.g., National Science and Technology Library (State Council), National Science Library (CAS) released a public statement in support of the EU's Plan S.<sup>19</sup> However, since that statement no significant national OS policy comparable to Plan S has been launched.

## Open Science's Growing Presence in China from 2020

The government's science policy promoted OS in key policy documents, highlighting its importance in documents such as the revised Science and Technology Progress Law of the People's Republic of China 2021 (中华人民共和国技术进步法, 2021年修订科学): “The state strengthens the construction of academic journals, improves the exchange mechanism for scientific research papers and scientific and technological information, promotes the development of open science, and promotes the exchange and dissemination of science and technology,” (Article 94).<sup>20</sup> On top of this, six additional articles of the same law mention OS, two articles refer to OA publishing, five mention open data practices, and three reference science communication and outreach (i.e., popularization of science).

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Other than policy documents, OS enjoys increasing institutional acceptance based on a new consortium. The Open Science Promotion consortium (OSPC) was established in 2022 by the China Association for Science and Technology (CAST). The OSPC, which includes Chinese and foreign organizations related to OA publishing, open data, and OS infrastructure construction, was created “to respond to UNESCO's Open Science Recommendation to promote the in-depth practice of OS in China and the world.”<sup>21</sup> No exact plan, however, to launch an OS policy has been voiced from the OSPC yet.

## China’s Comparatively Modest OA and Open Data Development

Although the past two decades in China have brought optimism around OS, the government’s speed and readiness has been lacking when it comes to implementation. For some time now China has acknowledged OA as important, but in practice there are few parallels with the initial excitement and the policy attention it received. According to recent research by Zhang et al. (2022), using Web of Science data (available mostly in English), China’s degree of OA publishing scores lowest when compared to the USA, UK, Norway, Netherlands, and France.<sup>22</sup> The STM Association’s 2022 publication statistics (based on Scopus data) lists China as the biggest publisher of OA articles in absolute numbers with 337,611 OA articles, the US, in second place published 226,013 OA articles. The percentage of OA publications, however, paints a different picture, as China’s total scientific output was 38 percent OA in 2022 which, compared to the 54 percent in the US or 68 percent in Germany, highlights the potential China has to increase its OS practices.<sup>23</sup>

What’s more, China is not a leading country in open data development. According to Li et al. (2022) who used the Re3data registry of scientific research data repositories, China ranked 12th with 48 registered repositories, whereas the number one was the US with 1136 repositories in 2021.<sup>24</sup> In addition, the current data from the Directory of Open Access Repositories (DOAR) reporting data and journal repositories, paints the same picture. In 2023, China, with 65 listed repositories, ranked 22nd whereas, the US, ranked 1st, has 925 listed repositories.<sup>25</sup> The Re3data and DOAR repositories are available in English and Chinese and include journal articles and research data.<sup>26</sup> As China is the world’s largest producer of scientific articles, one may expect its ranking to be higher.<sup>27</sup>

One central player that determines access to scientific articles and data is the China National Knowledge Infrastructure (CNKI, 知网). It is the largest journal and research database in China housing approximately 95 percent of the Chinese academic resources, of which 40 percent sit behind a pay-wall<sup>28</sup>(21世纪经济报道 2022). The Chinese academic community has complained for some time about CNKI’s IP misconducts as well as high subscription fees.<sup>29</sup> Criticism of CNKI’s subscription fees and paywalls echo those of European academics that ultimately catalyzed the Plan S. In April 2022, CAS complained about CNKI’s high subscription fees and suspended its use.<sup>30</sup> In May 2022, the Chinese government intervened as the State Administration for Market Regulation of China (SAMR) launched an antitrust investigation into CNKI without further elaboration on the causes.<sup>31</sup> The investigation was reportedly related to the increasing subscription fees, and one month later the CNKI made its plagiarism-checking services free of charge.<sup>32</sup> Finally in December 2022 CNKI was fined 87.6 million yuan for abusing its dominant market position.<sup>33</sup> These outcomes seem to illustrate the importance that the government assigns to OA and affordable subscription fees for the wider public. The outcome of a recent China Cyberspace Administration (CAC) investigation into CNKI,

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however, directly contradicts the attention given to OA and deems it a national security risk. An investigation was launched for "preempting security risks of national data, protecting national security and safeguarding public interest" in June 2022.<sup>34</sup> According to the CAC, CNKI comprises "sensitive information" regarding the country's major projects, significant technological achievements, and the development of core technologies.<sup>35</sup> In March 2023, CNKI informed their foreign subscribers that the company would restrict their access from April 1, 2023 to ensure its "cross-border services are in compliance with the law."<sup>36</sup> This access restriction is another signal that the Chinese government perceives OA and open data as a national security risk.

## Reasons for Open Access Publishing and Open Data Development

Factors such as Chinese scholars' optimism, the determination of some institutions' OS development and its' increased occurrence in science policy, were apparently not enough to boost China's OA and open data base rates. Li and Chen (2020) explain that the OS movement has been widely acknowledged as an important matter for all sectors of Chinese society.<sup>37</sup> However, academic incentive mechanisms, technological infrastructure, legal risks, and research culture are still obstacles for the movement. According to Zhang et al. (2022) a reason for low OA outcomes might be the fact that China's OA policies are mostly advisory, not mandatory. Also, overall confusion and skepticism towards OA were raised as potential reasons for the low OA figures.<sup>38</sup> In addition, Huang et al. (2021) concluded that as the idea of openness has a relatively weak resonance in the Chinese context, open data remains in its infancy in China.<sup>39</sup> Another explanation as to why OA and open data have not been urgently on the policy agenda could be that China's science policy priority has been to increase its scientific research capabilities. The outcomes of which are now visible in terms of number and citation metrics of publications.

In the light of the government interventions on CNKI, reasons for the modest developments in OA publishing and open data may be due to the same contradiction visible in the case of the CNKI: the different ways in which the Chinese government views OS. The progress that China has made in OS raises the question as to whether its support for international OS initiatives such as Plan S and the UNESCO's Open Science Recommendation is merely a reaction to recent developments in a scientific code of conduct, defined by Western academia.

## Outlook for China's Future Open Science Development

China's OA and open data development has progressed slowly since the 2000s despite several institutional initiatives and times of high hopes expressed by the academic community. And, therefore, it is hard to predict whether future OS implementation will remain as gradual as it has been. Stronger commitment to OS is visible in China's core science policies such as the revised Science and Technology Progress Law and the launch of the OSPC. But the public should not get their hopes up too soon, as neither the government nor the OSPC have announced concrete plans to launch an OS policy that would include OA publishing and open data.

There are many factors that would be advantageous for China's future OA development. First, as OA publishing increases the potential to get cited, embracing OA could be a means to succeed in

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the global competition for the world's largest and most influential producer of scientific knowledge. Second, as the US recently launched an OA policy, it could be that in (the distant) future OA publishing becomes a race of signaling scientific leadership and progress between the two countries. Whatever China's OS development trajectories will be, they are likely to differ from the ones in the EU and the US. As Braun Střelcová et al. (2022) discussed in their recent Observations paper, China is "gradually scaling back on open exchange and possibly establishing a new national model of science infrastructure and the conduct of science" rather than emulating foreign models. One outcome of this could be that other aspects of OS, such as open education and science communication become the central focus in the future in China.<sup>40</sup>

As this paper shows, there is an emerging understanding and body of reports and literature about the macro level of OS in China, especially in Chinese.<sup>41</sup> What's more, OS is both a top-down and bottom-up movement, and grassroots initiatives can have a significant impact, such as the Chinese, English-language, OA journal "The Innovation." The multidisciplinary three-year old journal established by young Chinese scientists is currently ranked third in terms of its "impact factor," just behind the world's two most-cited journals *Nature* and *Science*.<sup>42</sup> Further research could investigate this type of grassroots-led OS initiatives in China for a deeper understanding of the different disciplines of the OS movement. Finally, as China's influence in the global system of science continues to grow, the impact of its' current two-sided attitude towards OS on the global scientific community, especially in terms of OA and open data, requires further attention and analysis.

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