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How China Governs Open Science: Policies, Priorities, and Structural Imbalances

Xiaoting Chen [1,2], Abdelghani Maddi [2,*] and Yanyan Wang [1]

[1] School of Information Resources Management, Renmin University of China, Beijing 100872, China; cxt@ruc.edu.cn (X.C.); yanyanwangruc@ruc.edu.cn (Y.W.)
[2] Groupe d'Étude des Méthodes de l'Analyse Sociologique de la Sorbonne, GEMASS, Sorbonne Université, CNRS, 75017 Paris, France
* Correspondence: abdelghani.maddi@cnrs.fr

Abstract

This article investigates the architecture and institutional distribution of policy tools supporting open science (OS) in China. Based on a corpus of 199 policy documents comprising 25,885 policy statements, we apply an AI-assisted classification to analyze how the Chinese government mobilizes different types of tools. Using Qwen-plus, a large language model developed by Alibaba Cloud and fine-tuned for OS-related content, each policy statement is categorized into one of fifteen subcategories under three main types: supply-oriented, environment-oriented, and demand-oriented tools. Our findings reveal a strong dominance of supply-oriented tools (63%), especially investments in infrastructure, education, and public services. Demand-oriented tools remain marginal (11%), with little use of economic incentives or regulatory obligations. Environment-oriented tools show more balance but still underrepresent key components like incentive systems and legal mandates for open access. To deepen the analysis, we introduce a normalized indicator of institutional focus, which captures the relative emphasis of each policy type across administrative levels. Results show that supply-oriented tools are concentrated at top-level institutions, reflecting a top-down governance model. Demand tools are localized at lower levels, highlighting limited strategic commitment. Overall, China's OS policy mix prioritizes infrastructure over incentives, limiting systemic transformation toward a more sustainable open science ecosystem.

Keywords: open science policy; policy tools; open science governance; open access

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Academic Editor: Andrew Kirby

Received: 17 April 2025
Revised: 3 June 2025
Accepted: 20 June 2025
Published: 23 June 2025

Citation: Chen, X., Maddi, A., & Wang, Y. (2025). How China Governs Open Science: Policies, Priorities, and Structural Imbalances. *Publications*, *13*(3), 30. https://doi.org/10.3390/publications13030030

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1. Introduction

Over the past few decades, the open science (OS) movement has gained momentum globally. As a new paradigm of scientific research, OS emphasizes the public sharing of research results, data, and methods to improve the transparency and reproducibility of scientific research (Gong, 2022). Its importance is reflected in promoting knowledge dissemination, accelerating scientific progress, enhancing research credibility, enhancing public participation, and achieving global scientific research equity, especially in responding to global challenges, such as the COVID-19 pandemic (Besançon et al., 2021) and climate change (Cai et al., 2012). Today, OS encompasses a wide range of practices, such as open access, open data, open code, open peer review, etc., that are being advanced through policy initiatives, technological developments, and evolving social and cultural norms (Hosseini et al., 2024). Since the early 2000s, governments, research institutions, and funding agencies

have increasingly adopted policies promoting open science (OS) to scientific publications, data sharing, and collaborative research infrastructures. These efforts seek to enhance the impact of publicly funded research, democratize knowledge production, and accelerate scientific discovery.

There are regional differences in the implementation of open science policies around the world. Latin America has been a pioneer in open science, a movement that is now rapidly gaining momentum in Europe (Oliveira et al., 2021). North America, Africa, and Asia have also introduced numerous open science policies. In Portugal, the government has mandated the Ministry of Science, Technology, and Higher Education (MCTES) to establish an inter-ministerial working group tasked with proposing a strategic plan for the implementation of a national OS policy. This working group encompasses four distinct areas: open access and open data, infrastructures and digital preservation, scientific assessment, and the social responsibility of science (Lígia et al., 2021). In Europe, the European Commission has endeavored to promote open science in a holistic and comprehensive manner, encompassing all facets of the research cycle from scientific discovery and peer review to knowledge dissemination, publication, and promotion (Burgelman et al., 2019). The European Union aims to take a global leadership role in research data management, ensuring that European researchers fully benefit from data-driven science (J. Huang et al., 2020). Several European nations have developed open science policies, generally structured around three dimensions of "open input", "open process", and "open output". Within the "open input" dimension, recommendations pertaining to the performance of research data repositories and management standards are considered (Moradi & Abdi, 2023). The Finnish government aims to strengthen basic scientific research and to deepen the connection between scientific inquiry and society. In North America, Canada seeks to democratize access to science in order to maximize its benefits for public well-being, health, and economic prosperity (J. Huang et al., 2020).

Although the goals of open science policies in different countries tend to be consistent, there are significant differences in core priorities and resource allocation. In the United States, although participation equity is part of the recent government's task of promoting public access to research results, its importance is relatively low. Furthermore, since the second Trump administration, science policy—particularly in areas related to equity, diversity, and inclusion—has faced increasing political and institutional challenges, leading to a more fragmented and uncertain policy landscape (Vid, 2025). On the African continent, access to executive research is on a more equal footing, but this may reflect a history of under-investment in supporting infrastructure and access to infrastructure. Compared with Europe, the United States, and Latin American countries, China still has a lot of room for improvement in the implementation of open science policies. Yang et al. (2023) pointed out that the formulation of China's open science policy mainly focuses on open access and infrastructure construction, but lacks investment in overall policy frameworks, international cooperation, and scientific research culture (Yang et al., 2023).

China, now the world's largest producer of scientific publications (Baker, 2023), has actively engaged with the open science movement. However, its approach remains complex, shaped by competing priorities: fostering research accessibility while safeguarding national security and economic competitiveness. This tension has led to fragmented policy developments that require further examination.

Despite China's prominence in global scientific output, little is known about the structure, coherence, and evolution of its national open science policies. While some studies have analyzed open access publishing trends and data-sharing initiatives (Yang et al., 2023), the broader policy landscape—including the interplay between government strategies, institutional mandates, and researcher incentives—remains understudied. Furthermore,

the balance between transparency and state control in China's open science policies presents a unique case that diverges from Western models (Lattu, 2023).

This study aims to systematically analyze the evolution of China's national open science policies over the past two decades. It seeks to track the development of open science policies at the national level since 2002, identifying key policy priorities reflected in government directives and institutional mandates. A particular focus is placed on examining the policy tools—such as funding incentives, legal mandates, and research infrastructure investments—that are used to implement open science initiatives. Additionally, this study assesses how policy authority is distributed among different actors, including ministries, research-performing organizations, funding agencies, universities, etc., while also analyzing joint policy initiatives ("co-policies") to understand the degree of coordination between governmental and institutional stakeholders.

This study addresses the following key questions:

- How has the volume and nature of China's national open science policies evolved since 2002?
- What are the primary policy priorities?
- What types of policy tools are most commonly employed?
- How is policy authority distributed among different governmental and institutional actors?
- How are open science policies coordinated across multiple entities?

To address these research questions, this study compiles and analyzes the full corpus of national open science policies issued in China—199 official documents. A mixed-methods approach is used, combining content analysis, large language model-based text classification, and social network analysis to investigate how open science governance is structured in China.

The methodological framework follows three key analytical steps. First, all policies are classified into three broad types based on their content to identify major open science priorities. Second, this study assesses how these priorities are distributed across different levels of governance by assigning impact scores ranging from 1 to 5, distinguishing between policies issued by high-level ministries, national research organizations, and national associations. Finally, co-policy analysis is conducted to examine jointly issued policies and assess the level of coordination between policy-issuing entities.

Understanding China's open science policy landscape is crucial not only for national-level reform but also for informing global debates. Domestically, greater policy coherence could enhance not only effectiveness, but also research transparency, collaboration, and innovation. Internationally, China's growing role as a leading producer of scientific knowledge makes its approach to open science particularly influential in shaping global norms around data sharing, research infrastructure, and knowledge accessibility. For instance, China actively contributed to the development of the UNESCO Recommendation on Open Science and continues to invest in global scientific infrastructure and open data platforms.

Beyond describing national policies, this study offers an in-depth analysis of the structure, types, and governance model of open science policy within a highly centralized political system. This perspective is essential for broadening the current literature, which largely focuses on multi-stakeholder, decentralized governance models prevalent in Europe and North America. By examining how open science policies operate in a different institutional context, this study provides valuable empirical insights into the tools, mechanisms, and constraints involved in implementing openness within a state-led framework.

While recognizing that policies must ultimately be assessed in terms of their implementation and outcomes, this research contributes to a comparative understanding of how emerging economies build open science ecosystems. It offers both theoretical reflections and practical implications for policy design in countries with similar governance structures,

particularly in the Global South. Rather than presenting a domestically bound case, it aims to enrich global discussions on the diversity of open science pathways and the conditions under which they emerge and function.

The remainder of this article is structured as follows: Section 2 reviews the existing literature on open science policies. Section 3 outlines this study's data and methodological approach, including data sources, the classification framework, and analytical techniques. Section 4 presents the key findings from the results and discusses China's open science policy landscape. Finally, Section 5 provides the conclusion and discussions.

2. Open Science Policies: A Global Overview

Open science has become a global policy priority, reshaping the way knowledge is produced, shared, and governed. The European Union has taken a particularly strategic role, positioning open science at the heart of its research agenda. Since 2008, successive initiatives—such as the Open Access pilot in FP7, the revised 2018 recommendations on scientific information, and the establishment of the Open Science Policy Platform—have sought to align national policies, promote open access to publications and data, and support the transition to a more equitable knowledge ecosystem (Burgelman et al., 2019). Ambitious initiatives like Plan S, launched by cOAlition S, require publicly funded research to be openly available, reinforcing a model based on transparency, interoperability, and public value (Moradi & Abdi, 2023). Complementary platforms like OpenAIRE, OPERAS, DIAMAS, and FAIR-related projects help build a coherent infrastructure for open and responsible science (Schmidt et al., 2016).

Beyond Europe, open science is gaining momentum across regions—though through diverse paths. Latin America, often seen as a pioneer, has promoted open access since the early 2000s through public, non-commercial infrastructures such as SciELO and RedALyC, prioritizing bibliodiversity and equity (Appel et al., 2018). In Asia, China has emerged as a key actor, investing heavily in research infrastructure, participating in global initiatives like the UNESCO Recommendation on Open Science, and using centralized coordination to align open science with national innovation strategies (Yang et al., 2023). African countries are advancing through regional platforms and policy dialogs, despite disparities in capacity and infrastructure (Mwelwa et al., 2020; Okafor et al., 2022). In North America, Canada has embraced open science as part of a broader societal agenda centered on equity, health, and prosperity (CRC, 2024). In contrast, the United States has shown a more fragmented trajectory: while public access to federally funded research has progressed (Plutchak et al., 2022), recent years—particularly since the second Trump administration—have seen a relative decline in attention to equity, inclusivity, and open knowledge as strategic priorities (McWilliams et al., 2025).

Globally, open science policies are increasingly shaped by multilateral cooperation and shared norms. The UNESCO Recommendation on Open Science (2021) marked a milestone in establishing a common vision grounded in inclusivity, collective benefit, and global participation (UNESCO, 2021). At the same time, international networks like CoAR, OASPA, and the Research Data Alliance are reinforcing interoperability and trust in open infrastructures (Rieger & Schonfeld, 2023). These developments reveal that open science is not a uniform model exported from one region to another—it is an evolving set of principles and practices that take shape within specific institutional, political, and cultural contexts. A comparative perspective is thus essential: understanding how different countries design, implement, and govern open science policies offers valuable insights not only for national reform, but for building a truly global and pluralistic scientific commons.

As this article focuses specifically on the case of China, we develop a more detailed theoretical framework and literature review to contextualize its open science policies within

both national and global dynamics. Open science has become a significant topic in China, reflecting broader global movements towards transparency, collaboration, and accessibility in scientific research. The trajectory of open science in China is shaped by a complex interplay of governmental policies, institutional initiatives, economic constraints, and cultural factors. While China has made substantial progress in open access, research data management, and institutional repositories, challenges remain in terms of economic sustainability, policy implementation, and the adaptation of global open knowledge frameworks to local contexts.

One of the most visible aspects of open science in China is the development of institutional repositories (IRs). The Chinese Academy of Sciences (CAS) played a pioneering role in this domain with the establishment of the CAS IR Grid in 2009, creating a network of repositories across its research institutes. By April 2025, these repositories housed over 1.42 million full-text research papers, with approximately 22.84 million downloads and 380,000 full-text open access articles, highlighting their significant impact on knowledge dissemination. Similarly, the China Academic Library and Information System (CALIS) launched an IR initiative in 2011, with 5 university libraries and 21 universities jointly building the China Academic Institutional Repository (CHAIR) (Wei & Li, 2017). The open access policy requires that government-funded scientific research results be made available to the public immediately after publication and be mandatorily deposited in the national knowledge repository or an institutional knowledge base in order to promote the rapid dissemination and utilization of knowledge. The National Natural Science Foundation of China (NSFC) has issued the implementation rules for the open access policy concerning the Basic Research Knowledge Base. In May 2014, the NSFC officially launched the "National Natural Science Foundation Basic Research Knowledge Base" to collect the full texts of research papers resulting from NSFC-funded projects. This initiative aims to provide open access to the public, disseminate cutting-edge scientific and technological achievements in basic research, and promote scientific and technological progress (Noorden, 2014). The flagship platform is the NSFC Big Data Knowledge Management Service Portal database. These efforts indicate a strong institutional commitment to fostering open access, yet questions remain regarding their long-term sustainability and integration within broader international frameworks.

The open scientific research infrastructure primarily emphasizes the open sharing of scientific data and academic papers. In practice, China has developed a framework characterized by "open data infrastructure as the core, supplemented by open scientific research instruments and equipment, and open literature infrastructure" (Wen et al., 2021). At the data infrastructure level, the "Digital Belt and Road" International Science Program (DBAR) serves as a representative initiative (Guo et al., 2018). Regarding the openness of scientific research instruments and equipment, the State Council of China released the Opinions on the Opening of Major National Scientific Research Infrastructure and Large Scientific Research Instruments to Society in 2015 (Xinhua News Agency, 2015). Subsequently, the Ministry of Science and Technology and the Ministry of Finance jointly formulated the National Science and Technology Resource Sharing Service Platform Management Measures in 2018 (MoST & MoF, 2018). In 2019, the Ministry of Science and Technology issued the National Science and Technology Resource Sharing Service Platform Optimization and Adjustment List (Cui, 2016), followed by a joint evaluation and assessment of the sharing of scientific research infrastructure instruments among central universities and research institutes in 2020, conducted by the Ministry of Science and Technology and other relevant departments (MoST & MoF, 2018). At the literature infrastructure level, the Chinese Academy of Sciences has established open access paper discovery platforms, namely GoOA.

Despite these advances, economic factors present substantial obstacles to the full realization of open science in China. The shift towards open access publishing has introduced new financial burdens, particularly in the form of article processing charges (APCs). Zhang et al. (2022) argue that this "pay-to-publish" model may lead to unintended consequences, where only well-funded researchers can afford to disseminate their work, potentially reinforcing inequalities in the research landscape. However, it is important to note that concerns regarding APCs are not unique to China but are part of a broader global debate on the sustainability of open access publishing. Moreover, Xiao et al. (2022) emphasize the frustrations of Chinese researchers over high access fees for domestic academic databases, which paradoxically restrict access to research produced within the country itself (Xiao et al., 2022). These economic tensions illustrate a critical paradox: while open science aims to democratize knowledge, its financial mechanisms can create new barriers to entry.

The cultural dimensions of open science in China add another layer of complexity. Montgomery and Ren (2018) explore how China's engagement with open knowledge differs from Western models, emphasizing the role of state-led initiatives and controlled dissemination strategies. Unlike the grassroots-driven open access movements in Europe and North America, China's open science policies are heavily influenced by government priorities, shaping how openness is defined and implemented. Ren and Montgomery (2015) further discuss how open access aligns with China's broader "soft power" strategy, enhancing its visibility in international scholarship. However, these efforts must navigate longstanding traditions of academic publishing, hierarchical research structures, and concerns about intellectual property protection.

Research data management (RDM) is another area where open science in China is evolving. Y. Huang et al. (2020) note that while national policies such as the 2018 "Measures for Managing Scientific Data" provide a framework for RDM, their implementation at the institutional level remains inconsistent. Many universities lack comprehensive data-sharing policies, and libraries play a minimal role in facilitating open data initiatives. Similarly, Liu and Ding (2016) highlight the absence of standardized RDM practices at Wuhan University, where researchers largely manage their data independently, leading to inefficiencies and security risks. C. Li et al. (2022) trace the growth of open research data repositories in China, reporting that by 2021, 48 registered repositories had been developed, positioning China 12th globally in terms of open data infrastructure. However, these repositories often lack clear licensing policies, privacy regulations, and long-term preservation strategies, raising concerns about their effectiveness and usability.

Although China has implemented national open science initiatives for several decades and has broad institutional support, the actual outcomes remain relatively modest compared to regions like the EU and the US, where open science is strongly promoted (Yang et al., 2023). A fundamental tension in China's open science landscape is the government's ambivalent stance on openness. While open science is widely acknowledged as a mechanism for democratizing knowledge, improving research transparency, and fostering reproducibility, the Chinese government remains cautious about fully embracing open access and open data. This ambivalence stems from concerns about national security and the strategic control of scientific knowledge (Lattu, 2023). Amid rising geopolitical tensions—such as between the United States and China—debates have intensified in many Western countries over whether to impose restrictions on international scientific collaboration. Governments are increasingly concerned that unrestricted open science could lead to technology leakage or loss of competitive advantage (Colglazier, 2023). There could also be risks to research integrity: open datasets could be misinterpreted or misused, sensitive information could be exposed, and the rapid dissemination of research results could put pressure on peer review and reproducibility standards (Winker et al., 2023). Existing

inequalities could be inadvertently exacerbated: researchers in low-income countries or under-resourced institutions may lack the tools, infrastructure, or training necessary to fully engage in open science practices (Winker et al., 2023). A paradox arises from the conflict between open science policies and other policy objectives: it highlights the tension between the goal of making research publicly accessible and the need to safeguard scientific information considered sensitive by the state.

In sum, China's open science movement is at a turning point, marked by both impressive progress and persistent challenges. Institutional repositories and national policies signal a strong commitment to openness, yet economic constraints, cultural factors, and policy inconsistencies complicate full implementation. The interplay between state-driven initiatives and grassroots adoption will likely shape the future trajectory of open science in China, determining whether it can balance national interests with international collaboration, economic sustainability with accessibility, and control with openness.

3. Data and Methods

Figure 1 provides a global overview of the data extraction and processing of this study.

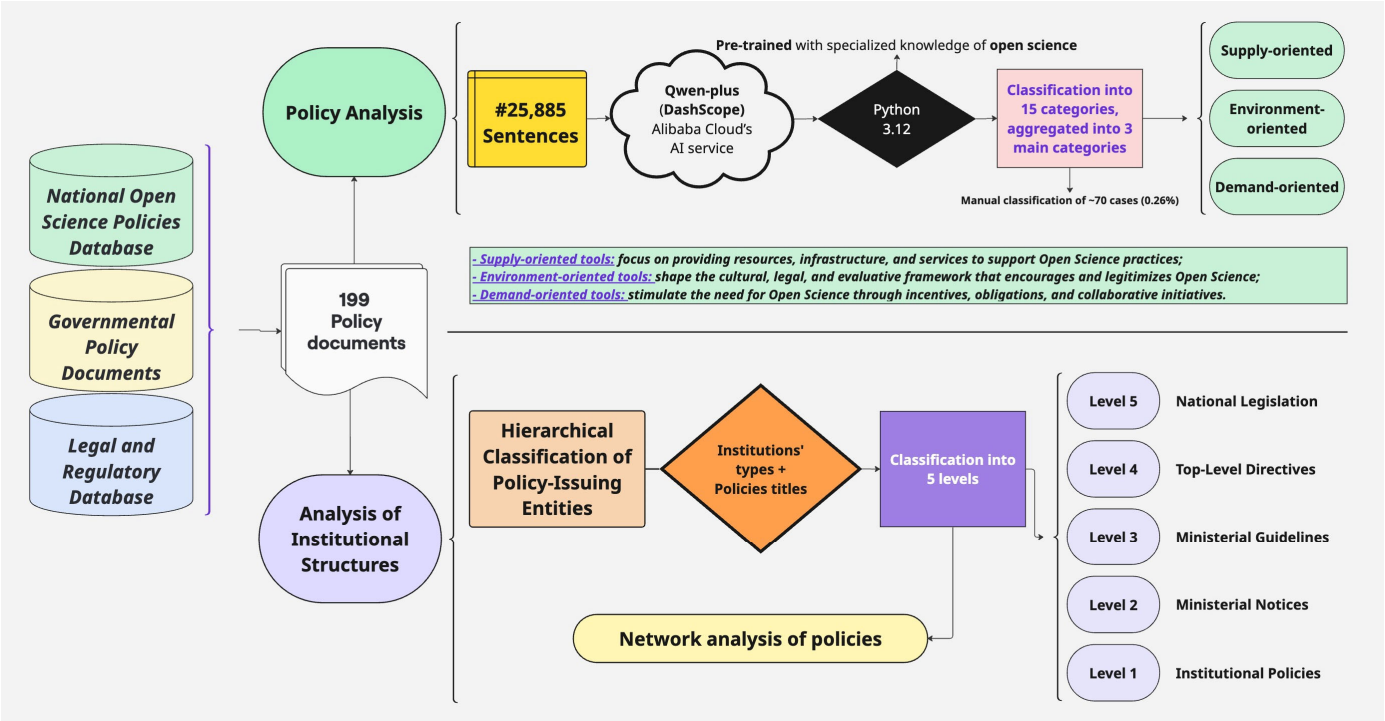


Figure 1. Global overview of methods and data processing.

3.1. Data Collection

China and Western countries generally share a common core understanding of "open science". The current official definition of open science is largely based on the "UNESCO Recommendation on Open Science", issued in 2021 by the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2021). It defines open science as 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. Open science is based on the following main pillars: open scientific knowledge, open scientific infrastructures, scientific communication, open engagement of social actors, and open dialogue with other

knowledge systems. Based on the above definition and previous research (Sheng & Zhang, 2024), this study defines the search keywords "open science", "open access", "open data", "open infrastructure", "open education", "open publishing" and "open cooperations" as keywords for full-text search. These keywords were originally formulated in Chinese, and the search queries (Table 1) were conducted in Chinese; the English terms presented here are translations for reference purposes. This study draws on three primary data sources to analyze open science policies in China.

Table 1. Policy data retrieval table.

Category	Data Source	Search Queries (Translated from Chinese)	Amount
National Open Science Policy Database	Open Science Research Center of Chinese Academy of Sciences	Manual extraction	212
Government Policy Documents	China Central People's Government website, Ministry of Science and Technology, China Meteorological Administration, China Earthquake Administration, etc.	Full text = "Open Science" OR "Open Access" OR "Open Data" OR "Open Infrastructure" OR "Open Education" OR "Open Publishing" OR "Open Collaboration"	225
Legal and Regulatory Database	Peking University Law Database	Full text = "Open Science" OR "Open Access" OR "Open Data" OR "Open Infrastructure" OR "Open Education" OR "Open Publishing" OR "Open Collaboration"	42

- National Open Science Policies Database

The Open Science Global Policy Evolution Atlas, maintained by the Open Science Research Center of the Chinese Academy of Sciences (http://os.las.ac.cn/zh-CN/policy, accessed on 1 June 2025), provided a comprehensive inventory of national-level policies, accessed on 22 January 2025.

- Governmental Policy Documents

Relevant policy documents—including notices, regulations, guidelines, and implementation details—were collected from official government portals, including the Central People's Government of China website and the Ministry of Science and Technology, accessed on 25 January 2025. Additional documents were sourced from ministerial agencies such as the China Meteorological Administration and the China Earthquake Administration. Informal drafts and discussion papers were excluded to prioritize finalized policies.

- Legal and Regulatory Database

The Peking University Law Database (https://www.pkulaw.com (accessed on 1 June 2025)), a comprehensive repository of over 4.6 million laws and 150 million case records, was used to retrieve legal documents related to open science, accessed on 27 January 2025. Advanced search functions allowed for targeted queries on national and local regulations.

3.2. Categorization of Policies

Policies were systematically filtered and categorized using the following criteria:

- Only official national- and state-level documents from government agencies and scientific funding institutions were included. Policies issued by individual journals or professional societies were excluded.
- The focus was restricted to legal and regulatory documents explicitly addressing open science principles, including open access, data sharing, and infrastructure requirements.

After deduplication of policy data, the final dataset includes 199 national open science policies published up to December 2024. Each policy was assigned a unique identifier (e.g.,

"C" for China + number) and cataloged with details such as issuing entities, classification, and policy title (Table 2).

Table 2. National open science policies in China (structure of data).

Policy ID	Date of Issue	Issuing Entities	Category	Policy Title
C1	2002-06	People's Congress	Open Science Governance	Law of the People's Republic of China on the Popularization of Science and Technology
C2	2002-08	State Council	Open Science Governance	Guiding Opinions of the National Informatization Leading Group on the Construction of E-Government in China
...	...	...	...	...
C40	2015-01	State Council	Open Infrastructure	Opinions of the State Council on Opening Major National Scientific Research Infrastructure and Large Scientific Research Instruments to the Public
...	...	...	...	...
C199	2024-10	Ministry of Industry and Information Technology, Ministry of Finance, National Bureau of Statistics	Open Infrastructure	Overall Construction Plan for New Material Big Data Center

Given the hierarchical structure of Chinese legal documents (consisting of Parts, Chapters, Sections, Articles, Paragraphs, Subparagraphs, and Items), the policy texts in this paper are divided into the smallest possible unit, "sentences", to ensure that each policy component is considered as an independent unit of analysis. Considering that multiple policy tools may appear in one sentence, the number of policy tools appearing in the policy unit is calculated in detail. Each policy text was assigned a structured code following the format policy ID—chapter—specific clause (e.g., C1-2-10 for the 10th clause of the second chapter of policy C1). This coding scheme allowed for systematic classification and content analysis across policies (Table 3).

This study applies the policy tool classification framework developed by Rothwell and Zegveld (1981), which is widely used to analyze public policies in science and technology. It categorizes policy tools into three main types based on their function:

- Supply-oriented policies: These focus on direct support for open science, such as funding, infrastructure, training, and technical standards.
- Demand-oriented policies: These aim to stimulate demand for open science through incentives like subsidies, regulations, and business model innovations.
- Environment-oriented policies: These create a supportive framework for open science through regulations, monitoring, evaluation, and cultural initiatives.

Building on this framework and a review of existing research (Jiang et al., 2022), we identified 15 subcategories of open science policy tools (Table 4).

Table 3. Open science policy text coding (structure of data).

Policy ID	Policy Title	Content Analysis Unit	Coding	Category	Subcategory
C1	Law on the Popularization of Science and Technology	Article 10: Governments at all levels shall integrate science popularization into national economic and social development plans.	C1-2-1	Supply-Oriented	Legal Regulation
…	…	…	…	…	…
C101	Measures for the Open Sharing of Duty-Free Imported Scientific Research Instruments and Equipment (Trial)	Article 7: The General Administration of Customs supervises open sharing of scientific research instruments.	C101-2-7	Environment-Oriented	Monitoring and Evaluation
…	…	…	…	…	…
C199	Overall Construction Plan for New Material Big Data Center	Strengthen administrative adjudications on patent infringements and protect material big data intellectual property.	C199-5-6	Environment-Oriented	Intellectual Property and Privacy Protection

Table 4. Classification of open science policy tools.

Tool Type	Sub-Tool	Explanation
Supply-oriented	Education and training	The government implements education and training programs to cultivate open science professionals and ensure talent pool
	Infrastructure	The government builds and improves infrastructure to provide material support for open science
	Technical standards	Governments formulate and promote technical standards to promote open sharing, such as the FAIR principle
	Capital investment	The government has allocated special funds to support open science work
	Public services	The government provides basic services such as policy consultation and information sharing to ensure the smooth progress of open science
Environment-oriented	Cultural construction	Cultivate an open and shared scientific culture and encourage scientific research to embrace the concept of openness
	Legal regulation	Formulate laws and regulations to regulate and supervise open science activities and ensure legitimacy
	Intellectual property and privacy protection	Emphasize intellectual property protection, add privacy protection, and balance openness and protection
	Monitoring and evaluation	Establish a monitoring and evaluation mechanism to track policy effects and ensure that goals are achieved
	Scientific evaluation and reward system	Reform the evaluation system to encourage researchers to participate in open science

Table 4. *Cont.*

Tool Type	Sub-Tool	Explanation
Demand-oriented	Advocacy and collaboration	The government initiates initiatives, builds collaboration, and mobilizes social forces to jointly advance policy goals
	Mandatory opening	The law requires that scientific research results be published and shared on open platforms
	Business model innovation	Encourage scientific research and publishing institutions to explore new models of scientific exchange and promote open innovation
	Demand-oriented subsidies	Government subsidies reduce open access publishing costs and increase demand for open science
	Public procurement	Government procurement of open science-related services to promote open access and data sharing

To classify policy documents efficiently, we used Qwen-plus, a large language model developed by Alibaba Cloud. This model was chosen for its advanced reasoning and classification capabilities. The classification process followed these steps:

1. Model Selection and Setup:
    - The Qwen-plus model was accessed via DashScope, Alibaba Cloud's AI service.
    - The model was integrated into a Python 3.12 environment using the OpenAI-compatible DashScope SDK, using version 1.88 of the Visual Studio Code software.
2. Fine-tuning for Policy Classification:
    - The incremental pre-training method was used to fine-tune the training.
    - The model was incrementally pre-trained with specialized knowledge of open science policy tools.
    - This ensured it could recognize terminology, concepts, and case studies across the 15 subcategories.
3. Classification Process:
    - The model processed policy texts and assigned each document to 1 of the 15 subcategories under supply-oriented, demand-oriented, or environment-oriented policies.
    - Results were manually verified, with 0.26% of cases requiring human correction due to ambiguity.
4. Final Data Refinement:
    - Misclassifications (e.g., confusion between funding policies and technology transfer initiatives) were corrected.
    - Non-relevant content was removed.
    - The final normalized dataset contained 25,885 classified policy sentences.
5. Sampling verification:
    - A professional familiar with open science policy randomly selected 1000 samples using the RANDBETWEEN function, manually annotated them, and recorded the actual classification results for each text.
    - The accuracy, recall, and F1 value of the model were calculated. The overall accuracy of the model was 92.71%, the recall rates of supply, environment, and demand policies were 91.10%, 87.68% and 86.30%, respectively, and the F1 values were 91.90%, 90.12% and 89.39%, respectively. These results indicate that the model demonstrates good robustness.

This approach allowed for a systematic and scalable classification of open science policies, ensuring accuracy while significantly reducing the time required for manual analysis.

3.3. Hierarchical Classification of Policy-Issuing Entities

To analyze the role of different entities in shaping open science policies, we classified the 199 policies based on the hierarchical level of their issuing institutions. The classification follows the framework proposed by Zhong et al. (2009) and the Regulations on the Procedure for Formulation of Regulations issued by the State Council of China (The State Council, 2001). Policies were assigned to one of five levels, with Level 5 representing the most powerful entities (e.g., National People's Congress) and Level 1 the least politically influential (e.g., research institutes) (Table 5).

Table 5. Policy strength scoring.

Number of Statements	Whole Count	Fractional Count	Description	Level
379	2	2.0	Laws, regulations, and guidelines promulgated by the National People's Congress and its Standing Committee	5
7498	64	52.0	Regulations, rules, opinions, etc., issued by the CPC Central Committee and the State Council	4
15,379	173	63.7	Notices issued by the CPC Central Committee and the State Council; guidance opinions and measures issued by national ministries and commissions, etc.	3
6013	130	70.6	Notices and announcements from national ministries and commissions	2
2139	30	10.8	Opinions, methods, notices, etc., from national scientific research institutes and research institutes	1
-	-	199.0	Total	

This classification enables us to address two key questions:

1. How many policies are issued by each type of institution?
2. What is the policy focus of each level of institution?

The assumption is that higher-level entities (Levels 4 and 5) are more likely to implement policies with broader influence, while lower-level entities (Levels 1 and 2) tend to focus on more specialized or localized issues.

Given that a policy may involve multiple institutions from different levels, we applied fractional counting to quantify the number of policies issued by each institution. This ensures the following:

1. Accurate Aggregation: Multiple institutions co-issuing the same policy are counted proportionally, preventing overestimation of policy counts.
2. Institutional Strength: The method weights the contributions of higher-level institutions more heavily, based on the number of co-issuing institutions. For example, if a policy involves three Level 4 institutions and one Level 1 institution, each institution's contribution is counted fractionally based on its level. Consequently, the fractional count for Level 4 is 0.75 and that of Level 1 is 0.25.

However, for analyzing the focus of policies according to the level of institutions, we use the whole count of policies, meaning that each policy is considered as a whole, regardless of how many institutions from different levels are involved. This method reflects the interest in which type of policy (supply-oriented, demand-oriented, and environment-oriented) each level of institution is involved in, rather than the exact number of institutions per policy. In other words, for each institutional level, we counted how many policies fell into each of these three categories using the whole count. This approach enables us to understand which types of policies are more prominent at each institutional level.

To facilitate comparisons of policy focus across different institutional levels, we calculated a normalized indicator for each policy type. The normalized indicator is calculated by dividing the mean percentage contribution of each policy type by the total contribution at each institutional level. This normalizes the data, making it possible to compare policy priorities across levels, regardless of the total number of policies.

For example, if supply-oriented policies account for 44% of policies at Level 1 institutions but 62% of all policies combined, the normalized indicator is 44/62 = 0.71. This means that supply-oriented policies are 29% less prominent in Level 1 institutions compared to the global average. Conversely, if demand-oriented policies represent 28% at Level 1 but 20% overall, the indicator is 28/20 = 1.40, indicating that such policies are 40% more prevalent at this level. This approach allows us to highlight whether institutions at different levels prioritize specific policy orientations more or less than the overall trend.

To visualize the distribution of policy focus across institutional levels, we created a heatmap based on the normalized indicators for the three policy types (supply-oriented, demand-oriented, and environment-oriented). We also performed clustering of both rows (institutional levels) and columns (policy types) to group similar institutional levels and policy types based on their focus. This clustering helps identify patterns and variations in policy priorities across different institutional levels.

In the clustering process, the following processes occur:

- Row clustering groups institutional levels with similar policy focus distributions.
- Column clustering groups policy types that exhibit similar focus distributions across institutional levels.

The resulting heatmap visually displays the differences in policy priorities across institutional levels, aiding in the interpretation of how various institutions shape open science policies.

3.4. Network Analysis of Policies

Social network analysis provides a powerful framework for understanding the collaborative dynamics between institutions involved in policy issuance. In this study, we conceptualize the policy landscape as a network of entities that jointly issue policies, where each node represents an institution, and each edge signifies a collaboration between entities in drafting and endorsing policy documents.

To visualize these interactions, we use Gephi 0.9.7 software, which enables the mapping of institutional collaborations and the identification of key actors within the policy network. This approach allows us to detect clusters of cooperation, highlight dominant entities driving open science policies, and assess how policy influence is distributed among different types of institutions. Combining content analysis with social network analysis allows us to systematically examine both thematic policy focus and institutional relationships, offering a more comprehensive perspective on the governance of open science.

4. Results and Discussion

4.1. Open Science Policies over the Years

The evolution of open science policies in China from 2002 to 2024 reveals a growing commitment to institutionalizing open science at the national level. The timeline shows a gradual increase in policy issuance until 2013, followed by a sharp acceleration from 2015 to 2017, peaking in 2016 (Figure 2). This aligns with findings in the literature identifying 2013, 2016, and 2021 as key moments for international open science policy developments (Yang et al., 2023). The surge in policy issuance around 2016 coincides with global discussions on open access and data sharing, as well as China's broader push for scientific and technological modernization.

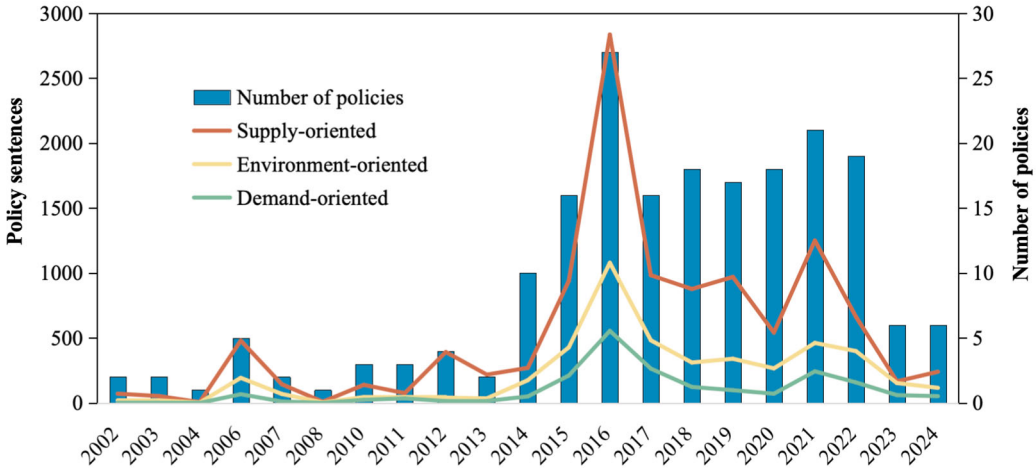


Figure 2. Open science policy release and changes in policy types.

After a brief decline in 2018 and 2019, policy activity rebounded in 2021 and 2022, reflecting China's renewed focus on integrating open science into its national strategy. This period also aligns with the 2021 revision of China's Science and Technology Progress Law and the 2022 National Congress directive to develop an open innovation ecosystem. The relative drop in 2023 and 2024 may not indicate a slowdown but rather a shift from policy creation to implementation and consolidation. Additionally, the literature highlights that China's approach to open science is state-driven, emphasizing governance and systemic frameworks (Yuan et al., 2023). The observed fluctuations in policy issuance suggest that key political and legislative moments, rather than a continuous, linear process, drive China's engagement with open science. In addition, the number of the three categories of policy tools fluctuates with the number of policy releases, with supply-oriented policy tools accounting for the largest proportion, while the number of the other two categories of policy tools changes relatively slowly.

4.2. Structural Imbalances in China's Open Science Policy Portfolio

The overall distribution of policy tools related to open science (OS) in China reveals a clear and marked orientation toward supply-oriented measures, which account for 63% of all identified tools. In contrast, environment-oriented tools represent 26%, and demand-oriented tools only 11%, of the total (Figure 3). This significant imbalance in favor of supply-driven tools reflects both the technocratic nature of China's science policy and the emphasis placed by the central government on infrastructural development and direct state intervention as primary vehicles for policy implementation.

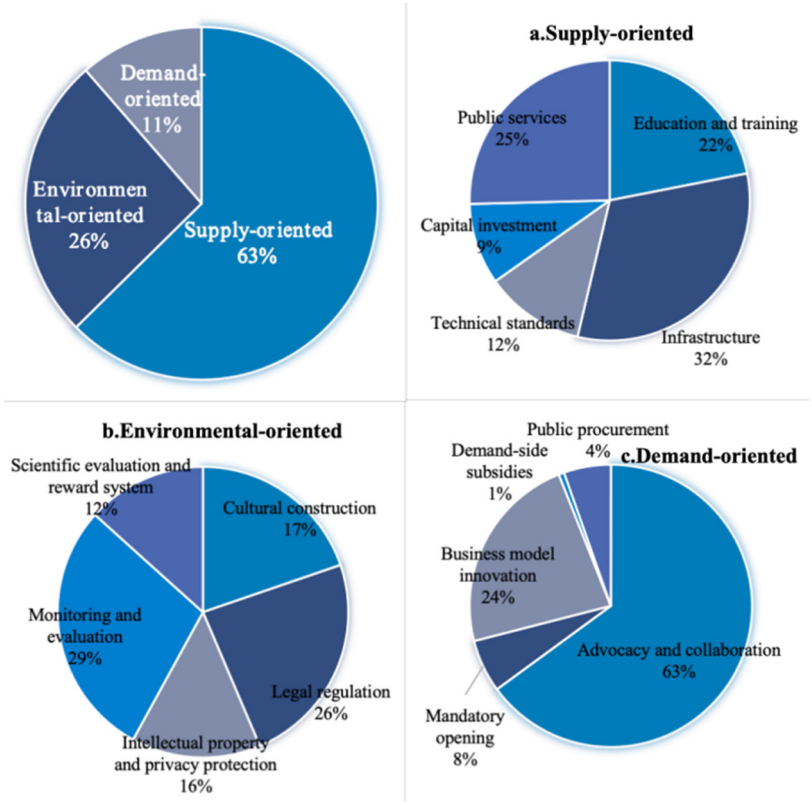


Figure 3. Distribution of open science policy tools.

4.2.1. Dominance of Supply-Oriented Tools: A Technocratic Logic

Supply-oriented tools are led by investments in infrastructure (32%) and education and training (22%), followed by public services (25%) and, to a lesser extent, technical standards (12%) and capital investment (9%). This structure mirrors China's longstanding strategy in science and technology governance, which prioritizes state-led capacity building. The emphasis on infrastructure—both digital and institutional—signals the Chinese government's intent to lay the technical and organizational foundations for open science, often through targeted national programs and pilot initiatives. This approach fits within the broader Chinese governance model, where the state assumes a strong directive role in mobilizing resources and coordinating reforms across sectors.

The relatively high share of public services also reflects the government's function as a service provider, offering information, consultation, and coordination mechanisms to support policy rollout. However, the relatively modest share of capital investment may indicate that while infrastructure is prioritized, long-term financial sustainability for OS projects is not always guaranteed through dedicated funding.

4.2.2. Underdeveloped Demand-Oriented Tools: A Key Weakness

At the opposite end of the spectrum, demand-oriented tools are severely underrepresented, comprising just 11% of the policy mix. Within this category, a staggering 63% are related to advocacy and collaboration, suggesting that most demand-oriented efforts remain limited to rhetorical or mobilizational strategies rather than systemic incentives. Crucially, mandatory opening policies (8%) and subsidies to offset the costs of open access publishing (1%) are strikingly rare. Similarly, business model innovation (24%) and public procurement (4%) appear only marginally in the dataset.

This lack of robust economic or legal incentives risks limiting the behavioral shift required for a deeper adoption of OS practices. Researchers and institutions may lack sufficient motivation or support to change long-standing practices in data sharing, open access

publishing, or collaborative openness. In the context of China, where compliance with top-down mandates is often strong, the absence of enforceable obligations for open publishing (i.e., "mandatory opening") may reflect a policy gap rather than a cultural resistance.

4.2.3. Environmental Tools: Framing Openness Without Mandating It

Environmental tools—which include regulatory, cultural, and evaluative frameworks—make up 26% of the total. These are fairly well-distributed across subtypes, with particular emphasis on monitoring and evaluation (29%), legal regulation (26%), and cultural construction (17%). This distribution suggests a growing awareness among Chinese policymakers of the need to frame OS not just as a technical or infrastructural reform, but as a normative shift in research practice.

However, the relatively modest share of scientific evaluation and reward system (12%) reveals that current frameworks still do not sufficiently link researchers' careers or incentives to their engagement in OS. Given the importance of performance-based incentives in China's academic system, this may hinder the mainstreaming of open practices, despite top-level promotion.

4.2.4. Implications for the Governance of Open Science in China

Overall, the Chinese OS policy architecture reflects a state-centric, technocratic model with a strong emphasis on supply-oriented enablers. While this model enables rapid infrastructure deployment and coordinated reform, it risks overlooking the behavioral and institutional change required at the level of researchers and knowledge users. The weak presence of demand-oriented tools and the moderate weight of incentive-based evaluation tools suggest that open science in China is primarily built "for" researchers, not necessarily "with" them.

Furthermore, the mismatch between policy emphasis and systemic need—especially in terms of demand stimulation and sustainable incentive structures—may limit the transformative potential of the current OS policy regime. Without stronger mechanisms to reward openness and reduce the cost barriers for publishing and sharing, open science risks remaining a technical reform, rather than a systemic one.

In sum, the structure of China's OS policies reflects a clear supply-driven developmental logic, which is well-aligned with the country's broader governance approach. However, addressing the current imbalances—particularly the underdevelopment of demand-oriented tools—will be crucial for fostering a more comprehensive, participatory, and sustainable transition to open science.

4.3. Policy Focus According to the Institutional Strength Level

To better understand how different institutional levels contribute to the implementation of open science (OS) in China, we analyzed the distribution of policy tools—categorized as supply-oriented, demand-oriented, and environment-oriented—across five levels of governance. These levels reflect a range of actors, from grassroots research institutions (Level 1) to national laws and strategic documents issued by central authorities (Level 5). A normalized indicator was calculated to evaluate the relative focus on each policy type per level, by comparing the share at a given level to its global share across all levels. Scores above 1 indicate a stronger-than-average focus; scores below 1 suggest underrepresentation.

The results reflect the logic of China's centralized yet multi-level governance structure (see Figure 4). Level 1 institutions, which include research institutes and associations, show a strong relative focus on environment-oriented ($\approx$1.4) and demand-oriented policies ($\approx$1.2), and a significant underrepresentation of supply-oriented tools ($\approx$0.7). For example, the Notice on the Trial Implementation of the Scientific Data Management and Open Sharing Methods of the Chinese Academy of Sciences states that the responsible departments

must include the data management plan for scientific and technological projects as a necessary condition for project establishment and include it in the project review content; the submission management and open sharing of data associated with papers in the journals of the Academy should be supervised and evaluated. The Open Access and Scientific Data Management Methods of the Chinese Academy of Agricultural Sciences states that researchers and graduate students of the Academy are encouraged to store papers before the release of this policy in the Academy's institutional repository for open access. This pattern suggests that local institutions primarily serve as implementers of overarching policy objectives—adjusting internal evaluation criteria, responding to mandates, and fostering an open research culture—rather than initiating large-scale infrastructural or technical transformations.

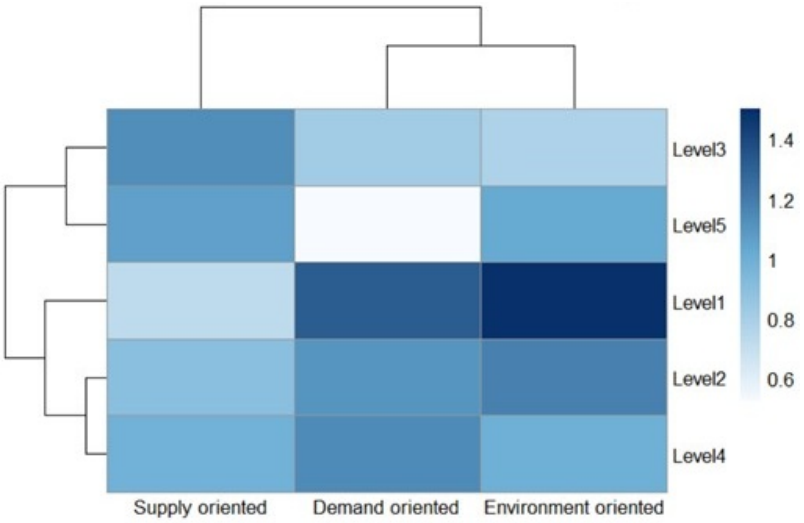


Figure 4. The focus of open science policies, according to the institutional strength level.

In contrast, Level 3 institutions, such as ministries and technical bureaus, are strongly associated with supply-oriented policies, scoring well above average. These mid-level actors serve a pivotal role in China's governance architecture: they operationalize top-level policy guidance by developing infrastructures, standards (e.g., aligned with the FAIR principles), and training programs. Their prominence in this category reflects the technocratic and programmatic implementation mechanisms typical of China's policy system.

At the top of the hierarchy, Levels 4 and 5—which include State Council regulations and national-level strategic frameworks—are characterized by a strong emphasis on environment-oriented tools and a clear de-emphasis of demand-oriented tools, especially at Level 5. This likely reflects the nature of high-level policy in China: setting the normative tone, defining long-term goals, and ensuring legal legitimacy. However, specific mechanisms to stimulate behavioral change or increase demand for open practices are generally delegated to lower levels or omitted altogether.

These findings illustrate a distinct top-down coordination pattern, characteristic of China's policy-making system. Central authorities (Levels 4 and 5) provide overarching frameworks and symbolic guidance, while intermediate bodies (Level 3) convert these visions into operational policies. Grassroots institutions (Level 1) adapt and internalize these tools, particularly those that affect evaluation and research culture.

This tiered architecture supports efficient policy deployment but also requires robust vertical coordination mechanisms to ensure alignment across levels. The underrepresentation of certain tools at specific levels—especially the low presence of demand-oriented tools in national policies—raises questions about how effectively behavioral change is incentivized without explicit mandates or subsidies from the top.

In sum, the differentiated distribution of open science policy tools across institutional levels in China reflects a broader logic of centralized vision, technical mediation, and local adaptation, with each level playing a distinct yet complementary role in promoting openness in science.

4.4. Interdepartmental Coordination and Structure of Joint OS Policies

Between 2002 and 2022, a total of 199 open science policy documents were issued by 70 different governmental entities, including key players such as the State Council, the Ministry of Science and Technology (MOST), and the Ministry of Education (MoE). Among these, 142 policies (71.4%) were issued independently, while 57 policies (28.6%) were jointly issued, reflecting an institutional effort toward interdepartmental coordination (Figure 5). This practice aligns with China's Regulations on the Handling of Official Documents by Party and Government Agencies, which explicitly allow for joint issuance of policy documents when inter-agency collaboration is deemed necessary.

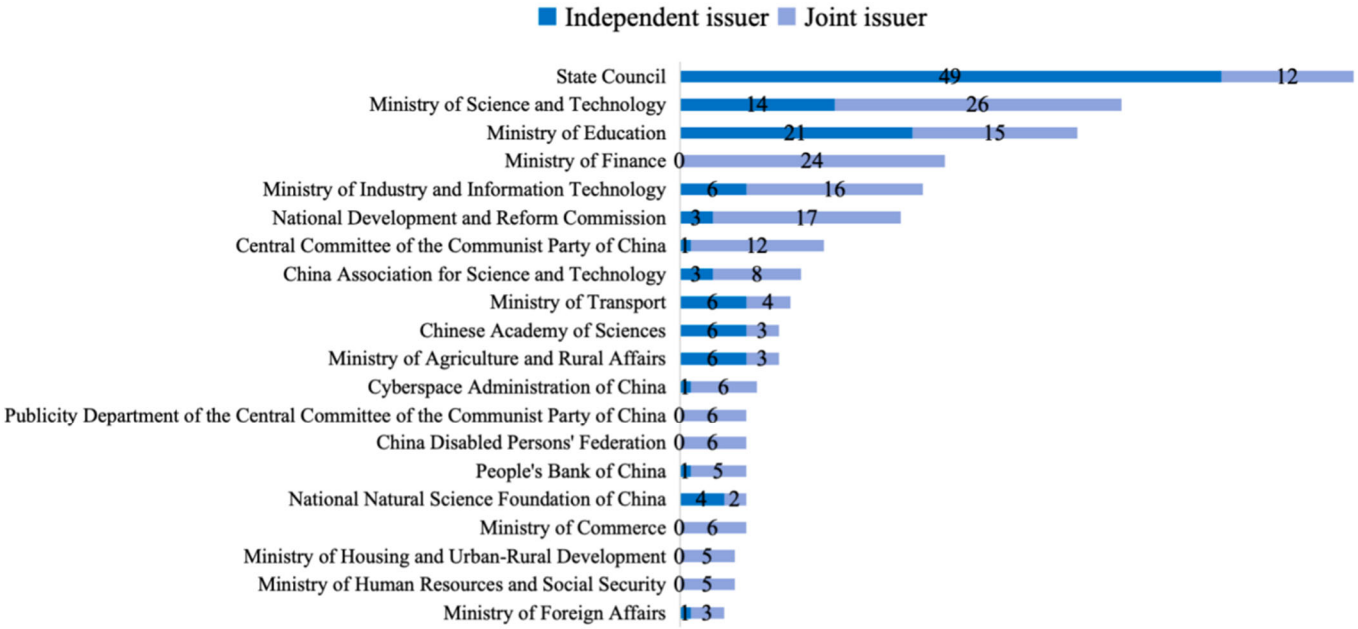


Figure 5. Open science policy text and quantity (copies).

The State Council, as the highest executive authority, emerged as the most prolific policy issuer, responsible for 61 documents, of which 49 (80.3%) were issued independently and 12 (19.7%) jointly. The Ministry of Science and Technology followed with 40 policies, demonstrating strong leadership on the technological dimensions of open science. The Ministry of Education, although not a major issuer independently, participated in 15 jointly issued policies, often in partnership with other ministries.

This multi-actor configuration reflects the Chinese government's intent to build a comprehensive open science governance framework aligned with the UNESCO Open Science Recommendation, addressing pillars such as open scientific knowledge, open infrastructures, science communication, societal engagement, and integration of diverse knowledge systems. Policy design appears to emphasize functional differentiation, with the Ministry of Finance supporting economic instruments, the China Association for Science and Technology contributing to infrastructure and community building, and the Ministry of Education fostering educational integration.

To analyze the structure and dynamics of interdepartmental collaboration, we conducted a social network analysis (SNA) using Gephi. These metrics indicate a moderately

clustered network with strong local connectivity but relatively sparse global integration (Figure 6). Node size reflects the volume of issued policies, while edge thickness indicates the strength of collaboration.



Figure 6. Social network of open science policy publishers.

As expected, the Ministry of Science and Technology, the Ministry of Industry and Information Technology, and the Ministry of Education are central nodes in the OS policies landscape. Secondary hubs include the Ministry of Finance, the National Development and Reform Commission, and the Ministry of Human Resources and Social Security. In the core network composed of the above six central nodes and secondary hubs, the Ministry of Finance is at the center of the network, which shows that the Ministry of Finance plays a core role in promoting cross-departmental coordination.

4.4.1. Overload of Core Nodes

The open science policy network presents typical "core–edge" structural characteristics. As leading institutions, the Ministry of Science and Technology, the Ministry of Industry and Information Technology, and the Ministry of Education play a hub role in policy formulation and collaborative cooperation, showing a significantly high degree of connectivity. However, this centralized pattern also exposes the problem of structural imbalance: a large number of peripheral institutions have only one-way or weak connections with core nodes, insufficient horizontal interaction, and lack of equal participation and multi-point coordination mechanisms.

Although the high connectivity of leading institutions is conducive to policy integration and overall promotion in the short term, its high load state also significantly increases the coordination cost. Cross-departmental cooperation is highly dependent on these core nodes, which is prone to form a "bottleneck effect", which may limit the autonomous

collaboration capabilities of non-core institutions and inhibit the release of distributed innovation potential in the network.

4.4.2. Insufficient Participation of Scientific Research Resources and Data Governance Institutions

In the policy collaboration network, the participation of departments related to scientific research resource management and data governance is obviously insufficient. Although the Chinese Academy of Sciences and the National Natural Science Foundation of China have an important strategic position in the scientific research system, the two have not formed multiple cross-coupled two-way connections in the network, showing a lack of depth and breadth of collaboration.

Institutions such as the National Data Administration and the National Bureau of Statistics, which should play a basic supporting role in the opening of scientific research data, are on the edge of the figure, with sparse cooperation networks and lack of effective linkage with scientific research leading departments. This weak participation state is not conducive to promoting the institutional development of scientific research data governance and data sharing mechanisms.

In addition, the National Intellectual Property Administration is closely related to the transformation of scientific research results and data reuse, but it does not reflect the characteristics of multilateral cooperation in the collaborative network. There is currently a policy disconnect and coordination gap between data opening and the intellectual property system.

5. Discussion and Conclusions

This study provides a comprehensive analysis of the policy tools shaping open science (OS) governance in China. Drawing on a large-scale dataset of 25,885 policy statements from 199 official documents, we applied a fine-tuned large language model to classify policy tools and assess their distribution across institutional levels. The findings reveal a striking imbalance: Chinese OS policies are overwhelmingly dominated by supply-oriented tools, with a strong emphasis on infrastructure development, education, and public services. Demand-oriented tools remain largely underutilized, and environment-oriented tools, while more diversified, lack sufficient focus on legal enforcement and incentive systems.

The institutional mapping further reveals a highly centralized governance model, with Levels 3, 4 and 5 institutions concentrating the majority of supply-driven initiatives. Demand-oriented policies, conversely, are more prominent at local levels, pointing to a fragmented and possibly ad hoc approach to mobilizing user engagement and uptake of open science practices. This configuration suggests that while China has made significant efforts to build the material and procedural foundations for OS, it has yet to develop a coherent, multi-level strategy that balances top-down directives with bottom-up participation and innovation.

According to the recommended framework for an open science policy system aligned with the dynamics of China's scientific and technological innovation (Yang et al., 2023), the ideal states of the three types of policies can be summarized as follows:

- Supply-oriented policies should focus on building infrastructure and talent systems with a global perspective, institutionalizing and pre-deploying resource provision through mandatory national open access and open data policies.
- Demand-oriented policies should aim to stimulate active participation from research actors, particularly by encouraging universities and research institutes to transition from "passive acceptance" to "active innovation and application", thereby enhancing the high-quality reuse of data and research outputs.

- Environment-oriented policies should strive to establish a continuously evolving evaluation and coordination framework for open science, enabling dynamic monitoring and feedback mechanisms to support regional innovation collaboration and policy maturity.

Furthermore, we also observed that China's current open science policies remain heavily concentrated on infrastructure and macro-level planning (supply-oriented), while the participation of key research entities (demand-oriented) remains limited. Greater efforts are urgently needed to mobilize universities and research institutes to actively engage in open science practices.

Both existing studies and the findings of this research highlight a structural imbalance in China's current policy mix, characterized by a predominant focus on supply-side measures and insufficient attention to demand stimulation. Given that research institutions and researchers are the core implementers of open science, their low level of engagement represents a fundamental bottleneck to effective policy implementation. Therefore, strengthening demand-oriented policies is not only critical to bridging current policy gaps but also essential for ensuring the sustainable functioning of the open science ecosystem once the foundational supply capacity is in place.

China's open science policies are comparable in number to those of other countries, but it lags behind in the formulation and implementation of "open access" policies, while its "open data" and "open science governance" policies are on par with international peers, in stark contrast to the active open access policies of the EU and the United States (Yang et al., 2023). China's open science governance adopts a centralized, top-down approach, using national resources to promote large-scale infrastructure construction and innovation projects, while Western countries tend to adopt a decentralized multi-stakeholder governance model involving universities, funding agencies, and civil society, with a greater focus on demand-oriented and environment-oriented tools such as legal frameworks and incentive mechanisms (Abrams et al., 2025). Despite this, China's systematic evaluation and public reporting of open science policy results remain limited, which not only hinders accurate assessment of policy impacts and comparisons with international best practices (B. Li & Li, 2022), but also reflects the challenges of effectively translating open science policies into practice worldwide. However, China actively participates in global open science governance frameworks, such as the UNESCO Open Science Recommendation, which aims to align national policies with international standards while meeting unique domestic innovation needs (Jin et al., 2023).

Future policy development should explicitly address the political and economic constraints identified in this study. While infrastructure and supply-side investments have laid a solid foundation, the success of open science governance ultimately depends on incentivizing demand, particularly from the private sector and research communities. Introducing targeted incentive mechanisms, such as funding opportunities, recognition programs, and legal frameworks, could encourage greater private-sector engagement and cultural shifts within academia. Without tackling these multifaceted challenges, open science policies risk remaining incomplete and less impactful, hindering the sustainable growth of China's open science ecosystem.

This study has several limitations that warrant attention. First, while this study examined the distribution and coordination of policies, it offered limited evaluation of their actual implementation effects, lacking in-depth analysis of specific outcomes or impacts. Second, this research focused solely on national policy documents, omitting local policies and informal policies, which may hinder a comprehensive understanding of the policy framework. Third, although decentralized coordination among government agencies was observed, the underlying reasons were not thoroughly explored. Fourth, the absence of

comparative analysis with other countries' open science policies restricts the universality and international applicability of the findings. Future research should prioritize evaluating policy implementation effects, incorporating local and informal policies, investigating the causes of decentralized coordination, and conducting international policy comparisons.

Future research should explore how China's open science policies evolve in response to global trends, as well as how researchers and institutions navigate the tensions between financial constraints and knowledge democratization.

Author Contributions: Conceptualization, X.C. and A.M.; methodology, X.C. and A.M.; software, X.C. and A.M.; validation, A.M., X.C. and Y.W.; formal analysis, A.M. and Y.W.; investigation, X.C. and Y.W.; resources, X.C. and A.M.; data curation, X.C. and A.M.; writing—original draft preparation, X.C. and A.M.; writing—review and editing, A.M. and Y.W.; visualization, X.C. and A.M.; supervision, A.M. and Y.W.; project administration, A.M.; funding acquisition, A.M. and X.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the China Scholarship Council (CSC), grant number 202406360084, and the French National Research Agency (ANR), grant number ANR-24-RESO-0001.

Data Availability Statement: The original data that support the findings of this study are available from the Open Science Research Center (http://os.las.ac.cn/zh-CN/policy (accessed on 1 June 2025)) and Chinese government websites.

Conflicts of Interest: The authors declare no conflicts of interest.

References

Abrams, E., Leone, P. V., Cambrosio, A., & Faraj, S. (2025). The governance of open science: A comparative analysis of two open science consortia. *Research Policy*, *54*(3), 105195. [CrossRef]

Appel, A. L., Lujano, I., & Albagli, S. (2018). Open science practices adopted by Latin American & Caribbean open access journals. *Journal d'Interaction Personne-Système*. [CrossRef]

Baker, S. (2023). China overtakes United States on contribution to research in nature index. *Nature*. Available online: https://www.nature.com/articles/d41586-023-01705-7 (accessed on 13 February 2025).

Besançon, L., Peiffer-Smadja, N., Segalas, C., Jiang, H., Masuzzo, P., Smout, C., Billy, E., Deforet, M., & Leyrat, C. (2021). Open science saves lives: Lessons from the COVID-19 pandemic. *BMC Medical Research Methodology*, *21*(1), 117. [CrossRef]

Burgelman, J.-C., Pascu, C., Szkuta, K., Schomberg, R. V., Karalopoulos, A., Repanas, K., & Schouppe, M. (2019). Open science, open data, and open scholarship: European policies to make science fit for the twenty-first century. *Frontiers in Big Data*, *2019*(2), 43. [CrossRef]

Cai, Y., Judd, K. L., & Lontzek, T. S. (2012). Open science is necessary. *Nature Climate Change*, *2*(5), 299. [CrossRef]

Colglazier, E. W. (2023). The precarious balance between research openness and security. *Issues in Science and Technology*, *39*(3), 87–91. [CrossRef]

CRC. (2024). *Communications research Centre Canada open science action plan: 2024–2029*. Available online: https://ised-isde.canada.ca/site/communications-research-centre-canada/en/publications/communications-research-centre-canada-open-science-action-plan-2024-2029 (accessed on 13 February 2025).

Cui, Y. (2016). Policy analysis and recommendations on data center in the process of openly sharing scientifc data. *Library and Information Service*, *60*(8), 73–78.

Gong, K. (2022). Open science: The science paradigm of the new era. *Cultures of Science*, *5*(1), 3–9. [CrossRef]

Guo, H., Liu, J., Chen, F., & Liang, D. (2018). Progress of the "digital silk road" international science program (phase I). *Bulletin of Chinese Academy of Sciences*, *33*(Suppl. S2), 55–60.

Hosseini, M., Hidalgo, E. S., Horbach, S. P. J. M., Güttinger, S., & Penders, B. (2024). Messing with merton: The intersection between open science practices and Mertonian values. *Accountability in Research*, *31*(5), 428–455. [CrossRef]

Huang, J., Zhao, Z., & Wang, F. (2020). Analysis on open science roadmap and design on decision-making method of open science road. *Journal of Library and Information Sciences in Agriculture*, *32*(12), 5.

Huang, Y., Cox, A., & Sbaffi, L. (2020). Research data management policy and practice in China. *International Journal of Digital Curation*, *15*(1), 1. [CrossRef]

Jiang, T., Jia, P., & Zhang, Z. (2022). Content analysis and enlightenment of open science Policiesby European and American countries and international organizations from the perspective of policy tools. *Library and Information Service*, *66*(22), 119–133.

Jin, H., Wang, Q., Yang, Y., & Zhang, H. (2023). The Chinese open science network (COSN): Building an open science community from scratch. *Advances in Methods and Practices in Psychological Science*, *6*(1), 25152459221144986. [CrossRef]

Lattu, A. S. (2023). Open science in China: An open or closed case? [Application/vnd.openxmlformats-officedocument.wordprocessing ml.document]. *Observations*, *13*, 8. [CrossRef]

Li, B., & Li, X. (2022). A review of China's open data policy research. *Open Access Library Journal*, *9*(11), 1–10. [CrossRef]

Li, C., Zhou, Y., Zheng, X., Zhang, Z., Jiang, L., Li, Z., Wang, P., Li, J., Xu, S., & Wang, Z. (2022). Tracing the footsteps of open research data in China. *Learned Publishing*, *35*(1), 46–55. [CrossRef]

Liu, X., & Ding, N. (2016). Research data management in universities of central China: Practices at Wuhan university library. *The Electronic Library*, *34*(5), 808–822. [CrossRef]

Lígia, R., Maria Manuel, B., & Diana, S. (2021). National policy on open science in Portugal: Recommendations of the working group on research evaluation. *Arbor-Ciencia Pensamiento Y Cultura*, *2021*(197), 799.

McWilliams, O. E., III, Grumet, A. M., Param, T. S., Fenton, M., & Schonberger, M. (2025). *DEI on the ropes? The future of DEI in the trump administration*. Holland & Knight Alert.

Montgomery, L., & Ren, X. (2018). Understanding open knowledge in China: A Chinese approach to openness? *Cultural Science Journal*, *10*(1), 17–27. [CrossRef]

Moradi, S., & Abdi, S. (2023). Open science–related policies in Europe. *Science and Public Policy*, *50*(3), 521–530. [CrossRef]

MoST & MoF. (2018). *Notice of the ministry of science and technology and the ministry of finance on issuing the "administrative measures for the national science and technology resources sharing service platform"*. Available online: https://www.most.gov.cn/xxgk/xinxifenlei/fdzdgknr/fgzc/gfxwj/gfxwj2018/201802/t20180224_138207.html (accessed on 20 February 2025).

Mwelwa, J., Boulton, G., Wafula, J. M., & Loucoubar, C. (2020). Developing open science in Africa: Barriers, solutions and opportunities. *Data Science Journal*, *2020*(19), 31. [CrossRef]

Noorden, R. V. (2014). Chinese agencies announce open-access policies. *Nature*, *2014*(509), 262. [CrossRef]

Okafor, I. A., Mbagwu, S. I., Chia, T., Hasim, Z., Udokanma, E. E., & Chandran, K. (2022). Institutionalizing open science in Africa: Limitations and prospects. *Frontiers in Research Metrics and Analytics*, *2022*(7), 855198. [CrossRef] [PubMed]

Oliveira, T., Marques, F. P. J., Leão, A. V., de Albuquerque, A., Prado, J. L. A., Grohmann, R., Clinio, A., Cogo, D., & Guazina, L. S. (2021). Towards an inclusive agenda of open science for communication research: A Latin American approach. *Journal of Communication*, *71*(5), 785–802. [CrossRef]

Plutchak, T. S., Dylla, H. F., Taylor, C., & John, V. (2022). Public access policy in the United States: Impact of the scholarly publishing roundtable. *Learned Publishing*, *2022*(35), 4. [CrossRef]

Ren, X., & Montgomery, L. (2015). Open access and soft power: Chinese voices in international scholarship. *Media, Culture & Society*, *37*(3), 394–408.

Rieger, O. Y., & Schonfeld, R. C. (2023). Common scholarly communication infrastructure landscape review. *Ithaka S+ R*, *2023*, 24.

Rothwell, R., & Zegveld, W. (1981). *Industrial innovation and public policy: Preparing for the 1980s and the 1990s*. Longman.

Schmidt, B., Orth, A., Franck, G., Kuchma, I., Knoth, P., & Carvalho, J. (2016). Stepping up open science training for European research. *Publications*, *4*(2), 16. [CrossRef]

Sheng, X., & Zhang, Y. (2024). Moving with the times: Analysis of national open science policies in China. *Library Tribune*, *44*(8), 143–152.

The State Council. (2001). *Decree of the state council of the people's Republic of China (No. 322) Regulations on the procedure for formulating regulations*. Available online: https://www.gov.cn/gongbao/content/2002/content_61556.htm (accessed on 14 March 2025).

UNESCO. (2021). *UNESCO recommendation on open science*. Available online: https://unesdoc.unesco.org/ark:/48223/pf0000379949?posInSet=3&queryId=4e9e5e25-46d0-428c-86ae-4191da67426c (accessed on 20 March 2025).

Vid, T. (2025). Trump 2.0: An assault on science anywhere is an assault on science everywhere. *Nature*, *2025*(639), 7.

Wei, L., & Li, X. (2017). A comparative study of national level institutional knowledge base services between China and Japan: Taking CHAIR and JAIRO as examples. *Information and Documentation Services*, *2*, 48–53.

Wen, L., Li, Y., & Guo, L. (2021). The practice progress and future exploration of openscience at home and abroad. *Library and Information Service*, *65*(24), 109–122.

Winker, M. A., Bloomb, T., Onie, S., & Tumwine, J. (2023). Equity, transparency, and accountability: Open science for the 21st century. *The Lancet*, *402*(10409), 1206–1209. [CrossRef]

Xiao, H. W., Wang, J., & Fang, X. M. (2022). Frustration over Chinese academic database charges. *Nature*, *605*(7911), 620. [CrossRef]

Xinhua News Agency. (2015). *The state council issued the "opinions on opening major national scientific research infrastructure and large scientific research instruments to the public"*. Available online: https://www.gov.cn/xinwen/2015-01/26/content_2809973.htm (accessed on 12 March 2025).

Yang, W., Liu, X., Huang, J., Xiao, M., Zheng, X., & Chang, R. (2023). Research on China's open science policy system. *Bulletin of Chinese Academy of Sciences (Chinese Version)*, *38*(6), 829–844.

Yuan, Y., Wei, X., Wang, Y., & Zhou, Y. (2023). Research on open science governance framework model. *Bulletin of Chinese Academy of Sciences*, *38*(6), 818–828.

Zhang, L., Wei, Y., Huang, Y., & Sivertsen, G. (2022). Should open access lead to closed research? The trends towards paying to perform research. *Scientometrics*, *127*(12), 7653–7679. [CrossRef]

Zhong, W., Peng, J., & Sun, W. (2009). Measurement of policy, coordination of policy and economic performance: An empirical study on innovation policy (1978–2006). *Science of Science and Management of S.& T.*, *30*(3), 54–60.

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