A Study on the Output Scale and Impact of Beijing Natural Science Foundation During the 12th Five-Year Plan Period Based on InCites Analysis (Postprint)

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Abstract

[Purpose/Significance] By analyzing the funding status, research productivity of funded projects, research impact and competitiveness, and international collaboration during the "Twelfth Five-Year Plan" period of the Beijing Natural Science Foundation, this study helps reflect the changing trends in output of funded project outcomes, disciplinary structures and characteristics, and can provide a basis for fund management decision-making.

[Method/Process] Using citation analysis methods and citation statistics from the InCites database, a comparative analysis was conducted on the funding status of the municipal fund over the past 10 years.

[Results/Conclusion] Compared with the "Eleventh Five-Year Plan" period, the municipal fund's financial investment, total number of applications, and funding amount all increased during the "Twelfth Five-Year Plan" period. The number of highly cited papers increased from 10 to 115, hot papers achieved a "zero" breakthrough, and international collaboration papers were 5.6 times that of the "Eleventh Five-Year Plan" period. Currently, the dominant disciplines of the municipal fund's funded projects are mainly concentrated in chemistry, engineering, materials science, etc., which have the potential to further grow into dominant disciplines with the support of the municipal fund. It is recommended to subsequently optimize the disciplinary layout, strengthen international collaboration, enhance the guidance and evaluation of the "quality" of paper output, and improve scientific research competitiveness and influence.

Full Text

Preamble

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Research on Output Scale and Impact of Beijing Natural Science Foundation During the "12th Five-Year Plan" Period Based on InCites Analysis

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Abstract

[**Purpose/Significance**] By analyzing the funding distribution, research productivity, influence, competitiveness, and international cooperation of Beijing Natural Science Foundation projects during the "12th Five-Year Plan" period, this study reflects trends in funded project outputs, disciplinary structures, and characteristics, providing a basis for funding management decisions. [**Method/Process**] Using citation analysis methods and InCites database statistics, we conducted a comparative analysis of the Foundation's funding situation over the past decade. [**Result/Conclusion**] Compared with the "11th Five-Year Plan" period, the Foundation's funding investment, total applications, and number of funded projects all increased during the "12th Five-Year Plan" period. The number of highly cited papers increased from 10 to 115, hot papers achieved a "zero" breakthrough, and international cooperation papers were 5.6 times those of the "11th Five-Year Plan" period. Currently, the Foundation's dominant disciplines are concentrated in chemistry, engineering, and materials science, with computer science and microbiology science emerging as new advantages. Environment and ecology, as well as clinical medicine, may develop into advantageous disciplines with continued Foundation support. We recommend optimizing disciplinary layout, strengthening international cooperation, enhancing guidance and evaluation focused on paper quality over quantity, and improving research competitiveness and influence.

Keywords: Beijing Natural Science Foundation; InCites; scientific research output; competitiveness; research influence
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1 Overview

As an important component of the scientific and technological innovation system, the Beijing Natural Science Foundation (hereinafter referred to as "the

Foundation") "supports basic research, upholds free exploration, and plays a guiding role," funding basic research and applied basic research in natural sciences and interdisciplinary fields, with funding primarily from municipal fiscal appropriations. During the "12th Five-Year Plan" period, the Foundation invested over 400 million yuan in total funding, supporting nearly 3,000 projects. To better understand the Foundation's role in developing emerging and advantageous disciplines and cultivating talent in the capital, it is necessary to analyze its funding outputs.

The new generation InCites™ platform includes the InCites™ database, Essential Science IndicatorsSM (ESI), and Journal Citation Reports® (JCR). It is a research evaluation and analysis platform based on Web of Science® data, containing paper statistics for over 180 countries and 9 regional organizations across all disciplines for more than 30 years. With comprehensive data resources, diverse indicators, and rich visualization effects, it can assist research managers in making strategic decisions more efficiently. For example, it can analyze the current status and trends of disciplinary development in an institution, or compare competitive and disciplinary advantages between different regions/research institutions, to monitor institutional research performance and global standing, identify high-impact and high-potential researchers, and provide decision support for developing institutional disciplinary strategies and optimizing scientific layouts. However, few studies have analyzed the Foundation's funded project outputs using InCites. This paper attempts to conduct a scientometric analysis of literature data based on InCites, exploring the Foundation's funding situation and its role in supporting basic research during the "12th Five-Year Plan" period.

2 Data Sources

This study conducts citation analysis and tracking based on the InCites and ESI databases. ESI is a basic analytical evaluation tool developed by the Institute for Scientific Information (ISI) to measure scientific research performance and track development trends. It is a bibliometric analysis database built from academic journals indexed in the Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). ESI divides indexed journals into 22 broad disciplines: Agricultural Science, Biology & Biochemistry, Chemistry, Clinical Medicine, Computer Science, Environment/Ecology, Economics & Business, Engineering, Geosciences, Immunology, Materials Science, Mathematics, Microbiology, Molecular Biology & Genetics, Multidisciplinary, Neuroscience & Behavior, Pharmacology & Toxicology, Physics, Plant & Animal Science, Psychiatry/Psychology, Social Sciences, and Space Science.

3 Research Objects and Scope

This study conducts statistical analysis on papers funded by the Foundation and indexed in the ESI database between 2006-2015. The Foundation primarily

funds nine major disciplines: mathematics and physics, chemistry and materials, engineering, information science, biology, agriculture, medicine, urban construction and environment, and management. Among ESI's 22 fields, all except Space Science, Economics & Business, and Social Sciences can be mapped to the Foundation's nine disciplines. Therefore, this analysis excludes these three disciplines, comparing Foundation-funded papers across metrics including output volume, major research institutions, disciplinary distribution, journal distribution, paper influence, and international cooperation. This provides reference for analyzing the Foundation's role in promoting basic research and formulating the "13th Five-Year Plan" for basic research.

4 Analysis of Funding Situation

During the "12th Five-Year Plan" period, the Foundation invested 417 million yuan in total funding, supporting 2,944 projects. Compared with the "11th Five-Year Plan" period, funding investment increased by 81.4%, total applications grew by 53.1%, and the number of funded projects increased by 60%, as shown in Figure 1 [Figure 1: see original paper].

4.1 Continuously Improving Research Productivity

Research productivity is measured by the number of ESI-indexed papers. During the "12th Five-Year Plan" period, the research productivity of Foundation-funded projects improved significantly. The number of Web of Science (WoS) papers grew substantially from 1,863 to 9,438, a fourfold increase (see Figure 2 [Figure 2: see original paper]). In terms of disciplinary distribution, papers were concentrated in chemistry, engineering, clinical medicine, materials science, and physics, each exceeding 1,000 papers and accounting for approximately 65% of the total papers across the 19 disciplines analyzed (see Figure 3 [Figure 3: see original paper]). Examining growth rates, geosciences (364%), immunology (271%), psychiatry/psychology (225%), engineering (225%), and molecular biology & genetics (218%) all exceeded 200% growth. However, due to small baseline numbers in 2011, their total paper counts remained relatively low despite rapid growth. Computer science (188%), materials science (179%), clinical medicine (160%), and chemistry (143%) showed both rapid growth and large absolute numbers. Environment/ecology (194%), pharmacology & toxicology (144%), agricultural science (129%), biology & biochemistry (127%), and microbiology (107%) also demonstrated fast growth despite currently lower absolute numbers, consistent with the Foundation's recent funding priorities. Other disciplines grew more slowly, below 100% (see Figure 4 [Figure 4: see original paper]).

During the "12th Five-Year Plan" period, institutions receiving more Foundation funding included Beijing University of Technology, Chinese Academy of Sciences (CAS), Peking University, Beihang University, Tsinghua University, Capital Medical University, Academy of Military Medical Sciences, and Chinese

PLA General Hospital. High research productivity institutions were primarily among these: CAS, Peking University, Capital Medical University, Beijing University of Technology, and Tsinghua University, whose combined papers accounted for 55% of the total (see Figure 5 [Figure 5: see original paper]). CAS publications under Foundation support concentrated in chemistry, materials, physics, engineering, and computer science, each exceeding 100 papers. Peking University produced over 90 papers each in clinical medicine, chemistry, biology & biochemistry, molecular biology & genetics, and neuroscience & behavior. Capital Medical University's top five disciplines were clinical medicine, neuroscience & behavior, molecular biology & genetics, biology & biochemistry, and immunology. Beijing University of Technology exceeded 100 papers in physics, materials science, engineering, chemistry, and computer science, showing concentrated advantages. Tsinghua University's Foundation-funded papers were mainly distributed in engineering, materials science, chemistry, physics, and computer science.

4.2 Expanding Research Influence and Competitiveness

Research influence and competitiveness can be measured by metrics including average citations per paper, percentage of papers in the top 1% of citations, highly cited papers and their percentage, category normalized citation impact, and publication levels.

Statistics from 2006-2015 show that 11,301 WoS papers acknowledged Foundation funding, with 9,438 published during the "12th Five-Year Plan" period. Total citations reached 46,501, with chemistry, materials, engineering, physics, and clinical medicine receiving the most citations (see Figure 6 [Figure 6: see original paper]). Citation impact (average citations per paper) was 4.93 (see Table 1). Citation impact shows the average number of citations received by a paper in the dataset and can measure academic influence within a certain timeframe. However, since papers from the "12th Five-Year Plan" period were published relatively recently with insufficient citation accumulation time, this metric is not suitable for comparing research influence across different time periods in this study.

4.2.1 Analysis of Top 1% Cited Papers Percentage The percentage of papers ranked in the top 1% of citations is generally considered an indicator of high-level research, as only highly cited papers can rank in the top 1% within their respective discipline, publication year, and document type. Higher values indicate better performance. Despite low citation impact due to short accumulation time, this metric reached 1.19% during the "12th Five-Year Plan" period, significantly higher than the "11th Five-Year Plan" period, demonstrating improved paper quality and influence. Over the past five years, institutions with Foundation-funded papers in the top 1% were primarily China Meteorological Administration, National Center for Nanoscience and Technology, Beijing Institute of Petrochemical Technology, Institute of Medicinal Plant Development

(Chinese Academy of Medical Sciences), and CAS (see Figure 7 [Figure 7: see original paper]).

4.2.2 Analysis of Highly Cited Papers and Their Percentage Highly cited papers are those ranked in the top 1% within their discipline and year in ESI. This metric and the percentage of highly cited papers reflect the status of discipline leaders and corresponding output ratios. As shown in Table 2 , the number of Foundation-funded highly cited papers is basically on par with global benchmarks. However, compared with the "11th Five-Year Plan" period, highly cited papers increased from 10 to 115 during the "12th Five-Year Plan" period, primarily in materials science, engineering, computer science, and chemistry. Major institutions included CAS, Peking University, Tsinghua University, Beijing University of Posts and Telecommunications, and National Center for Nanoscience and Technology (see Figure 8 [Figure 8: see original paper]), indicating significantly improved research levels of Foundation-funded projects.

4.2.3 Category Normalized Citation Impact Analysis Category normalized citation impact is an unbiased influence indicator that excludes the effects of publication year, discipline, and document type, enabling comparison across paper sets of different sizes and disciplines. Table 2 shows that during the "11th Five-Year Plan" period, Foundation-funded advantages were mainly in traditional fields such as agricultural science, engineering, materials science, mathematics, pharmacology & toxicology, physics, and plant & animal science, consistent with funding priorities. For example, in mathematics, Capital Normal University received 48 Foundation projects, through which team members achieved numerous internationally advanced results in differential geometry, algebraic topology, and nonlinear analysis, strongly promoting disciplinary growth. During the "12th Five-Year Plan" period, chemistry, engineering, materials science, pharmacology & toxicology, and plant & animal science remained advantageous. Meanwhile, with Foundation support, computer science, microbiology, geosciences, neuroscience & behavior, and psychiatry/psychology gradually emerged as advantageous disciplines. In the future, environment/ecology and clinical medicine may further develop with Foundation support.

4.2.4 Publication Level Analysis During the "11th Five-Year Plan" period, Foundation-funded projects published 1,683 WoS papers across 929 journals. The most frequent was *Neuroscience Letters* (30 papers). Only 6 papers (0.4%) had impact factors exceeding 10, with just 1 paper published in high-level journals like *Science*. During the "12th Five-Year Plan" period, 9,438 papers were published across 2,263 journals, primarily in *PLOS ONE* (310 papers), *Chinese Medical Journal* (117 papers), and *RSC Advances* (114 papers) (see Figure 9 [Figure 9: see original paper]). Among these, 202 papers (2.1%) had impact factors exceeding 10, published in journals including *New England Journal of Medicine* (impact factor 55.873, 1 paper), *Chemical Reviews* (46.568, 1 paper), *Nature Biotechnology* (41.514, 1 paper), *Nature* (41.456, 2 papers),

Nature Nanotechnology (34.048, 1 paper), and *Science* (33.611, 3 papers) (see Figure 10 [Figure 10: see original paper]).

4.3 Strengthening Research Innovation Capability

Hot papers are those ranking in the top 0.1% of citations in a field within the past two years in the ESI database. This metric primarily reflects innovation and may guide frontier trends in scientific development. Based on our statistics, Foundation-funded projects achieved a "zero" breakthrough in hot papers during the "12th Five-Year Plan" period, mainly in agricultural science, computer science, and engineering. Major institutions producing hot papers included Beijing Forestry University, University of Chinese Academy of Sciences, Beijing University of Posts and Telecommunications, CAS, and Tsinghua University (see Figure 11 [Figure 11: see original paper]).

4.4 Deepening Research Collaboration

Continuous Foundation funding has effectively promoted substantive cooperation between Beijing research institutions and international peers, with international cooperation papers showing clear growth trends (see Figure 12 [Figure 12: see original paper]) and expanding cooperative institutions and regions. During the "12th Five-Year Plan" period, 1,801 international cooperation papers were published, 5.6 times the 322 papers during the "11th Five-Year Plan" period. Cooperation primarily occurred in traditional advantageous disciplines such as chemistry, materials, and engineering, as well as emerging frontier disciplines including computer science, clinical medicine, neuroscience & behavior, and physics (see Table 2).

During the "12th Five-Year Plan" period, the CAS system published the most international cooperation papers (325), with partners including Georgia Institute of Technology, University of California, and 263 research institutions across 34 countries and regions including the US, Germany, Australia, UK, Japan, and Canada (see Figure 13 [Figure 13: see original paper] and Figure 14 [Figure 14: see original paper]).

5 Conclusions and Recommendations

Based on statistical analysis of categorized papers from Foundation-funded projects, this study systematically reviews the Foundation's funding situation during the "12th Five-Year Plan" period, reflecting funding performance to a certain extent. Specific conclusions and recommendations are as follows:

(1) Compared with the "11th Five-Year Plan" period, Foundation-funded projects showed rapid growth in research productivity, with significant improvements in research influence, competitiveness, original innovation capability, and international cooperation among funded institutions.

(2) Through guideline guidance and forward-looking deployment, advantages in chemistry, engineering, and materials science were further strengthened, while emerging frontier disciplines such as computer science and microbiology developed rapidly and gradually formed new disciplinary advantages. The next step should increase support for environment/ecology and clinical medicine to help them quickly become potential advantageous disciplines.

(3) Analysis of funding distribution and research productivity shows that institutions like CAS, Peking University, Capital Medical University, Beijing University of Technology, and Tsinghua University are both major project recipients and high-productivity institutions. Some host institutions receive many projects but have low productivity; research productivity could be incorporated as an evaluation criterion in performance assessment systems.

(4) Analysis of highly cited and hot papers reveals that next-generation communication technology, nanomaterials, ecological environment, and microbiology have attracted increasing attention, representing future research directions to some extent. The Foundation should fully consider these areas in guideline deployment.

(5) Based on WoS-indexed papers, Foundation-funded institutions' advantageous disciplines are mainly chemistry, materials, physics, engineering, computer science, clinical medicine, molecular biology & genetics, biology & biochemistry, and immunology. However, compared with central government-affiliated institutions, municipal research institutions still lag significantly in productivity and competitiveness. Municipal institutions should analyze their potential disciplines, optimize disciplinary layouts, allocate resources rationally, strengthen talent cultivation and team building, and develop competitive advantages in certain disciplines or fields to enhance influence.

(6) Capital basic research is at a critical transition from scale expansion to quality improvement. Compared with the "11th Five-Year Plan" period, Foundation-funded project paper output grew rapidly, and international cooperation strengthened. However, research competitiveness and influence remain relatively weak compared with global benchmarks, and innovation capability is still insufficient. Future project evaluation should emphasize "quality" incentives while de-emphasizing "quantity" assessments.

(7) Funding acknowledgment fields were only indexed after 2008, so "11th Five-Year Plan" statistics are lower than actual. Additionally, this study only counted WoS-indexed papers acknowledging Foundation support, excluding non-acknowledged results and Chinese papers, which may cause some indicators to be lower than actual.

References

[1] Dong Zheng'e, Chen Huilan. Prediction of discipline development of Donghua University based on ESI and InCites databases [J]. *Journal of Donghua University: Natural Science*, 2013, 39(5): 689-694.
[2] Zhang Ziqian, Shi Liwen, Li Maomao, et al. Analysis of current status and development trend of agricultural science of China Agricultural University based on ESI [J]. *Journal of Anhui Agricultural Sciences*, 2011, 39(23): 14443-14445.
[3] Li Maomao, Zhang Ziqian, Chen Shiji, et al. Competitiveness analysis of plant and animal science of China Agricultural University based on ESI [J]. *Science and Technology Management Research*, 2012(8): 128-132.
[4] Gao Xiaoqiang, He Pei, Zhao Xing. Research on output scale and impact of basic research of "BRICS" based on ESI [J]. *China Science and Technology Forum*, 2010(1).
[5] Yang Mei, Li Yajun, Liu Zhuoyan, et al. Analysis of development status of chemistry discipline in Chinese universities based on ESI [J]. *Sci-Tech Information Development & Economy*, 2010, 20(17): 160-162.
[6] Qiu Junping, Sun Kai. Bibliometric analysis of research competitiveness of Chinese universities based on ESI database [J]. *Library and Information Service*, 2007, 51(5): 45-48.
[7] Guo Xuemei, Chang Hong. Research on evaluation system of scientific and technological competitiveness of "211 Project" universities in Tianjin based on ESI [J]. *Library Work and Study*, 2015(1): 52-54.
[8] Qiu Junping, Yang Ruixian. Bibliometric analysis of materials science based on ESI database [J]. *Information Science*, 2010, 28(8): 1121-1126.
[9] Yu Jie, Tong Hefeng, Huang Muxuan, et al. Analysis of regional imbalance of research output of Chinese universities: comparison from ESI perspective [J]. *Science and Technology Management Research*, 2012(19): 54-60.
[10] Yu Tongpu, Yin Yan, Shao Fuqiu, et al. Research on development of high-level basic disciplines based on ESI and first-level discipline evaluation: taking physics as an example [J]. *Journal of Higher Education Research*, 2013, 36(4): 65-67.

Author Contributions:
Ni Wenlong: Data analysis and manuscript writing;
Jiang Nan: Results discussion and English proofreading;
Feng Yongqing: Data collection and organization;
Wang Hong: Research direction and overall manuscript refinement.

Note: Figure translations are in progress. See original paper for figures.