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CHINA SCIENCE POLICY

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AUTHORS

Asst. Prof. Sanem YAMAK

Prof. Dr. Hüseyin KARAMELİKLİ

Asst. Prof. Abu Saleh Mohammad Mahmudul HASAN

Lect. Ayça GÜLÜNAY

Lect. Serra Nur YILDIRIM

Özlem ÜSTÜN

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KAMU POLİTİKALARI ARAŞTIRMA VE GELİŞTİRME MERKEZİ

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AUTHORS
Asst. Prof. Sanem YAMAK ♦ Prof. Dr. Hüseyin KARAMELİKLİ ♦ Asst. Prof. Abu Saleh Mohammad Mahmudul HASAN ♦ Lect. Ayça GÜLÜNAY ♦ Lect. Serra Nur YILDIRIM ♦ Özlem ÜSTÜN

EDITED BY
Prof. Dr. Fatih KIRIŞIK
Prof. Dr. Ersin MÜEZZİNOĞLU

GRAPHICS DESIGNER
Yaşar KURTTEPE

Contact
Karabuk University
www.karabuk.edu.tr
Karabük University, Iron and Steel Campus, Kılavuzlar Village Öte Karşı University Campus, Central/Karabuk
444 0 478

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AUTHORS:

Sanem YAMAK	ORCID: 0000-0002-9282-5485
Hüseyin KARAMELİKLİ	ORCID: 0000-0001-7622-0972
A. S. M. Mahmudul HASAN	ORCID: 0000-0001-8833-5101
Ayça GÜLÜNAY	ORCID: 0000-0002-7983-2074
Serra Nur YILDIRIM	ORCID: 0009-0001-9370-8584
Özlem ÜSTÜN	ORCID: 0009-0003-8833-8144

EDITED BY

Fatih KIRIŞIK	ORCID: 0000-0002-9663-7502
Ersin MÜEZZİNOĞLU	ORCID: 0000-0001-7095-7869

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FOREWORD

China has become a dominant force in the field of science today, thanks to its contributions to global scientific output and the remarkable rise of its universities in world rankings. This book, prepared within the Karabuk University Public Policy Research and Development Center (KAPGEM), aims to comprehensively examine the science policy that has made China's success in the field of science possible. In this regard, we aim to clarify the background of this success by focusing on the fundamental components of Chinese science policies.

We would like to express our gratitude to Prof. Dr. Fatih Kırışık and Prof. Dr. Ersin Müezzinoğlu, our table members Prof. Dr. Hüseyin Gümüş and Prof. Dr. Mustafa Boz, for their valuable opinions and suggestions during the preparation of this study; to Assoc. Prof. Dr. Mehmet Kırlıoğlu for his support in the publication process of the book; and also to Dr. Ş. Tuğçe Renda, another table member, for sharing her valuable observations from China.Sincerely,

KAPGEM China Policies Desk
December 2025

ABBREVIATIONS

AI	Artificial Intelligence
BRI	Belt and Road Initiative
BRICS	Brazil, Russia, India, China, South Africa
CAS	Chinese Academy of Sciences
CCG	Center for China and Globalization
CPC	Communist Party of China
CSNS	China Spallation Neutron Source
EU	European Union
FAST	Five-hundred-meter Aperture Spherical Telescope
FTE	Full Time Equivalent
FWCI	Field-Weighted Citation Impact
GDP	Gross Domestic Product
HCR	Highly Cited Researchers
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITER	International Thermonuclear Experimental Reactor
JCM	Joint Consulting Mechanism
MOST	Ministry of Science and Technology
MSRA	Microsoft Research Asia
NSFC	National Natural Science Foundation of China
NYU	New York University

PCT	Patent Cooperation Treaty
PIFI	President's International Fellowship Initiative
PRC	People's Republic of China
PTSTA	Promoting the Transformation of Scientific and Technological Achievements
R&D	Research and Development
RFIS	Research Fund for International Scientists
RMB	Chinese Yuan (*Renminbi*-"People's Currency")
SKA	Square Kilometer Array
SME	Small and medium-sized enterprise
SRE	Science, research, and education
SSRF	Shanghai Synchrotron Radiation Facility
SSTC	State Science and Technology Commission
S&T	Science and Technology
STA	Science and Technology Agreement
STEM	Science, Technology, Engineering, and Mathematics
TÜBİTAK	The Scientific and Technological Research Council of Türkiye
WIPO	World Intellectual Property Organization
XJTLU	Xi'an Jiaotong-Liverpool University

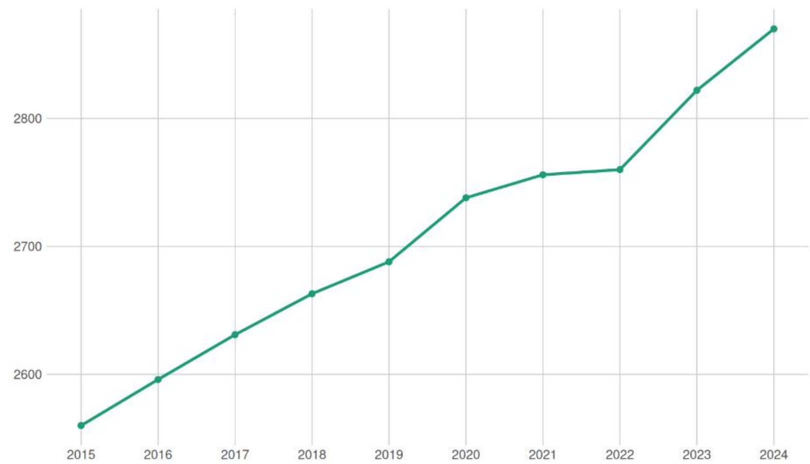
INTRODUCTION

China stands out as the country making the largest contribution to global publication output today and exemplifies a radical transformation in scientific production. In a conference in 2016, Xi Jinping, President of the People's Republic of China, set forth China's goal of becoming an "innovative" power in science and technology by 2020, a "pioneering" power by 2030, and a "leading" power by 2049. He also emphasized that science and technology are the foundation of "the nation's strength, the triumphs of enterprises, and a better life for people", and that innovative development in these areas is necessary not only for development but also for gaining a competitive advantage (China Daily, 2016). In another conference in 2024, Xi Jinping reiterated the goals of achieving self-sufficiency in innovation and becoming a world leader in science and technology, emphasizing increased international partnerships, the training of skilled human resources, relying on market forces in resource allocation while maintaining the guiding role of the state, and strengthening ties between industry, universities, and research institutions (Xu, 2024). As a result of the significant role assigned to science and technology, policies in this area were centralized and placed under the control of Communist Party during this period. In 2023, the role of the Ministry of Science and Technology was redefined, and the Central Science and Technology Commission, a party body hierarchically above the Ministry, was established (Ahlers, 2024, p. 4).

Since Deng Xiaoping reign, China has achieved a significant portion of its goals through its policies and has already become a dominant player in the field of science. This position is the result of a strategy of long-term planning, centralized coordination, continuous investment in universities and other research institutions, and providing scientists with a favorable working environment and support in terms of research opportunities and incentives. Over the past two decades, China has increased public funding for research and development at an unprecedented rate, established latest technology facilities, engaged in international collaborations, and made significant progress in reversing the brain drain.

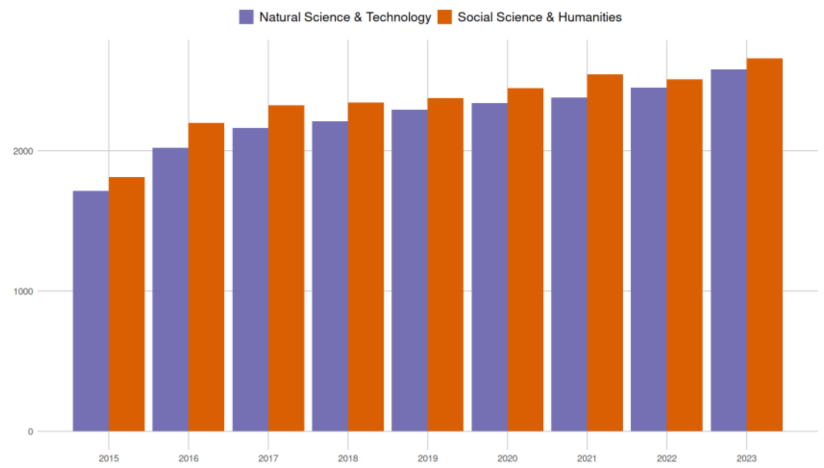
In this process, in line with its policy of training qualified human resources, China has prioritized expanding and strengthening higher education. The number of higher education institutions, which was 2,560 in 2015, reached 2,870 in 2024. The 50.55% growth in the number of units in higher education institutions focused on natural sciences and technology (from 1,713 in 2015 to 2,579 in 2023) reflects China's priority on STEM (Science, Technology, Engineering, and Mathematics). The growth rate in Social Sciences and Humanities is 46.53% (from 1,814 in 2015 to 2,658 in 2023). R&D (Research and Development) units showed the largest increase, with a growth rate of 129.13%, raising the number of R&D units in higher education from 11,732 in 2015 to 26,881 in 2023. In this context, the number of R&D personnel in higher education institutions also increased by 121.15%, from 838,800 in 2015 to 1,855,000 in 2023 (National Bureau of Statistics of China, 2024).

Figure 1: Total Growth of Higher Education Institutions (2015–2024)



Source: (National Bureau of Statistic of China, 2024)

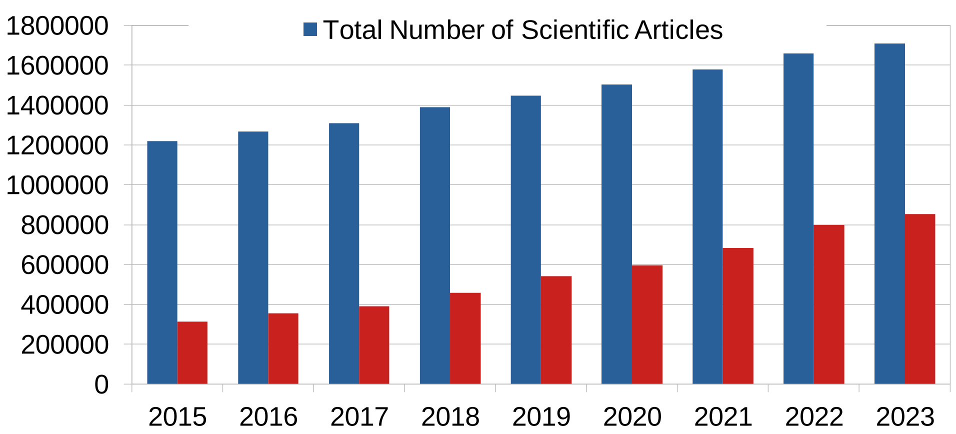
Figure 2: Growth of Natural and Social Sciences Institutions (2015–2023)



Source: (National Bureau of Statistics of China, 2024)

A significant increase has also been observed in the total number of articles published by Chinese higher education institutions. The number of articles published by higher education institutions increased from 1,220,467 in 2015 to 1,707,581 in 2023, representing a 39.9% increase. The number of articles published in foreign journals increased from 313,698 in 2015 to 851,635 in 2023, indicating a 171.48% increase (National Bureau of Statistics of China, 2024).

Figure 3: China's Scientific Publications and Growth Rates (2015–2023)



Source: (National Bureau of Statistics of China, 2024)

Impactful scientific publications by Chinese scientists have also significantly increased. In 2022, China surpassed the US in relative participation in the top 1% of most cited studies; its representation in Web of Science arose from less than 2% in 1990 to 25% in 2023 (Wagner, 2024, p. 1). Chinese Academy of Sciences (CAS) ranked first with 9445 publications and a share of 2776.90, while the University of Science and Technology of China ranked third among the *Nature Index*'s "Research Leaders of 2025", based on data from January 1, 2024, to December 31, 2024. Even more noteworthy is the presence of eight Chinese universities in the top ten (Nature Index, 2025). According to *Times Higher Education World University Rankings 2025*, four Chinese universities are among the top 50: Tsinghua University (12th), Peking University (13th), Fudan University (36th), and Zhejiang University (47th) (Times Higher Education, 2025).

The number of R&D projects, which was 841,520 in 2015, reached 1,701,829 in 2023. Total expenditure on these projects increased from 76.56 billion Yuan in 2015 to 171.13 billion Yuan in 2023 (National Bureau of Statistics of China, 2024).

Another significant growth is seen in the patent statistics in China. The number of accepted higher education patent applications rose from 190,351 in 2015 to 346,835 in 2023; the total number of patents granted increased from 127,329 in 2015 to 254,978 in 2023; accepted invention patent applications increased from 109,911 in 2015 to 254,978 in 2023; and accepted invention patents increased from 55,021 in 2015 to 184,693 in 2023 (National Bureau of Statistics of China, 2024).

The foundations for these scientific advancements in China were laid during the "reform and opening-up" process that began with Deng Xiaoping's rise to power in 1978. Deng's "reform and opening up" policy aimed to achieve development by transitioning from central planning to a "socialist market economy", integrating with the global economy through investment and trade, and transferring science and technology from abroad. In this context, household-based production was encouraged, particularly to increase agricultural output; small-scale enterprises were allowed to revitalize rural industries; and Special Economic Zones operating on free-market principles were established in some provinces to attract foreign investment and promote foreign trade. As a result of all these policies, China became one of the world's largest economies (Cable, 2017, pp. 4-5; De Freitas, 2019, pp. 14-17).

During this development process, Deng also placed special emphasis on advancements in science and technology. He viewed science and technology, alongside agriculture, industry, and defense, as one of the "four pillars of modernization" and a strategic tool for development (Xiong, 2021, pp. 162-163). Deng considered it necessary to learn advanced foreign technologies, send students abroad, invite scientists from abroad to teach at universities in China, and give priority to applied sciences in order to advance in science and technology (Xiong, 2021, p. 166). In line with this, in 1977, the State Commission for Science and Technology was re-established by the Party to be responsible for general science and technology policy and managing cooperation with the West in these areas; agreements were made with Japan, Europe and the USA for the exchange of science and technology (Xiong, 2021, pp. 167-168, 179-182).

In this period, where science and technology policies were shaped around the goal of contributing to economic development, the Central Committee of the Communist Party of China (CCP) adopted a resolution in March 1985 to reform the management of science and technology. Following this resolution, the State Science and Technology Commission (SSTC) published the "White Paper on

Science and Technology Policy" (1986), implemented reforms in funding, gave research institutions the initiative to undertake their own projects while national projects remained under the control of central planning authorities, motivated researchers with awards, bonuses, and patent rights, and directed some research institutions towards producing "commercially viable technology" (Baark, 1987, pp. 390-391, 393). In this respect, the Deng reign was a period in which foreign cooperation was pursued, and policies aimed at diversifying infrastructure investments and financial resources for scientific and technological development were followed.

China has achieved its current position in science through a multifaceted science policy pursued from the Deng reign to the present day. The basic components of China's science policy will be examined below.

1. Strategic State Vision, Long-Term Planning and Central Coordination

China's science policy is multifaceted, ranging from infrastructure development and funding solutions to human resource training and increasing and improving scientific output. The most fundamental characteristic of this multifaceted policy is its success through long-term and detailed state planning and the stable implementation of these plans under central coordination.

Among the institutions responsible for China's science and technology policy, the Central Science and Technology Commission, the State Council, and especially the Ministry of Science and Technology are the most important. The Central Science and Technology Commission combines the responsibilities of the previously established National Science and Technology Leading Group, National Science and Technology System Reform and Innovation System Construction Leading Group, and the Medium- and Long-Term Science and Technology Development Plan Leading Group, all of which were subordinate to the State

Council. The Commission is responsible not only for coordinating science and technology policy but also for formulating policies in this field and is directly accountable to the Party. Its powers include determining strategies, plans, and policies in the field of science and technology, setting priorities, and allocating strategic resources (Naughton et al., 2023, pp. 5-6, 12). In addition to the Ministry of Science and Technology, other relevant ministries, primarily the Ministry of Education, the Chinese Academy of Sciences, the Chinese Academy of Engineering, the Chinese Academy of Social Sciences, and the National Natural Science Association of China are also among the responsible institutions (Serger and Breidne, 2007, p. 157).

China prepares medium- and long-term plans in the field of science and technology and they also allocate significant space to science and technology in their five-year development plans. During the Hu Jintao reign (2002-2012), which highlighted the goals of reducing technological dependence and increasing domestic innovation, the "Medium- and Long-Term Plan for the Development of Science and Technology (2006-2020)" was prepared. This plan set out the goals of China becoming an "innovation-oriented society" by 2020 and a world leader in science and technology by 2050. To implement the plan, amendments were made to the Science and Technology Advancement Act and the Patent Act, and the five-year plans related to science and technology have been important tools for its implementation (Sun and Cao, 2021, p. 2).

Increasing the share of GDP allocated to R&D to 2.5%; raising the contribution of scientific and technological progress to economic growth to 60% or more; reducing dependence on foreign technology; and making China one of the top five countries in the world in terms of the number of patents and citations by Chinese researchers are concrete goals of this plan. By 2020, these goals had been largely achieved; for example, the number of patents increased from 524 in 2005 to 5323 in 2018, raising China's ranking from 13th to 3rd place, while the number of citations moved up to 2nd place by 2021 (Sun and Cao, 2021, p. 2).

The Plan, which involved 2,000 researchers during its three-year preparation phase, identified 11 priority areas, including biotechnology, aviation, maritime, and space technologies, and proposed 16 major projects in these areas. The Plan envisages increasing access to energy, water resources, and environmental technologies, developing patented products, investing more in fundamental and multidisciplinary research, providing tax breaks to small and medium-sized enterprises (SMEs), and directing these enterprises towards R&D. The State Council appointed a responsible ministry and a senior official for the 99 implementation policies supporting the Plan, and defined the implementation process, collaborating institutions, and work schedule (Serger and Breidne, 2007, pp. 149-151).

The 14th Five-Year Plan (2021-2025) and the 2030 Vision include strengthening the science and technology infrastructure, increasing and modernizing national laboratories; focusing on priority areas such as energy, artificial intelligence, biomedicine, nanoelectronics, infectious diseases, biosafety, and pharmaceuticals, and developing strategic projects in these areas; encouraging resource sharing and more rational allocation among universities, research institutes, and enterprises; strengthening fundamental research by developing a 10-year fundamental research action plan, increasing funding and public and private sector contributions; improving evaluation and incentive systems; establishing strategic platforms for innovation, transforming certain regions such as Beijing and Shanghai into global innovation centers; and establishing national science centers, scientific data centers, advanced technology and knowledge sharing platforms (The People's Republic of China, 2021, pp. 10-13).

Some of the key objectives highlighted in the "Recommendations" by CPC Central Committee's for the 15th Five-Year Plan (2026-2030) are: achieving breakthroughs in core technologies to increase self-sufficiency in science and technology and accelerate innovation; promoting innovation and supporting young scientists; promoting scientific literacy in society; ensuring coordination and talent flow among higher education institutions, research institutes, and enterprises; increasing and encouraging the role of enterprises in technological innovation; deepening international cooperation; and developing talent in strategic areas of expertise (Central Committee of the Communist Party of China, 2025, pp. 12-14).

In summary, China's science policy is implemented in line with development goals, through detailed plans involving a large number of people, including scientists, and under central coordination.

2. Infrastructure, R&D and Financing Policies

To advance in science and technology, China has focused on strengthening the infrastructure of higher education institutions and increasing and diversifying funding sources. In 1978, funding was provided to institutions directly under the State Education Commission to support trial production of new products, intermediate experiments, and major research projects; from 1979 onwards, Science and Technology funds were allocated; and from 1982, a special grant was provided for research to 88 major universities (Conroy, 1989, p. 49).

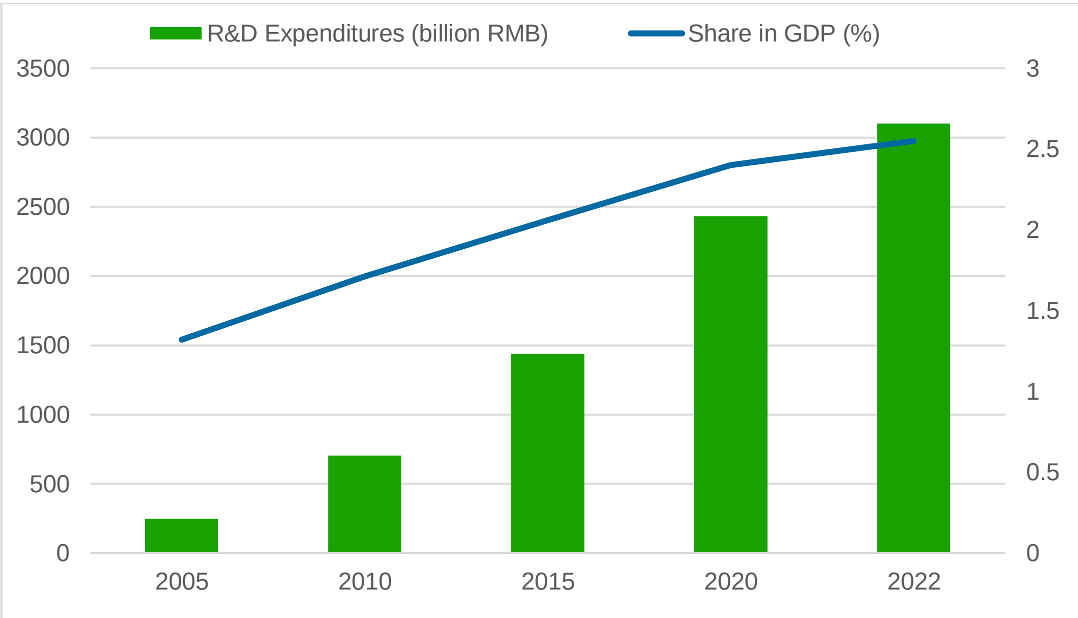
Investments were made in the R&D infrastructure of universities; in 1981, the number of institutes/laboratories in 23 universities, designated as "key points", reached 518, and the number of R&D personnel reached 16,800. While some of these institutes/laboratories were established in partnership with ministries, companies, and local governments and were largely financed by these partners, in

1985, a number of national research laboratories were established in higher education institutions with the aim of conducting research and training high-level personnel, financed by special funds of the State Planning Commission (Conroy, 1989, pp. 47-48, 61). From the late 1970s to mid-1985, higher education institutions won 45% of all State Natural Sciences Awards and 25% of all State Invention Awards, while in 1985, their share of all patent applications reached 42% (Conroy, 1989, p. 51). In 1984, the number of social science research institutes in higher education institutions ascended to 430, 70% of the country’s research staff were employed by these institutes, and half of the social science research projects that are listed in the 6th Five-Year Plan were undertaken by universities (Conroy, 1989, p. 52).

During this process, the autonomy of universities was increased, and attempts were made to solve their funding problems through the rights granted to them. In this context, the State Council published the “Temporary Regulations on the Administration of Higher Education Institutions” in 1986, granting universities the authority to accept projects from other institutions, establish independent or joint research organizations or teaching-research-production units, propose the appointment and dismissal of personnel, distribute funds, and play a role in developing international exchange using their own funds (Conroy, 1989, p. 56; Agarwala and Chaudhary, 2019, p. 210). With an annual budget of 50 million Yuan, the science foundation fund provided by the Chinese Academy of Sciences also provides a significant resource for research that does not directly contribute to production. In 1986, the State Council decided to establish a National Science Foundation with an annual budget of 100 million Yuan, and also created the Unified Center for Science and Technology Development of Higher Education to coordinate research resources within higher education institutions, “match the strengths of universities with industrial needs, and promote the commercialization of research results" (Conroy, 1989, pp. 59-60).

Driven by innovation, China's R&D budget has increased dramatically over the past two decades. As shown in Figure 4, China's R&D spending has increased more than tenfold between 2005 and 2022. Its share of GDP exceeding 2.5% has brought China to a level comparable to OECD countries. In 2024, China spent 3.63 trillion Yuan on R&D, representing 2.69% of GDP. University R&D spending reached 306.55 billion Yuan in 2024, an increase of 11.3% (National Bureau of Statistics of China, 2025).

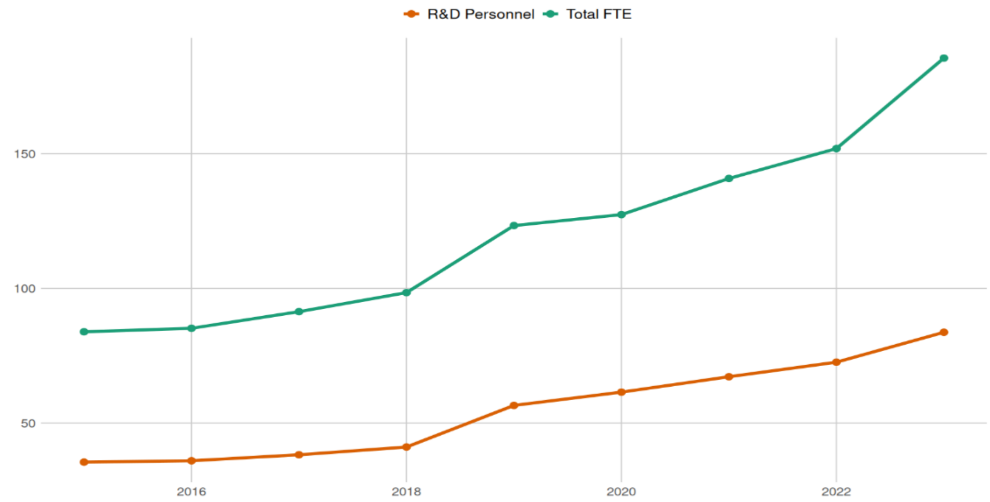
Figure 4: Development of China's R&D Expenditures (2005–2022)



Source: 国家统计局 (National Bureau of Statistics of China, 2023).

The growth of R&D-focused institutions in higher education is also noteworthy. The number of R&D-focused institutions increased from 11,732 in 2015 to 26,881 in 2023, representing a total increase of 129.13% (National Bureau of Statistics of China, 2024). The number of R&D personnel in higher education institutions increased from 838,800 in 2015 to 1,855,000 in 2023 (National Bureau of Statistics of China, 2024).

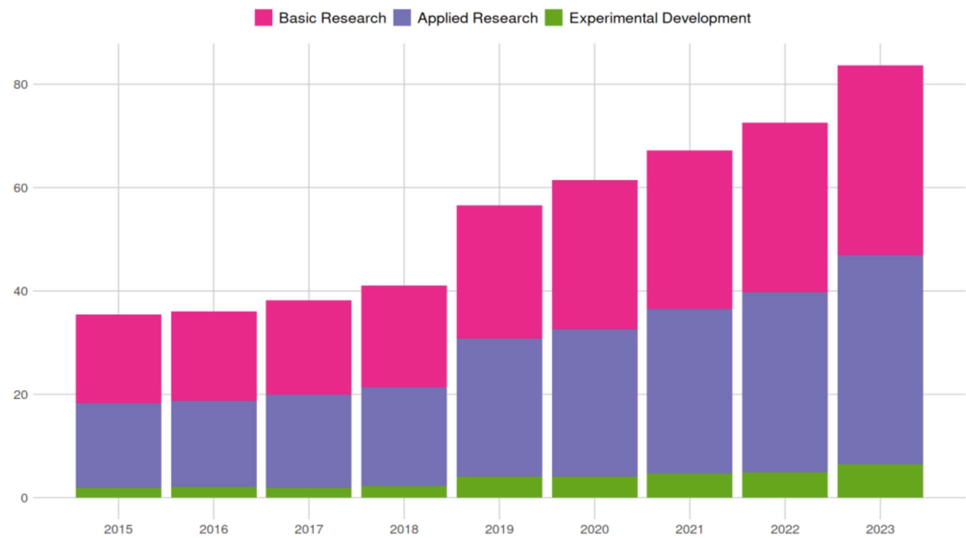
Figure 5: Growth of R&D Personnel and Total FTE (2015–2023)



Source: (National Bureau of Statistics of China, 2024)

As shown in Figure 6, which illustrates the distribution of FTE according to research types, basic research constitutes the largest category, while experimental development stands out as an area with rapid growth.

Figure 6: Distribution of FTE by Type of Research (2015–2023)



Source: (National Bureau of Statistics of China, 2024)

3. University-Industry Collaboration

Another component of China’s science policies is the collaboration between university and industry. With the science and technology reform of 1986, discussed above, China encouraged collaboration between research institutions and industry and included enterprises in the financing of science and technology. The “9th Five-Year National Economic and Social Development Plan” of 1995 also set out goals to create a mechanism that tightly links R&D, production, and marketing, and to strengthen cooperation between universities and industry. Specifically, it aimed to support the integration of research institutions developing applied technologies into large industrial groups or their transformation into high-tech firms, as well as to support large and medium-sized enterprises in establishing their own technology development centers. In line with this, collaborations between research institutions and enterprises were strengthened, and “Project 211”, launched in the same year and examined below, accelerated the sharing of knowledge and technology between universities and industrial enterprises (Liu and Jiang, 2001, pp. 278-279).

To enhance science-industry collaboration, particularly to encourage more active participation of universities and public research institutions in knowledge transfer activities, significant amendments were made to the Law on Promoting the Transformation of Scientific and Technological Achievements (PTSTA) in 2015. Adopted policies included establishing a coordination mechanism for industry, universities, and public research institutions; creating a commercialization base and a national technology trade network platform; developing “producer areas” to open up the resources of universities and research institutions to the public; and training knowledge transfer personnel (Chen et al., 2021, pp. 299, 307).

Universities and research institutes, in accordance with the law that "stipulates that at least 50% of the net profit from knowledge transfer must be given as awards or compensation to inventors and other individuals who have made significant contributions to the transfer, including knowledge transfer officers", have adopted policies to strengthen cooperation such as increasing the amount of awards given to participants, establishing knowledge transfer institutions like Hunan Chinese Medical University and Central South Forestry and Technology University, offering advancement opportunities to knowledge transfer participants, marketing products through participation in trade fairs, granting permission to academics to start businesses, encouraging entrepreneurship among staff and students, and establishing a joint research institute. In addition, policies aimed at fostering industrial technology innovation include establishing strategic alliances, involving businesses in the development of industrial development projects and research funded under the National Science and Technology Plan, building national technology innovation platforms or innovation centers to promote cooperation on national strategic industrial technologies, and establishing science parks, which are also encouraged by the government through tax exemptions and reductions (Chen et al., 2021, pp. 308-310).

In line with these policies, collaborations between universities, research institutes, and industry have increased. Institutions such as Tsinghua University and Peking University not only have been producing academic publications but also have been conducting joint projects with companies like Huawei, Alibaba, and ZTE. Through university-industry collaboration, China has made remarkable progress in artificial intelligence and advanced manufacturing. These collaborations enable China to gain a competitive advantage in global fields such as artificial intelligence, biotechnology, and renewable energy. Furthermore, companies have been establishing their own R&D centers, operating in accordance with government policies, thus enabling the rapid commercialization of fundamental knowledge produced in universities (Li & Zhang, 2021).

4. Human Capital Development and Strengthening Policies: Efforts to Transform Chinese Universities into World-Class Universities

China's scientific breakthrough is largely based on comprehensive strategies such as cultivating a high-quality scientific workforce, restructuring academic institutions, and aligning education systems with national development goals. There is a significant correlation between quantitative and qualitative achievements in higher education and the country's economic development at the national and regional levels. Huang et al. (2023, p. 28) found in their analysis that higher education in China contributes to high-quality economic development through human capital accumulation and technological innovation; Li and Kang (2025, p. 13) indicated a correlation coefficient of 0.423 between the number of higher education graduates and provincial-level per capita GDP, suggesting a significant contribution of higher education to regional economic development; and Xia and Qiu (2021, p. 304), in their analysis based on provincial panel data from 2012-2018, revealed a "significant and positive correlation" between the quality of teaching and research and regional economic development.

Human capital is central to China's progress and enhancing the quality and international competitiveness of Chinese researchers, students, and universities is crucial. However, what distinguishes China is not just the volumetric growth in the academic field, but also the shift from quantity to quality, heavily guided and managed by the state. Government policies such as "Double-First Class University Plan", "Thousand Talents Plan", and the restructuring of nationwide academic evaluation systems aim to address issues such as brain drain, institutional inefficiency, and an overemphasis on publication quantity.

Simultaneously, efforts have been made to improve the quality and reliability of research through new policies on evaluation systems, peer review, and research ethics.

An examination of post-Mao Chinese policies reveals that initiatives in education and science were cornerstones of the modernization process. Recognizing the direct link between education and economic and social development, it became a strategic goal to increase the educated workforce. Thus, to establish a higher education system compatible with China's rising economic power, education was restructured from the mid-1990s onwards to create world-class universities (Ngok and Guo, 2008, p. 546).

With the goal of transforming Chinese universities into world-class institutions, the "Outline for Reform and Development of Education in China" was published by the State Council in 1993, "Project 211" was launched by the Ministry of Education to support the development of 100 leading universities, and the "Revitalize China Through Science and Education" strategy was announced in 1995. The Higher Education Law of 1998 assigned universities the tasks of "talent development, scientific research, and social service", while "Project 985", which included some of the universities under "Project 211", was launched in 1999, and these universities benefited from preferential funding, as will be examined in detail below (Chen et al., 2021, p. 301).

4.1. Project 211 and Project 985

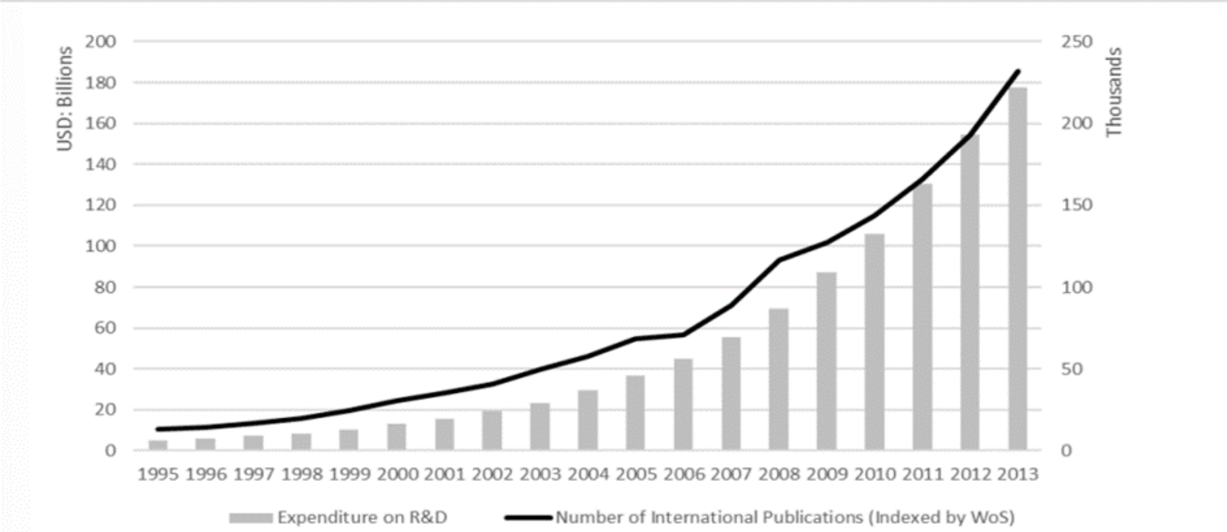
As part of its social and economic development strategy, "Project 211" was launched in 1995 under China's 9th Five-Year Plan. This project aimed to establish 100 world-class higher education institutions in the 21st century. The cultivation of a high-level professional workforce, enhancing China's international competitiveness, and advancing scientific and technological development was among the main objectives of the project. To achieve these goals, a group of universities was created that would improve quality in R&D, management, and institutional efficiency, benefiting from special funding (Brandenburg and Zhu, 2007, p. 37). Chinese government contributed approximately US$2.7 billion to this project, and 116 universities were included in "Project 211" (Quan et al., 2017, p. 488). The first phase of the project was implemented between 1996 and 2000, and it was announced that numerous important disciplinary fields were developed, yielding significant results and returns (Ngok and Guo, 2008, p. 546).

In May 1998, then-President Jiang Zemin of PRC declared the need for world-class universities and launched the "Education Action Plan Towards the 21st Century". Named "Project 985" because of its 1998, May announcement, this project aimed to establish a series of high-level research institutions alongside universities that could compete with the world's most successful higher education institutions. Between 1999 and 2003, over €1.26 billion was invested in the project, with ten universities (Peking University, Fudan University, Harbin Institute of Technology, Hefei University, Nanjing University, Shanghai Jiao Tong University, Tsinghua University, University of Science and Technology, Xi'an Jiao Tong University, and Zhejiang University) also included in "Project 211" becoming the focal point of the project (Brandenburg and Zhu, 2007, p. 39). Universities participating in "Project 985" received additional support beyond the special support provided under "Project 211"; for example, Peking and Tsinghua Universities received 1.8 billion Yuan (US$225 million) in the first phase, while Fudan, Zhejiang and Nanjing Universities received 1.2 billion Yuan (US$150 million) (Mohrman, 2005, p. 22).

In 2011, admissions to both projects were suspended, and a three-tiered hierarchy was established. The 39 universities in "Project 985" were grouped as Tier 1, while the 73 universities in "Project 211" were in Tier 2, and the 1124 universities not involved in either project were in Tier 3. Different budget allocations were given to universities in different tiers, with Tier 1 and Tier 2 universities receiving approximately 12 times more budget than Tier 3 universities (Quan et al., 2017, p. 488).

Driven by investment and economic development, China's academic input and output increased significantly between 1995 and 2013. During this period, R&D expenditure increased approximately 33-fold, while the number of international publications increased 17-fold (Quan et al., 2017, p. 487).

Figure 7: China Research Input and Output (1995-2013)



Source: (Quan vd., 2017, p. 487)

4.2. Double First-Class University Plan

Considering the need for new reforms in the policies of key institutions to ensure the sustainability of the achievements obtained, the Chinese government has continued its work in line with the results of Projects "211" and "985" (Liu et al., 2023, p. 1). To implement the "Medium and Long-Term Plan on Developing High-Skilled Talent (2010-2020)", CPC established the Central Leadership Group for Coordinating Talent Development. This plan, which includes goals such as developing the talents of the population, attracting human capital to the country, and prioritizing software and innovation, also identified what types of talents are needed in which sectors, what needs to be done to develop these talents, and the necessary policy and institutional-level improvements for their employment (Cao et al., 2020, p. 174).

In 2015, the Chinese Ministry of Education published the "General Program for Coordinating and Promoting the Construction of World-Class Universities and First-Class Disciplines", announcing new goals to further improve the quality of higher education. The implementation steps and the list of universities where "Double First Class" will be implemented were determined by the "Coordination Implementation Measures for Promoting the Construction of World-Class Universities and First-Class Disciplines" and the "Circular on the Announcement of the List of Universities and Disciplines to be Built by World-Class Universities and First-Class Disciplines", jointly published by the Chinese Ministry of Education, the Ministry of Finance, and the National Development and Reform Commission (Chen et al., 2024, p.2). In September 2017, the initiative officially launched with 42 universities being selected as "world first class" universities by the Ministries of Education and Finance and the National Development and Reform Commission, and 95 universities being selected for the implementation of world-class disciplines (Liu et al., 2023, p. 1).

The university selection process in China's "Double First Class" initiative was characterized by the predominant preference for established institutions possessing the cumulative advantages of "Project 985". Selection criteria prioritized serving national strategic needs and supporting advanced science and technology fields, particularly giving priority to Engineering and Natural Sciences disciplines. Fields such as Materials Science, Engineering, Chemistry, and

Biology were highlighted, while disciplines such as Marxist Studies and Traditional Chinese Medicine received special support. The program adopted a merit-based approach while prioritizing efficiency, resulting in developed regions like Beijing, Shanghai, and Jiangsu maintaining a clear advantage. Initiative's five-year cycles, implemented through a dynamic evaluation mechanism and continuous performance monitoring, created the risk of excluding underperforming universities from the program while offering participation opportunities to successful new universities. This selection strategy aimed to create a dynamic competitive environment while serving national development goals (Liu, 2018, pp. 148-149).

With this initiative, China has begun to implement new approaches, different from "Project 211" and "Project 985," such as developing disciplines, expanding the autonomy of universities, and choosing a performance-based evaluation mechanism for adjusting the allocated funds. The aim of these approaches is to complement the shortcomings of previous policies and to have universities that are considered among the best in the world (Lin and Wang, 2021, p. 819).

As a result of these efforts, according to Shanghai Ranking data for the years 2017-2025, while only two Chinese universities were among the top 100 universities in the world academic rankings in 2017 (Shanghai Ranking, 2017), this number increased to 15 in 2025 (Shanghai Ranking, 2025). According to SCImago Institutions Rankings data, as of 2020, China has risen to first place in the world in both publications and citations (SCImago Institutions Rankings, 2025).

4.3. Policies to Reverse Brain Drain: Thousand Talents Plan

One of China's policies regarding human capital in the field of science is to reverse the brain drain. "Thousand Talents Plan" is a strategy considered as the second phase of China's brain drain reversal process, which began in the 1980s. Building on the momentum gained from a report prepared by the Ministry of Education in 2007, "Thousand Talents Plan", presented by the Talent Central Coordination Group in 2008, aimed to bring back 2,000 highly talented Chinese citizens within 5 to 10 years (Zweig and Wang, 2013, p. 601).

Central Talent Coordination Group consists of members from several ministries and is directly subordinate to Central Organization Department of the Communist Party of China. All responsibilities of the group are related to providing guidance and advice to the leadership of the CPC on talent recruitment and development. The plan prepared by this group in 2008 points to the importance of human capital and emphasizes that attracting talented minds to the country is necessary for China to increase its global competitiveness (Zweig and Wang, 2013, p. 601).

"Thousand Talents Program", guided by the "talent super-power" strategy (Communist Party of China Central Organization Department, 2011, p. 1), has advised both national and local governments to implement their own plans, and many provincial and city governments have put talent attraction projects into practice (Centre for China and Globalization, 2017, pp. 20-21; Wang and Bao, 2015, p. 181; Zweig and Wang, 2013, pp. 601-602).

Participants in the program must be individuals under 55 years of age with a doctoral degree obtained abroad and agree to work in China for at least six months of the year. The program targets four types of talent (Zweig and Wang, 2013, p. 602):

> (a) experts and academics with the same title as professors at prestigious foreign universities and scientific research institutes;
>
> (b) senior technical and management experts working at well-known international companies;

(c) entrepreneurs with registered intellectual property rights or expertise in "core technologies," who have overseas experience as entrepreneurs and familiarity with international practices;

(d) other high-level innovative and entrepreneurial talent in urgently needed fields.

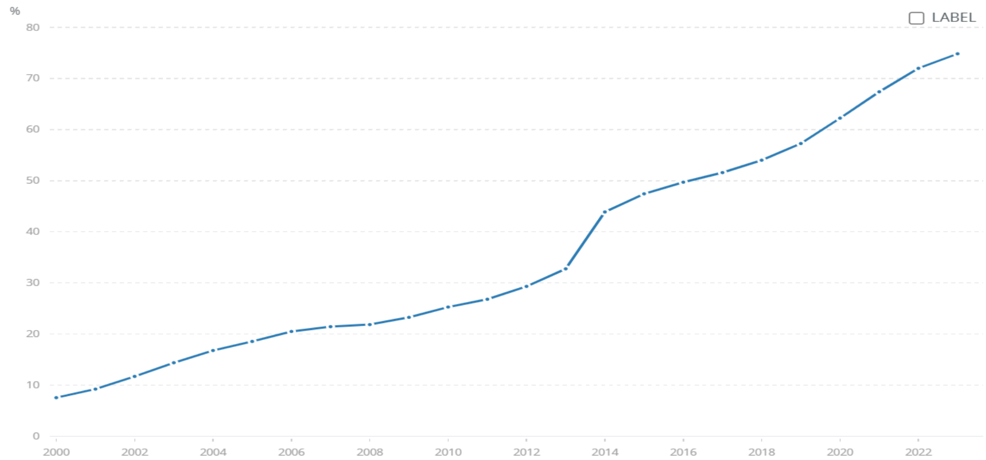
These individuals are provided with opportunities such as leadership positions in their workplaces, permanent residency or multiple-entry visas valid for 2 to 5 years, employment for their spouses, guaranteed admission to good schools for their children, residency in their chosen city, a subsidy of 1 million Chinese Yuan, retirement benefits, health insurance, and assistance for housing, food, etc. (Zweig and Wang, 2013, p. 602).

A funding system for universities and researchers has also been implemented within the framework of the "Thousand Talents Plan". Universities with students accepted into the program receive $1.2 million in support to use for addressing deficiencies or providing scholarships, thus contributing to the plan (Zweig and Wang, 2013: 604). The central government provides a one-time subsidy of approximately $160,000 per person to long-term project specialists under the program (Communist Party of China Central Organization Department, 2011). By 2012, exactly 3319 highly educated individuals had returned to China, and this number had risen to over 4000 in 2013 (CCG, 2017, p. 18).

In addition to this program, in December 2010, a new program, "Thousand Talents Youth Program" was launched, aiming to bring 2000 people under the age of 40 to China, and another program, "Thousand Foreign Talents", targeting "foreign scientists, engineers, and managers" (Zweig and Wang, 2012, p. 602).

With its vision of building a modern socialist nation by focusing on education as the cornerstone of society, China has taken steps to a leading position in education in 2022. In 2022, China had 518,500 educational institutions of all types and levels, and 293 million enrolled students. The number of full-time teaching staff was 18,803,600 (Ministry of Education The People's Republic of China, 2018). The increase in the enrollment rate in higher education in China from 8% to 62% between 2000 and 2020, and to 75% between 2020 and 2023, reflects the priority given to the massification of higher education (Figure 8).

Figure 8: Higher Education Enrollment Rate in China



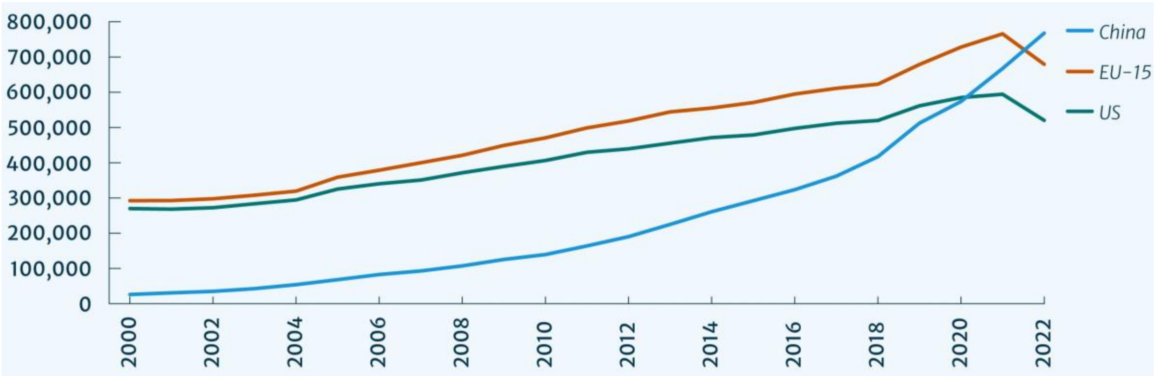
Source: (World Bank, World Development Indicators, 2025)

As a result of academic reforms, China has surpassed the US in scientific publications since 2018, becoming the world's largest producer of scientific publications (Figure 9).

The impact factor of these scientific publications has also been steadily increasing since 2000 and is comparable to much of Europe and the US (Figure 10).

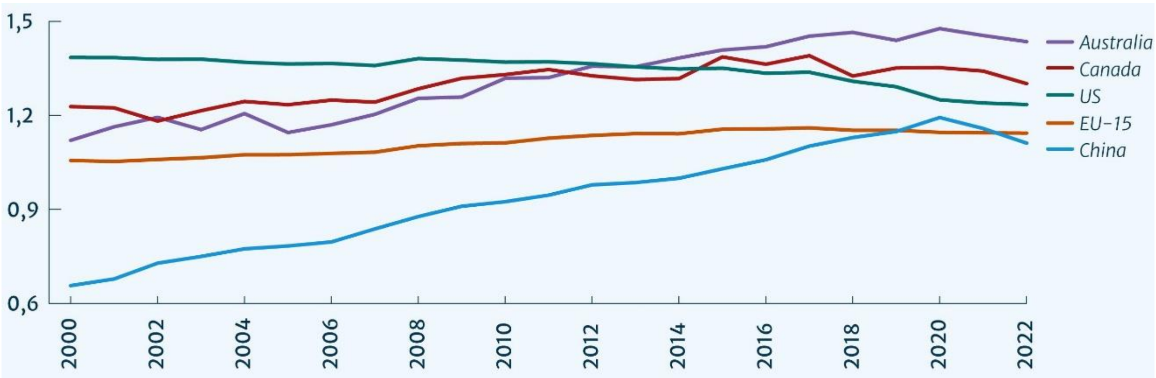
In parallel, Chinese universities have risen in global rankings; for example, Tsinghua University is ranked number 1 in Asia and among the top 20 globally in engineering and computer science (QS World Rankings, 2024).

Figure 9: Comparison of citable research papers from China, the USA and EU-15[1] between 2000 and 2022.



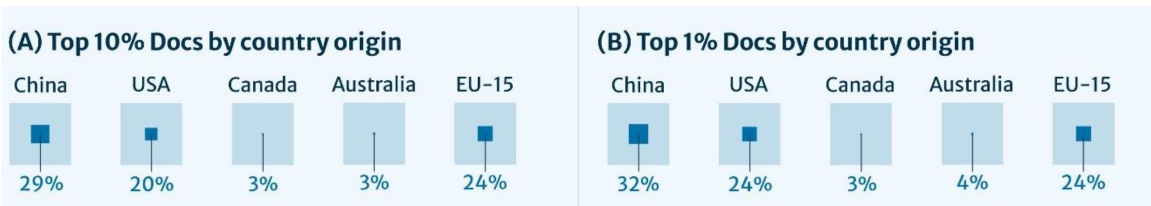
Source: (Springer Nature, Global Research Pulse: China, 2025)

Figure 10: Comparison of CNCI[2] in China, US, EU-15, Canada and Australia between 2000 and 2022.



Source: (Springer Nature, Global Research Pulse: China, 2025)

Grafik 11: Proportions of most cited papers from China, USA, Canada, Australia and EU-15. (A) Top 10%; (B) Top 1%.



Kaynak: (Springer Nature, Global Research Pulse: China, 2025)

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[1] EU-15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom

[2] Category Normalized Citation Impact

China, which was second only to the US in 2010, has climbed to first place by 2020. The number of publications and citation rates in China have increased rapidly, particularly in the fields of artificial intelligence, quantum technology, and biomedicine. China is the world leader in the number of artificial intelligence articles and citations (Zhang, 2020, pp.25-30).

The 14th Five-Year Plan for 2021-2025 and the Vision for 2030 outline the following goals regarding human capital: training innovative, skilled, and application-oriented human resources, particularly scientists and engineers with international competitiveness; prioritizing the education of outstanding students in fundamental sciences; establishing research and innovation centers to attract talent from both domestic and international sources; developing permanent residency and work systems for foreign experts; improving systems such as salaries, social security, child education, and tax incentives; developing income distribution mechanisms that reflect the value of science and technology; giving leading experts more say in technological direction and funding; expanding the freedom of researchers and providing them with greater opportunities to profit from their inventions; promoting scientific ethics and integrity; supporting a culture of innovation and entrepreneurship; and creating a societal environment that values science and innovation (The People's Republic of China, 2021, pp. 14-15).

In line with the policy of promoting the value of science in society, efforts have also been made to popularize science. To this end, the revised Science and Technology Popularization Act, which came into effect on December 25, 2024, designated September as the annual national science popularization month. Accordingly, throughout September 2025, events organized by the China Association for Science and Technology aimed to promote scientific innovation achievements, commemorate scientists, celebrate the scientific spirit, and make science accessible to the public (State Council of the People's Republic of China, 2025).

5. Shifting from Quantity to Quality in Scientific Production

China's academic policy has undergone radical transformations in the last thirty years, both in terms of national and international goals. Initially, higher education institutions were directed towards publishing extensively in journals indexed in international databases, a strategy directly linked to the country's pursuit of global visibility. However, this intense focus on bibliometric criteria has brought about some undesirable consequences. The proliferation of low-quality publications, the increase in problems related to academic integrity, and the establishment of an academic atmosphere that evaluates immediate success have been among the most prominent of these negative consequences (Liang et al., 2024, p. 473).

From the mid-1990s onwards, universities, supported by state initiatives, exerted intense pressure on academic staff, making a certain number of publications in SCI and SSCI journals a requirement for job security. While these publications became the primary indicator of academic power, promotions, salaries, and even housing rights were directly linked to publishing in these journals. This process resulted in an extraordinary increase in research output as intended; however, the quality of publications made due to this requirement was questioned, leading to increased rates of plagiarism, ghostwriting, and fraudulent peer review. Furthermore, scientists shifted from long-term research projects to publications that could be completed in a very short time (Tian et al., 2016, p. 3; Quan et al., 2017, p. 498). Since the early 1990s, Chinese universities, in line with their cash prize policy, have offered cash prizes ranging from US$30,000 to US$165,000 for articles published in journals indexed by WoS. In the 2000s, they largely determined the prize amount according to the JCR Quartile system. However, while the cash prize policy served as a motivator for academics, it also had a negative impact, prioritizing quantity over quality (Quan et al., 2017, pp. 489, 494-495).

In response to these problems, the Chinese government has begun implementing a comprehensive transformation of research evaluation since 2018. Through this transformation, it has been aimed to shift from an over-reliance on quantitative criteria to an approach that focuses on the essence, value, and impact of research. The process was initiated in 2018 with a joint statement by the Communist Party of China and the State Council; and accelerated in 2020 due to the impact of the COVID-19 pandemic. During this period, seven different policies were issued by key institutions such as the Ministry of Education, the Ministry of Science and Technology, and the Ministry of Human Resources and Social Security, signaling entry into the implementation phase of the reform. These policies emphasized the importance of the principles proposed in 2018, provided more specific trajectories, and demonstrated that the reform had entered the implementation phase at the institutional level (Liang et al., 2024, pp. 474-475).

Among the objectives were:

- balancing internationalization with local needs,
- ending per-publication payment practices,
- giving priority to qualitative peer reviews instead of quantitative evaluations,
- reducing the importance of criteria such as SCI and impact factor,
- giving more value to publications in Chinese-language and Chinese-language journals and Chinese citation indexes.

In this context, new centers were established to develop evaluation systems specific to China in the social and humanities sciences (Ahlers & Christmann-Budian, 2023, pp. 763-764).

Research findings have shown that the reforms have begun to produce positive effects. There has been a significant decrease in the number of SCI articles, indicating a reduction in the pressure of high-volume publications. More importantly, the proportion of high-impact factor publications has increased while the proportion of low-impact factor publications has decreased. This have resulted in a significant improvement in research quality. In addition, an increase has been observed in social science projects, patent applications, and applied outputs, and universities' contributions have expanded beyond traditional article publications (Wang and Guo, 2025, pp. 2-3).

In conclusion, China's academic policy process has evolved from a rigid, metric-driven system to a more balanced structure prioritizing quality, innovation, and social contribution. While the quantitatively focused era provided rapid global visibility, it also led to systemic problems, and recent reforms have aimed to align research evaluation with China's long-term strategic interests. This shift from quantity to quality and diversity represents a significant step in redefining academic achievement in the Chinese context.

6. International Collaborations in the Field of Science and Technology

China's rise in science, research, and education (SRE) has been shaped not only by national policies but also by systematic and multifaceted international collaborations. This structure, ranging from intergovernmental agreements and joint laboratories to co-financing mechanisms and talent exchange, has made China a central player in the global scientific ecosystem.

6.1. Bilateral and Multilateral Cooperation

Since the 1980s, internationalization has been integrated with both the transfer of knowledge and technology and China's goal of becoming a global science and technology hub. As of 2023, China has signed more than 110 intergovernmental science and technology agreements, ranging from Asia to Latin America, covering strategic areas such as space, climate, energy, and biotechnology (Embassy of the PRC in Canada, 2023).

The US-China Science and Technology Agreement (STA), China's first comprehensive bilateral framework, has encompassed more than 20 protocols since 1979, ranging from high-energy physics to public health, and has been extended for another five years since 2024 with new elements such as data reciprocity and dispute resolution (Obamawhitehouse, 2025; Congressional Research Service, 2023; Reuters, 2024). The Joint Consulting Mechanism (JCM), the STA's coordinating mechanism, remains one of the key tools for making bilateral cooperation permanent and structured (AlShebli et al., 2024; Suttmeier, 2014).

While the China-European Union Science and Technology Treaty (1998–) institutionalized cooperation in sustainable energy and digital technologies, joint centers within the BRICS[3] framework stand out particularly in materials and computational sciences (European Commission, 2022, February 14).

The EU–China Science and Technology Cooperation Agreement was implicitly renewed in 2019, preserving the institutional framework. The Joint Steering Committee identifies cooperation priorities and monitors progress (Ministry of

[3] BRICS is an intergovernmental organization comprising eleven countries: Brazil, China, Egypt, Ethiopia, India, Indonesia, Iran, Russia, South Africa and the United Arab Emirates.

Science and Technology of the PRC, 2022). Within the framework of Horizon Europe (2021–2027), Chinese institutions participate as Associated Partners, contributing to projects with their own resources without EU funding. Food-Agriculture-Biotechnology and Climate Change-Biodiversity are prominent areas in these collaborations (ANR, 2014; European Commission, 2023). These areas have been supported by the Administrative Arrangement of 2022 and the EU-China Co-funding Mechanism (2021–2024). However, China's participation in high-budget Innovation Action projects is limited (ANR, 2014, pp.1-2; ERA, 2024).

The cooperation model has evolved into a new form based on mutual funding. The Sino-German Center continues with co-financing of ¥10 million per year; the number of Dutch-Chinese projects has exceeded to 46, and French-Chinese projects have exceeded 50. Joint committees ensure thematic alignment and financial coordination (Deutsche Forschungsgemeinschaft (DFG), n.d.). The French-Chinese Cai Yuanpei Programme has provided up to €800,000 in annual funding through joint doctoral and co-mentorship structures and has been regularly renewed in the 2020s (ANR, 2014, pp.1-2).

Launched in 2017, the Belt and Road Initiative (BRI) aims to globalize the power of S&T through tangible means (Ministry of Science and Technology, MOST, 2017a&b). The program is based on four pillars: people-to-people exchanges, joint laboratories, science park collaborations, and technology transfer centers. Initial goals included 2500 short-term exchanges, training 5000 personnel, and the establishment of 50 joint laboratories (MOST, 2017a & b). By the end of 2023, China had hosted over 10,000 young scientists from BRI countries and trained 16,000 R&D managers (Embassy of the People's Republic of China in Canada, 2023; China Daily, 2025). The number of joint laboratories has exceeded 70 by mid-2025, with a target of reaching 100 within five years (Xinhua News Agency, 2023; Belt and Road Portal, 2024). Ten international technology transfer centers have been established, supporting research-trade integration (China Daily, 2025). More than 80 intergovernmental S&T agreements legally supporting cooperation have been in effect (State Council of the PRC, 2023a). The program, strategically updated in 2023, has deepened institutional coordination with S&T Conferences in Chongqing and Chengdu; and has strengthened the implementation level with concrete commitments such as increasing joint laboratories and expanding young researcher programs, along with the "Eight Great Steps" (State Council Information Office (SCIO), 2023; State Council of the PRC, 2023a, 2023b & 2025).

Table 1: Belt and Road STI Cooperation — Objectives and Progress Status

Field / Indicators	2017 Target	Mid-2023 Status	2024 Outlook	Mid-2025 (Most Recent
Young Scientists	2.500	>10.000 supported	–	>80% of BRI countries
Education (Executives/Staff)	5.000	16.000	–	–
Joint Laboratories	50	53	53	>70 (Target: 100)
Technology Transfer Centers	–	–	–	10
Intergovernmental S&T Agreements	–	>80	–	>80

Sources: (Ministry of Science and Technology MOST, 2017a & b; State Council of the PRC, 2023a & 2025; Xinhua, 2023; Belt and Road Portal, 2024).

The 2025–2027 Beijing Action Plan envisages comprehensive cooperation with Africa in higher education and S&T (Ministry of Foreign Affairs of the People's Republic of China [MFA], 2024). These include educational opportunities for 60,000 Africans, professional training in China for 1000 scientists, the establishment of 30 joint laboratories, and initiatives in satellite, deep space, and peaceful nuclear technology (Ministry of Foreign Affairs of the People's Republic of China [MFA], 2024; Reuters, 2025).

Protocols have also been signed between Türkiye and China to support the development of cooperation in the fields of science, technology, and innovation. Within the scope of the 2566 – TÜBİTAK – NSFC (China) Bilateral Cooperation Program, joint projects between Turkish and Chinese scientists are supported, and research and travel support is provided. For 2025, the budget limits have been set as follows: 3,000,000 TL per project by TÜBİTAK for researchers applying from Türkiye (excluding PTI and institutional share), and 800,000 to 1,000,000 RMB per project by NSFC for researchers applying from China (TÜBİTAK, n.d.). A Scientific and Technological Cooperation Protocol was also signed between TÜBİTAK and the Chinese Academy of Sciences (CAS) in 2019 to conduct joint projects in the fields of energy and S&T. Accordingly; project durations are a maximum of 3 years, and applications must be submitted by universities, public institutions or organizations, research institutions, training and research hospitals, or Turkish industry/private sector on the Turkish side, or by a partner working at an institution or university affiliated with CAS on the Chinese side. The Chinese private sector may participate in the project, provided it is not the main applicant, and in this case, it must be responsible for its own project financing (TÜBİTAK & Chinese Academy of Sciences, 2025).

6.2. China's Global Science and Technology (S&T) Diplomacy Network and Attaché Mechanism

China has transformed its science and technology (S&T) diplomacy into a comprehensive and multifaceted global strategy that goes beyond bilateral agreements. This structure includes nearly 115 intergovernmental S&T agreements, ongoing cooperation with more than 160 countries and regions, and

S&T attachés stationed in diplomatic missions in approximately 52 countries (Embassy of the People's Republic of China in Canada, 2013; 2023; ChinaFile, 2025; Fedasiuk et al., 2021, p.19).

Science and technology attachés produced 642 intelligence reports between 2015 and 2020 alone, mapping local ecosystems and identifying collaboration opportunities in fields such as artificial intelligence, biotechnology, energy, materials science, and advanced manufacturing (Fedasiuk et al., 2021, s.17). This diplomatic model enables China to strategically synchronize its national research funds (e.g., NSFC and National Key R&D Program) with global scientific priorities.

By 2024, China has the world's largest diplomatic network; this has allowed Beijing to diversify its scientific partnerships by turning to the Global South, especially in an environment where cooperation with the U.S. is shrinking (Lowy Institute, 2024; Glenn College, 2025).

Table 2: Development Since 2000

Indicator	2000s	2013	2023	2024–2025 (most recent)
Intergovernmental S&T Agreements	–	106	110+	~115
Number of Partner Countries/Regions	–	–	160+	160+
Number of Countries with S&T Attachés	–	–	≈52	≈52

Sources: (Embassy of the People's Republic of China in Canada. 2013 & 2023; ChinaFile, 2025, Fedasiuk et al., 2021, p.19).

6.3. Global Integration in Institutional Mechanisms and Talent Mobility

China supports talent mobility through institutional mechanisms to strengthen global science and education integration. The Young Thousand Talents Program (YTT) has improved scientific productivity and patent quality by bringing back more than 3500 researchers between 2011 and 2017 (Wang et al., 2023, pp.62-65;

Stanford Center on China's Economy & Institutions SCCEI, 2023; Sun et al., 2024; Xue, 2023). Programs such as RFIS and PIFI offer foreign researchers access to Chinese laboratories, use of advanced infrastructure, and long-term collaborations (Chinese Academy of Sciences, n.d., State Council of the PRC, 2023a). Joint campuses (NYU Shanghai, Duke Kunshan, Nottingham Ningbo, XJTLU) established under cross-border education (TNE–Transnational Education) provide pedagogical and structural integration through dual curricula, joint governance, and research projects (British Council, 2022). By 2025, 113 new partnerships and 159 new programs have been approved in this field. Furthermore, R&D centers established in China by multinational companies such as Microsoft Research Asia, BASF, and Siemens are accelerating both the absorption of external knowledge and the development of local talent (Microsoft, 1998); MSRA graduates are directly leading China's artificial intelligence ecosystem (BASF, 2025; Siemens Energy, n.d.).

6.4. Global Co-authorship, Networking Location and Influence

China has become one of the leading players in the global volume of scientific publications and has positioned itself at the center of global co-authorship networks. By 2023, China has produced approximately 1 million science and engineering publications; 17% of these were published with international co-authorship (National Science Board, 2021; 2025b). While this rate is below the global average (22%), it reflects China's strong domestic production capacity. The US-China partnership remains the world's highest-volume bilateral scientific collaboration with 25,530 articles. Countries such as the UK, Germany, Australia, Canada, Japan, and Singapore are also among China's major partners (National Science Board, 2025a; 2025b). Engineering dominates the field of publications (26%), followed by computer science, materials science, and life sciences. For example, in the field of semiconductors, only 17% of Chinese publications are internationally co-authored, compared to 51% in the US—a remarkable correlation between field-specific collaboration dependencies (National Science Board, 2025c). While the total number of publications has increased more than tenfold in the last two decades, the rate of international collaboration has declined since peaking in 2015 (32.6%). This indicates a shift towards internalizing China's domestic scientific capacity.

Table 3: Trends in China's International Co-Authorship (2002–2023)

Year	Total Chinese Articles	International Co-Authored	International Share (%)	Largest Partner	Co-Authored Articles
2002	89.974	15.000	16,7%	ABD	6.000
2005	138.221	30.000	21,7%	ABD	12.000
2010	302.674	90.000	29,7%	ABD	35.000
2015	460.420	150.000	32,6%	ABD	50.000
2018	626.953	140.000	22,3%	ABD	50.000
2020	716.983	135.000	18,8%	ABD	40.000
2023	1.000.000	168.887	16,9%	ABD	25.530

Sources: (National Science Board, 2025a;b;c).

International co-authorship is one of the key dynamics driving China's scientific influence. In 2023, Chinese articles co-authored with international authors (~168,887) received significantly higher citations than those produced solely by domestic authors (National Science Board, 2025d). FWCI analyses show this difference is even more pronounced in physics, life sciences, and environmental sciences (Hyland, 2023). According to Clarivate's 2024 HCR data, 1405 researchers from mainland China accounted for 20.4% of the world's most cited scientists (up from 7.9% in 2018), demonstrating the impact of international collaborations (Clarivate, 2024a; 2024b). WIPO highlights three Chinese science and technology clusters: Shenzhen–Hong Kong–Guangzhou (#2), Beijing (#3), and Shanghai–Suzhou (#5); these regions are centers of highly efficient publication and invention activities (WIPO GII, 2024; WIPO, 2024a; 2024b;

2024c). While US-China cooperation has shifted from physics and materials science to artificial intelligence, ties with the EU and Asia-Pacific countries have strengthened; and South-South collaborations under the BRI have increased network diversity (AP News, 2024; Cao et al., 2024). This scientific integration has also been reflected in the patent field: China became the global leader in 2024 with 70,160 PCT applications, while applications in artificial intelligence and green technologies reached record levels (WIPO, 2025a; Reuters, 2025a). The high proportion of foreign co-inventors in patents demonstrates China's openness to international technology transfer in certain sectors. The combination of publications, inventions, and regional clustering has made China both a producer and a transformative actor in global science and technology networks (WIPO, 2024a pp.2-15; 2024b; 2024c).

6.5. Shared Laboratories, Mega-Science, and Access to Research Infrastructure

China is institutionalizing scientific internationalization through joint laboratories, open-access mega-research infrastructures, and participation in global mega-science projects. Under the Belt and Road Initiative (BRI) Action Plan, more than 50 international joint laboratories were operational by the end of 2023, with a target of increasing this number to 100 under the "Eight Great Steps" initiative (State Council of PRC, 2023b; Belt and Road Portal, 2024). These facilities function for technology transfer and joint research in thematic areas such as renewable energy, artificial intelligence, agriculture, food security, and biosafety. Prominent examples include the China-Pakistan AI and Agriculture Laboratory (UN, 2020; The Nation, 2025), the Zhejiang-CUVAS Food Safety Laboratory, the China-Belarus Innovation Center, and the MARA-CABI Biosafety Laboratory. China is also opening its mega-research infrastructures, such as the FAST telescope, the SSRF synchrotron facility, and the CSNS neutron source, to international users; encouraging access for foreign principal investigators by publishing calls in English (IAEA, 2024; FAST, (n.d.); LSSF & SSRF, (n.d.); National Natural Science Foundation of China, 2025). Globally, China is a full member of the ITER fusion project with a 9% contribution, a founding member of the SKA radio telescope consortium, and has established data-sharing collaborations with more than 20 African countries through its satellite/ground station infrastructures (National Astronomical Observatories, 2021; SKA Observatory, 2025; ITER Organization, 2025). This multi-layered architecture integrates China's research capacity into global networks and reinforces its position as a rising actor in scientific governance.

6.6. Standardization, Patents and Knowledge Transfer

China is integrating its global scientific influence into global institutional structures not only through production but also through co-funded projects, standard development processes, and patenting. Through the EU-China Co-Funding Mechanism (2022–), China participates in Horizon Europe projects via MOST; supporting research teams with its own resources, particularly in the fields of food, agriculture, climate, and biotechnology (European Commission, 2023). Bilateral calls with countries such as Germany, France, and the Netherlands are structured based on equal cost-sharing. This model increases the alignment and applicability of scientific outputs with global standards. At the same time, China has strengthened its norm-setting position, particularly in strategic areas such as AI, by increasing its technical leadership in international standards organizations such as ISO and IEC by 50% in the last decade (ISO, 2025; ISO/IEC, 2023). By 2024, China maintained its leadership in global patent applications with over 70,000 PCT applications; Shenzhen, Beijing, and Shanghai have emerged as leading clusters in both publishing and standards production (WIPO, 2025b). This achievement has become symbolic of China's corporate integration into global information systems, with the country entering the top 10 of the 2025 Global Innovation Index for the first time (WIPO GII, 2024; WIPO, 2024a; 2024c).

CONCLUSION

China’s comprehensive and state-centric approach, linking education, research, funding, talent, and innovation, has not only boosted academic output but also fostered a qualitative shift that has positioned it as a sustainable global leader in science and technology.

The management of science and education policy has become increasingly centralized, and high-level (nationwide) strategies and policies are now overseen by the Central Commission for Science and Technology.

A policy has been pursued to establish large national laboratories to build research infrastructure in strategic areas (artificial intelligence, biotechnology, energy, etc.) and to increase and diversify funding for R&D. While particularly encouraging business participation, researchers have been given more initiative in the process of initiating, executing, and completing projects.

To achieve its growth targets, China has increased the number of higher education institutions and, through initiatives such as “Project 211,” “Project 985,” and the “Double-First Class University Plan”, a core group of universities has been systematically upgraded to world-class status. China has restructured its academic evaluation system since 2018, prioritizing quality over quantity. This new approach focuses on the quality and impact of research, particularly giving greater value to publications in Chinese language and Chinese language journals. It aims to transform R&D results into economic added value by increasing collaboration between universities, research institutions, and industry. The government has supported the process of turning scientific output into products through financial support, tax exemptions and reductions, as well as the establishment of techno-parks.

Programs like the "Thousand Talents Plan" have successfully reversed the brain drain by attracting thousands of top researchers back to China through funding, housing, and institutional support. The discovery and nurturing of young talent have offered high salaries, a favorable research environment, and living conditions to attract Chinese and foreign scientists studying and/or working abroad. China has undertaken strategic initiatives for joint laboratories, joint research projects, and student and academic exchanges with other countries, and actively participates in global science networks.

National campaigns and laws have been used to promote public science literacy and scientific culture, and September has been declared National Science Popularization Month, effective from 2024.

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