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Strategic Thinking on Deepening International Cooperation in National Natural Science Foundation of China

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Strategic Thinking on Deepening International Cooperation in National Natural Science Foundation of China

Abstract

As an important channel for China to support international cooperation in basic research, the National Natural Science Foundation of China (NSFC) should play a leading role in the international scientific and technological cooperation in the new era. This paper reviews the layout characteristics, achievements, and the new measures of the international cooperation projects of NSFC in the past decade, and summarizes the experiences of typical countries. It is found that the international cooperation in NSFC has formed a project layout with cooperative research, personnel exchange, and talent cultivation projects, providing important support for China's engagement in global scientific and technological governance and integration into the global innovation network. In the complex and changeable international situation, NSFC has been actively and steadily expanding the international cooperation network of science and technology, systematically deepening the international cooperation, continuously optimizing the funding mode of foreign scholars, and is establishing a support framework for foreign scholars at different levels. In the new era, NSFC is facing new needs, to adapt to the trend of globalization and to engage in the construction of global innovation network, to open up new ways of international scientific and technological cooperation and to adapt to the new paradigm of scientific research, and to meet new global challenges and actively engage in the construction of a community with a shared future for mankind, being endowed with the mission of planning and promoting the development of basic research in China from a global perspective so as to actively integrate into the global innovation network. At present, the international cooperation strategy in NSFC has not played enough role in China, and the layout level of international cooperation funding needs to be improved. Measures to serve the "Belt and Road Initiative" need to be improved, and the support for international scientific and technological talents needs to be improved. The review mechanism and support platform do not meet the needs of strategic international cooperation project management. In the new era, NSFC should take scientific value creation as the starting point and foothold, guide and support Chinese scientists to actively engage in the research on major issues related to human sustainable development, and expand and deepen multilateral cooperation. This study puts forward the policy suggestions that the development and management of international cooperation in NSFC should be systematically optimized and promoted, the toplevel design and capacity-building should be strengthened, the distribution of major tasks and platform funding should be upgraded, international cooperation channels should be expanded, and the international cooperation strategy should be refined.

Keywords

National Natural Science Foundation of China (NSFC); international collaboration; basic research; scientific research fund

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Strategic Thinking on Deepening International Cooperation in National Natural Science Foundation of China

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Abstract: As an important channel for China to support international cooperation in basic research, the National Natural Science Foundation of China (NSFC) should play a leading role in international scientific and technological cooperation in the new era. This paper reviews the layout characteristics, achievements, and the new measures of the international cooperation projects of NSFC in the past decade, and summarizes the experiences of typical countries. It is found that the international cooperation in NSFC has formed a project layout with cooperative research, personnel exchange, and talent cultivation projects, providing important support for China's engagement in global scientific and technological governance and integration into the global innovation network. In the complex and changeable international situation, NSFC has been actively and steadily expanding the international cooperation network of science and technology, systematically deepening the international cooperation, continuously optimizing the funding mode of foreign scholars, and is establishing a support framework for foreign scholars at different levels. In the new era, NSFC is facing new needs, to adapt to the trend of globalization and to engage in the construction of global innovation network, to open up new ways of international scientific and technological cooperation and to adapt to the new paradigm of scientific research, and to meet new global challenges and actively engage in the construction of a community of shared future for humankind, being endowed with the mission of planning and promoting the development of basic research in China from a global perspective so as to actively integrate into the global innovation network. At present, the international cooperation strategy in NSFC has not played enough role in China, and the layout level of international cooperation funding needs to be improved. Measures to serve the "Belt and Road Initiative" need to be improved, and the support for international scientific and technological talents needs to be improved. The review mechanism and support platform do not meet the needs of strategic international cooperation project management. In the new era, NSFC should take scientific value creation as the starting point and foothold, guide and support Chinese scientists to actively engage in the research on major issues related to human sustainable development, and expand and deepen multilateral cooperation. This study puts forward the policy suggestions that the development and management of international cooperation in NSFC should be systematically optimized and promoted, and the top-level design and capacity-building should be strengthened; the distribution of major tasks and platform funding should be upgraded, international cooperation channels should be expanded, and the international cooperation strategy should be refined. DOI: 10.16418/j.issn.1000-3045.20211125003-en

Keywords: National Natural Science Foundation of China (NSFC); international collaboration; basic research; scientific research fund

International scientific and technological (S&T) cooperation is an important way to promote the establishment of a new type of international relations with win-win cooperation as the core under the new situation. It is also an effective pathway for China to actively participate in global governance, integrate into the global innovation network, and support the implementation of national diplomatic strategy. As stated by President XI Jinping in the video congratulation to the 2021 Zhongguancun Forum, China attaches great importance to S&T innovation and remains committed to promoting global coordination in this regard; China will strengthen international S&T exchanges with a more open attitude and actively participate in the global innovation

network, so as to jointly promote basic research and transform S&T achievements. The National Natural Science Foundation of China (NSFC) is the main channel for China to support basic research. In the new era, playing the unique role of NSFC in international cooperation, creating and sharing scientific values with global scholars with the concept of a community of shared future for humankind, and deepening the international cooperation of NSFC are of great significance to China's S&T development.

The international cooperation management of NSFC is increasingly improved, which has experienced such development stages as opening up cooperation channels, building its funding system, and enhancing cooperation levels. It has

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formed a funding pattern based on cooperation and exchange and dominated by cooperative research, which has effectively supported the development of science funds and national science and technology international cooperation. A new round of S&T revolution and industrial reform has brought about changes in the international science and technology competition structure. Facing those challenges and opportunities, and in view of the strategic needs of building China's strength in science and technology in the new era for deepening the international development of science funds, it is necessary to ponder on the positioning and functions of international cooperation of NSFC, further optimize the international cooperation funding system, and improve the strategic management ability of international cooperation.

This study systematically analyzes the funding characteristics, effectiveness, and innovative measures of international cooperation projects of NSFC in the past 10 years (2011–2020). Given the new situation and demand of China's S&T development in the new era, this study puts forward some specific suggestions on deepening the international cooperation of NSFC from the aspects of functional positioning, project setting, and management mechanism. The international cooperation experience of the United States National Science Foundation (NSF), the UK Research and Innovation (UKRI), and the Japan Society for the Promotion of Science (JSPS) is also taken into consideration.

1 Rapid development and remarkable results of international exchanges and cooperation of NSFC

NSFC is an important national strategic resource and has played an important supporting role in international S&T cooperation activities. During the 12th Five-Year Plan period, NSFC established the “openness and cooperation strategy” for the first time^①, and proposed the development task of “deepening openness and cooperation and promoting new internationalization” during the 13th Five-Year Plan period^②, in order to comprehensively improve the internationalization level of NSFC funding and management. From 2011 to 2020, the international cooperation of NSFC developed rapidly, and the total funding of projects reached CNY 7.89 billion, five times more than the total funding of NSFC in the first 25 years. The annual funding scale of international cooperation projects increased from CNY 480 million in 2011 to CNY 975 million in 2020.

(1) The overall layout of international cooperation of NSFC has been continuously improved. International

cooperation of NSFC has formed the overall layout of three categories of funding projects: international (regional) cooperative research projects (hereinafter referred to as “cooperative research projects”), international (regional) cooperative exchange projects (hereinafter referred to as “cooperative exchange projects”), and research fund projects for foreign young scholars (hereinafter referred to as “foreign youth projects”).^① Cooperative research projects are the main form of international cooperation, accounting for the largest proportion (more than 85%) of international cooperation projects of NSFC, and the partners are mainly from developed countries. The average annual funding of joint research projects in 2016–2020 was about CNY 603 million, while the average annual funding of key cooperative research projects was less than half of joint research projects. In 2020, the partners of the funded joint research projects were mainly from Germany, Israel, the UK, and Russia, while 72% of the partners of the funded key cooperative research projects were from the US, the UK, Australia, and Canada^[1].^② Cooperative exchange projects lay a positive foundation for further substantive international cooperative research. In 2019, the fund for cooperative exchange projects was CNY 75 million, of which 81% was used to support the cooperative exchange dominated by personnel exchange visits. Although the COVID-19 pandemic restricted international cooperation activities to some extent, the funding for cooperative exchange projects in 2020 increased by 38.1% as compared to 2019. Affected by the pandemic, conference exchanges in 2020 decreased evidently, while personnel exchanges increased by 54.8% as compared to 2019, spiking to CNY 93 million.^③ The attraction of foreign youth projects to foreign young scholars has increased year by year. The proportion of foreign youth projects in the annual funds for international cooperation of NSFC is maintained at roughly 4.5%. Meanwhile, the cooperation mode of foreign young scholars in China is constantly explored. Foreign youth projects have attracted the attention of increasingly more supporting units and foreign young scholars. The number of annual application projects in the recent 10 years has increased by nearly 6 folds, and the average funding intensity in 2020 is 1.6 times that of 10 years ago. The foreign youth projects provide stronger financial support for foreign young scholars to conduct research in China.

(2) The international cooperation of NSFC has been continuously expanded in depth and breadth. ^① The scope of cooperation countries has been continuously broadened, yielding improved results. By the end of December 2020, NSFC has established cooperative relations with 98 scientific research funding institutions or international organizations in

^① The “Twelfth Five-Year Plan” of the National Natural Science Foundation of China. [2021-11-14]. https://www.nsf.gov.cn/nsfc/cen/bzgh_125/ml.html.

^② The “Twelfth Five-Year Plan” of the National Natural Science Foundation of China. [2021-11-14]. https://www.nsf.gov.cn/nsfc/cen/bzgh_135/index.html.

51 countries (regions), and the cooperative network covers five continents in the world, producing remarkable outputs of cooperative S&T achievements. Based on the statistics of the Web of Science Core Collection, it is found that the number of papers sponsored by international cooperative research projects has been steadily increasing, and the cooperative network has a high degree of connectivity and collectivization^[2]. ② The cooperation chain continues to extend and the influence continues to deepen. For example, in 2020, the Sino-German Science Center^① specially established the Young Scholars Academic Visit Project after the Post-Sino-German Bilateral Symposium and the German Excellent Young Scholars Fund Project, which has initially formed a whole chain funding pattern for German from doctoral students to excellent young scholars and then to senior excellent young scholars. ③ Through the combination of “bottom-up” and “top-down,” NSFC makes full use of inter-organizational channels to attract, select, promote, and nurture talents with overseas partners. For example, the foreign youth projects provided support for young talents from countries along “the Belt and Road”; the China-Canada-Cuba International Joint Research on Cognitive Aging has facilitated the joint master program of Biomedical Engineering-Neuroscience in universities in China and Canada (enrollment has been approved by the Ministry of Education).

(3) The international S&T cooperation mode of NSFC has been continuously optimized. Under the complex and changeable international situation, NSFC has actively explored the international S&T cooperation network. By expanding cooperation channels and improving the funding system, it has formed an international cooperation funding system based on cooperative exchanges and talent projects and dominated by cooperative research, and it has continuously optimized the funding pattern of foreign scholars. In April 2020, the Bureau of International Cooperation, NSFC signed a memorandum with the Foreign Expert Service Department of the Ministry of Science and Technology to give full play to their respective advantages and integrate resources. NSFC continues to provide scientific research funding to the heads of foreign youth projects, while the Foreign Expert Service Department of the Ministry of Science and Technology provides salary subsidies and living expenses, so as to provide more perfect conditions for foreign outstanding young scholars to engage in scientific research in China. In March 2021, NSFC revised the management measures for foreign youth projects; in April of the same year, it further expanded and upgraded the functions of foreign youth projects, established the foreign scholars’ research fund, and sponsored outstanding foreign scholars in a hierarchical and all-round way. Those measures help promote

long-term and sustainable academic cooperation and exchanges between Chinese scientists and international scientists.

2 Deepening international cooperation of NSFC required by the new situation and new goals

In the new era, NSFC is entrusted with the mission of planning and promoting the development of China’s basic research with a global perspective and actively integrating into the global innovation network. NSFC urgently needs to deepen international cooperation, support the overall strategic goals of NSFC with the mission as the guidance, focus on strategic needs^[3], and lead the global scientific research cooperation network. Measures should be taken to improve the basic research level of China and play a critical strategic role in international S&T cooperation.

(1) Deepening the international cooperation of NSFC embodies the need to adapt to the trend of globalization and build a global innovation network. With the deepening of international S&T innovation cooperation, the international flow of scientific research funds, technology, and researchers is accelerating, and emerging economies have become the non-negligible main body of global S&T innovation cooperation. The *Outline of 14th Five-Year Plan (2021–2025) for National Economic and Social Development and the Long-Range Objectives Through the Year 2035* regards “implementing a more open, inclusive, mutually beneficial, and shared international strategy for cooperation in science and technology and more actively integrating into the global innovation network” as an important task during the 14th Five-Year Plan period. This puts forward new requirements for NSFC to play a unique role—plan and promote the development of China’s basic research from a global perspective, actively integrate and arrange the global innovation network, gather and effectively utilize global innovation resources, and promote multi-level, all-round, and high-level international cooperation in basic research to serve the national strategy.

(2) Deepening the international cooperation of NSFC reflects the need to expand international development space and adapt to the transformation of scientific research paradigm. Basic research is the cornerstone of international S&T cooperation. The setback of the traditional international cooperation mechanism in science and technology poses a serious threat to China’s international S&T cooperation and the construction of a new development pattern, but new cooperation space can still be found in the field of basic research. For example, although the past three years have witnessed a downward trend in Sino-US S&T cooperation,

^① A research funding institution jointly established by the National Natural Science Foundation of China (NSFC) and the German Research Federation (DFG).

the two countries are still the major international partners in COVID-19 research^[4,5]. In the context of the COVID-19 pandemic, international cooperation on COVID-19 research also shows a new trend^[6]. Meantime, the paradigm of scientific research is undergoing profound changes: open science and interdisciplinary research have become important ways to make breakthroughs in basic research, and responsible research has gradually become a global consensus^[7]. Therefore, it is urgent for NSFC to adapt to the change in the new paradigm of scientific research by deepening S&T cooperation.

(3) Deepening international cooperation of NSFC demonstrates the need to meet the global challenges and participate in the construction of a community of shared future for humankind. The rapid development of science and technology in China has benefited from international S&T cooperation, scientific information, and knowledge sharing. In the new era, China's scientific research is facing a turning point. At present, in the context of the increasingly prominent global issues such as the COVID-19 pandemic, carbon neutrality, and carbon peak, a global perspective is a prerequisite for NSFC to build the concept of a community of shared future for humankind and create and share scientific values with global scholars. For example, since the outbreak of the COVID-19, Chinese scientists have actively shared the scientific information and knowledge of COVID-19 to create and share scientific value worldwide, and the global influence of academic papers in this field has increased obviously^[8]. The "double carbon" goal has exhibited China's responsibility to promote the construction of a human community with a shared future. NSFC should carry out in-depth cooperation on the scientific research issues of global concern, such as health, green and low-carbon, and climate change, and make positive contributions to the construction of a community of shared future for humankind.

3 Basic experience of international cooperation and exchange of typical foreign science funds

The science funds of the world's major powers in science and technology have established a multi-level and diversified international cooperation funding system. A distinctive funding system has been formed in terms of funding goals, funding methods, funding directions, and funding targets, which has exerted a positive influence on international cooperation and exchanges in science and technology.

(1) A mission-oriented strategy to promote international cooperation and exchange in science and technology. The scientific research funding of major S&T powers in the world has established a mission-oriented international cooperation strategy, which is implemented through specific measures in the context of the times. NSF began to cooperate with the Soviet Union in the 1970s and with China in the early 1980s,

accompanied by the major diplomatic strategy in the corresponding historical period of the US. UKRI has sponsored the Global Challenges Research Fund, the Newton Fund, etc. to promote cooperation between the UK and developing countries. Additionally, UKRI also set up an international cooperation fund of EUR 160 million to establish and/or strengthen the cooperation between the UK and S&T innovation countries; in the UKRI 2020–2021 program, international cooperation and exchange are regarded as its priority goal^[9]. JSPS, as the only independent fund distribution institution in Japan with the goal of academic revitalization, takes promoting international academic exchange and supporting university globalization as an important part of its institutional positioning^[10].

(2) Global layout of network sites for international cooperation and exchange in science and technology. The management mechanism of funding departments is geared to international standards, and strategic arrangements are made for the internationalization of management and international cooperation staff. NSF established the Office of International Science and Engineering (OISE) in January 2002 to serve as the coordination center for international scientific and engineering activities within and outside the NSF. OISE has set up 28 project officers in the UK, China, and other countries from the national level, and has special contacts in 5 regions including Africa and the Americas. UKRI has offices in the US, Canada, Brussels, China, and India. JSPS has established 11 liaison offices in 10 countries to provide Japanese universities with overseas footholds, train international exchange experts, and establish a network with scholars who have participated in the JSPS project.

(3) Relying on major S&T platforms and high-level implementation. Large-scale scientific instrumentation and scientific research platforms are built to strengthen international influence and international partnerships. NSF takes participating in international research projects and supporting overseas facilities as an important part of its international cooperation activities. In the fiscal year 2020, the US logistics support activities in the Antarctic were approved with USD 71 million, and the US Arctic Research Commission was approved with USD 1.52 million^[11]. UKRI is formulating a method to manage its infrastructure investment portfolio and will consider the potential of international cooperation and partnerships as an important principle^[12]. JSPS has established medium-sized research cooperation centers in the target regions of Asia and Africa through sustainable cooperative relations with counterpart institutions, in order to cultivate the main force of future S&T progress in the region.

(4) Emphasizing international talent programs for continuous cooperation and exchanges. The introduction, exchange, and cooperation of international talents are promoted by fund support. The international talent programs of typical countries have common characteristics: From the system design of the "whole career life cycle of S&T innovation talents," a multi-level and diverse funding system has been

constructed, which has an evident siphonic effect on international S&T innovation talents; there are usually internationally recognized project awards to motivate the improvement of project research quality and enhance the sense of honor of project undertakers. The “Marie Curie Actions: International Incoming Fellowships” of the European Union, the Newton Fund of the UK, and the Humboldt Fund of Germany have formed international brand effects. Those programs have played an important role in achieving global young and middle-aged talents, promoting global innovation exchanges and cooperation in science and technology, building a global innovation cooperation network in science and technology, and developing science and technology diplomacy.

4 General ideas and policy suggestions on deepening international cooperation of NSFC

In the new era, based on the basic national conditions and development stage, NSFC should create and share scientific values with global scholars with the concept of a community of shared future for humankind, play the link role of international cooperation in basic research, and create a better open cooperation environment to achieve innovation-driven development.

(1) It is necessary to strengthen the role of NSFC in international S&T cooperation. NSFC should take the creation of scientific values as the starting point and foothold, and play a fundamental role in the national innovation system, S&T talents, and S&T diplomacy. Efforts should be made to clarify the relationship with the S&T plans of other countries, guide and support Chinese scientists to actively participate in the research on major issues related to human sustainable development, and expand and deepen multilateral cooperation.

(2) It is advisable to set up the “major international cooperative research special projects of NSFC.” NSFC should play a leading role in the international cooperation strategy for national basic research, explore the joint funding mode with local governments and enterprises, and expand the scale of international cooperation funding. Additionally, importance should be attached to strengthening the top-level design and system layout of technological science and engineering science cooperation, and cultivating and supporting major international scientific research programs and major international cooperative research projects initiated and participated by Chinese scientists.

(3) “International cooperation project of global research center of excellence” can be established. Relying on scientific research platforms and bases such as large-scale scientific instrumentation, national laboratories, national science centers, national key laboratories, and top scientific research institutions, the following measures can be implemented: establishing the “international cooperation project of global research center of excellence,” supporting cooperation with foreign entities with obvious advantages and distinctive

characteristics, building an open scientific research and innovation system, strengthening forward-looking basic research and R&D capabilities for cutting-edge technology, and exploring long-term stable support and performance appraisal mechanisms.

(4) The “Belt and Road” international cooperation special project in basic research can be built. Focusing on the major needs of responding to global challenges and realizing the United Nations Sustainable Development Goals, we can expand bilateral and multilateral cooperation with countries along the “Belt and Road,” maintain and develop key bilateral and multilateral relationships with emerging research and innovation funding agencies. In addition, it is of significance to plan for joint construction of the “Joint Science and Technology Education Center (Alliance) of Developing Countries,” improve the capacity and level of science and technology education in developing countries, and cultivate and expand the space for international cooperation.

(5) It is essential to improve the system and mechanism of global-oriented scientific research funds. Starting from strengthening the function of NSFC in “connecting the world, achieving talents, densely weaving networks, and strengthening capabilities,” it is recommended to learn from international practices, strengthen strategic research, rely on NSFC to implement global-oriented scientific research funds, and build an outstanding talent funding system covering all development stages of overseas talents. At the same time, measures can be adopted to strengthen cooperation with the China Postdoctoral Science Foundation and the China Scholarship Fund to form an international funding system for S&T talents with multi-level linkage and complementary functions.

(6) The professional management and support capacity should be improved for the international cooperation of NSFC. NSFC should strengthen the construction of the international cooperation management team, intensify personnel training, improve its professional management skills, and strengthen the concept of a community of shared future for humankind throughout its funding system. Learning from typical international experience, NSFC can set up overseas offices for the exchanges and cooperation with local science and technology funding institutions, support the participants of the international program of NSFC to conduct research overseas, and maintain long-term and stable contact with the returned foreign scholars of the international talent program of NSFC.

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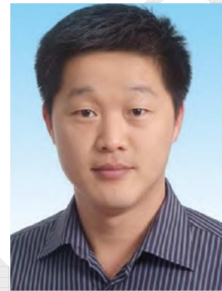
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