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Research on the Status Quo, Problems and Measures of Scientific and Technological Innovation in Shandong Section of Yellow River Basin

Yuxi Wu*, Xiaoxue Yu, Qingjun Lu

Shandong University of Technology, Zibo, China
**Corresponding author*

Keywords: Shandong section of the Yellow River Basin; Investment in scientific and technological innovation; Scientific and technological innovation output; Platform for Innovation

Abstract: This study uses literature retrieval and mathematical statistics to analyze the current situation, existing problems and measures of scientific and technological innovation in Shandong Province in the Yellow River Basin. This study analyzes the current situation of scientific and technological innovation from the aspects of scientific and technological innovation investment, scientific and technological innovation output, innovation platform and innovation highland, and finds that, the development level of scientific and technological innovation in Shandong section of the Yellow River Basin increases year by year, from low level to high level, Innovation platform and innovation highland play a significant role, The level of scientific and technological innovation in Shandong province continues to improve, and the growth rate is more obvious in recent years. Based on this, this study puts forward suggestions and measures from six aspects, strengthening regional linkage, coordinating innovation resources, increasing innovation investment, coordinating capital and talents, and building innovation platform.

1. Introduction

The Yellow River Basin is an important river basin in China, which is located in northern China and mainly covers the area through which the Yellow River and its tributaries pass. The Yellow River, with a total length of 5,464 kilometers, is the second longest river in China. It originates from the Qinghai-Tibet Plateau and flows through nine provinces and regions including Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shanxi, Shaanxi, Henan and Shandong in a shape of "several". It is an important barrier for ecological security, as well as an important area for population activities and economic development in China. Spanning the eastern, central and western regions of China, the Yellow River Basin is not only the main battlefield of poverty alleviation in the upper and middle reaches, but also the downstream provinces with large population concentrations. It has become an important strategic location for regional coordinated development and plays a pivotal strategic position in the overall situation of national development and modernization. As an important driver of regional high-quality development, scientific and technological innovation is particularly

important for the high-quality development of the Yellow River Basin. The Yellow River Basin plays an important strategic role in China's economic and social development and ecological security [1] Ecological protection and high-quality development of the Yellow River Basin has become a regional development strategy at the national level, and strengthening research on high-quality development and ecological protection of the Yellow River Basin has become a key scientific and technological demand [2,3]. The core of high-quality development is innovation-driven development, providing a better development environment and stronger factor guarantee for science and technology innovation enterprises is an important task for China to implement the innovation-driven development strategy [4].

2. Data Source and Research Method

2.1. Data Sources

2011-2021 China Statistical Yearbook, China Statistical Yearbook on Science and Technology, China Torch Statistical Yearbook, China Energy Statistical Yearbook and Statistical Bulletin of Shandong Province (District).

2.2. Research Methods

(1) Literature research. From the relevant literature in the field of innovation, the innovation data of Shandong Province are obtained.

(2) Statistical analysis. The innovation data of Shandong Province are obtained from the website of provincial and Municipal Bureau of Statistics.

3. Current Situation Analysis

3.1. Internal R&D Expenditure

R&D expenditure refers to the cost expenditure of enterprises for research and development of new products and technologies and improvement of existing products and technologies. Internal expenditure refers to the resources, including manpower, equipment, and materials, that the firm itself invests in R&D activities. As Figure 1, the internal R&D expenditure of Shandong Province was 844.3766 million yuan in 2011, increased to 17,530.7 million yuan in 2017, decreased in 2018 and 2019, and increased in 2020. In 2021, the internal R&D expenditure of Shandong Province was 19,446.588 million yuan, showing a trend of decreasing first and then increasing in fluctuations.

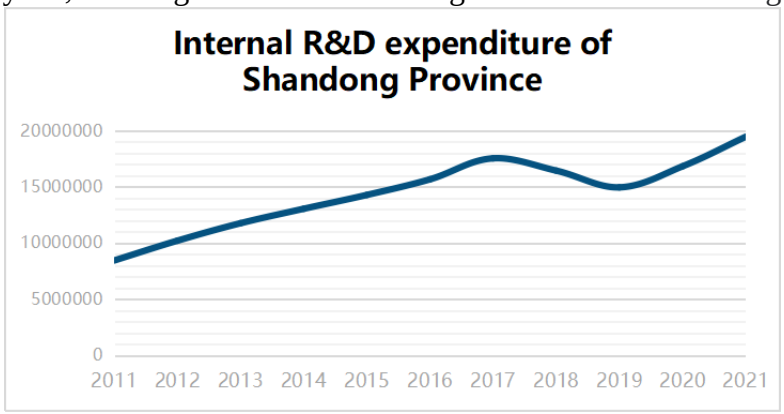

Figure 1: Internal R&D expenditure of Shandong Province

3.2. Number of R&D Personnel

R&D personnel are the main drivers of innovation. They are responsible for the research and development of new products, technologies and solutions to meet market needs and maintain competitive advantages. More R&D personnel means that more people are devoted to innovation activities, increasing the potential and speed of innovation. R&D personnel typically possess a high level of technical expertise and domain knowledge. They can gain insight into and apply the latest scientific research, technological trends, and industry developments. More R&D staff means that the organization has a wider range of technical expertise and is better able to deal with complex issues and challenges. As Figure 2, the number of R&D personnel in Shandong Province increased from 327,256 in 2011 to 695,945 in 2021, basically showing an increasing trend year by year, which shows that the innovation scale and vitality of the Shandong section of the Yellow River Basin are increasing.

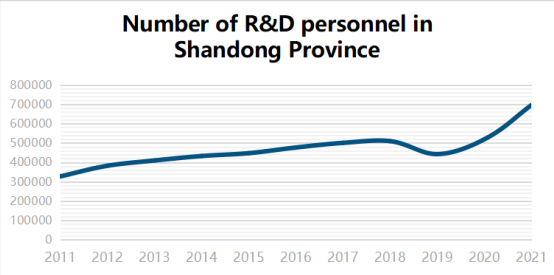

Figure 2: Number of R&D personnel in Shandong Province

3.3. Number of Patents Granted

The number of patents granted is one of the important indicators to measure the innovation capability of an organization. Having more patents granted means that the organization has a high innovation capability in terms of technology or products. Patents are the protection of unique and innovative inventions, which reflect the R&D investment and results of the organization in the field of technology. As Figure 3, the number of patents granted in Shandong Province was 58,843 in 2011, and then increased year by year.

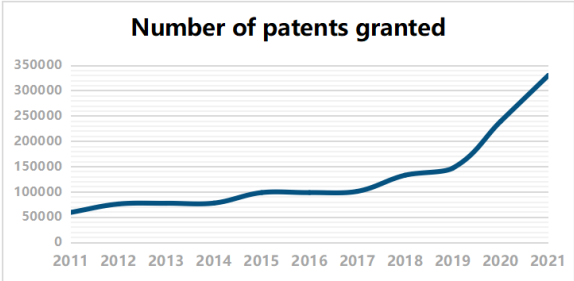

Figure 3: Number of patents granted

3.4. GDP

The level of GDP directly reflects the size and development of the economy of a country or region. Higher GDP usually means more resources are available for scientific and technological innovation. Countries or regions can enhance the capacity and level of scientific and technological innovation by increasing R&D expenditure and building scientific and technological research institutions, so as to promote the driving effect of scientific and technological innovation on the economy. As Figure 4, the regional GDP of Shandong Province shows an increasing trend year by year, which shows that the level of scientific and technological innovation is affected by the degree of economic development.

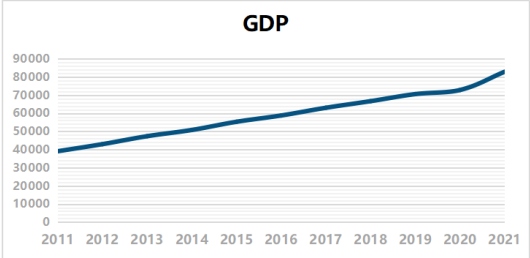

Figure 4: GDP

3.5. Innovation Platform

The data of scientific and technological innovation platforms are collected from the official websites of the Ministry of Science and Technology, the National Development and Reform Commission, the Chinese Academy of Sciences, and relevant public literature information. The data reflect the regional distribution of basic research forces in Shandong Province. The number of innovation platforms in Shandong Province is 45. It has attracted a large number of high-level domestic and foreign talents to carry out scientific research and scientific and technological cooperation. In addition, the innovation platform has a strong external radiation effect, which can significantly improve the scientific and technological strength and innovation ability of the region, enhance the talent environment and image of the region, and continuously support and promote the local economic and social development.

3.6. Status Quo of Scientific and Technological Innovation Highland

The total scale of national high-tech zones is comprehensively measured by the number of registered enterprises, the number of employed people, the operating income and the total industrial output value. The data come from China Torch Statistical Yearbook, a research platform for China's economic and social big data. The number of industrial and commercial registered enterprises in Shandong Province is 216,000, with 1.461 million employees at the end of the year. The operating revenue of enterprises in Shandong High-tech Zone is 2,630.201 billion yuan, and the total industrial output value is 2,023.611 billion yuan.

4. Problems in the Development of Science and Technology Innovation in Shandong Province

4.1. Innovative Atmosphere Needs to be Improved

Although Shandong province has made some achievements in scientific and technological innovation, the overall innovation atmosphere still needs to be further improved. In some regions and enterprises, the awareness and ability of innovation are relatively weak, and the enthusiasm for innovation activities is not high enough. The lack of a good innovation culture and atmosphere may limit the potential of science and technology innovation development. Insufficient investment in technology research and development, failure to fully invest capital, human resources and resources to support scientific and technological innovation, resulting in innovation activities subject to conditions, Most enterprises in Shandong Province lack innovation-driven corporate culture, lack the concept and culture of valuing innovation at the level of management and decision-making, and innovation is often treated as a lower priority, without forming an environment to encourage innovation. The introduction and training of talents in Shandong Province are insufficient, so it is necessary to further strengthen the introduction and training of talents, improve the quantity and quality of high-level talents, and stabilize or attract more innovative talents. The construction of

innovation resource sharing platform in Shandong Province lags behind, and the lack of effective innovation exchange, cooperation and sharing mechanism limits the development of innovation activities. The lack of extensive and in-depth innovation cooperation among enterprises, and the weak awareness and mechanism of cooperation affect the scale and effect of innovation activities[5].

4.2. R&D Internal Expenditure Continues to Increase and R&D Investment Intensity Continues to Increase.

The intensity of R&D investment (refers to the ratio of the total amount of R&D investment to the GDP of the province in the current year, which reflects the quality of a country's economic growth and the potential of economic development). The government should optimize the structure of financial investment, appropriately increase the investment in the field of scientific and technological innovation, and improve the policy support for enterprises, universities and other scientific research institutions. Companies, governments and education departments should be encouraged to innovate while providing them with an environment conducive to scientific research, including curriculum design, news services, consulting services, legal support and so on. Establish a talent training mechanism combining "industry, university, research and application", and connect talents in line with actual needs with laboratories and enterprises, so that talent training can be better close to reality. Strengthening R&D investment in the provinces along the Yellow River Basin and increasing the intensity of R&D investment can fundamentally promote the development of scientific and technological innovation. Therefore, with the continuous promotion and deepening of scientific and technological innovation, it will help the economic development of Shandong Province and enhance the international competitiveness of the whole region [6].

4.3. Innovation Platform and Innovation Highland Play a Significant Role.

By building innovation platforms and innovation highlands, we can promote the gathering of various resources such as talents, technology and capital, and improve innovation efficiency. These aggregated resources form a unique innovation environment, which can effectively support the implementation of innovation activities. Innovation platforms and innovation uplands are not only places for communication and collaboration, but also Spaces for joint problem solving and embodying the advantages of cooperation. These platforms can connect enterprises, research institutions, and government departments in different fields and NDS, thus breaking down certain barriers and promoting mutual cooperation between all parties. By introducing cutting-edge technologies, knowledge and management models, innovation platforms and innovation highlands strengthen the transformation and upgrading of traditional industries, improve the quality of products and services, promote the transfer of industrial chains to high value-added areas, and make the whole region's industries develop towards more sustainable, innovative, high value-added and competitive development. In short, innovation platforms and innovation highlands play a very important role in pooling resources, promoting cooperation, promoting industrial upgrading and cultivating innovation culture, and are important means to promote scientific and technological innovation and economic development. As a region in the lower reaches of the Yellow River, Shandong Province has a large number of innovation platforms and innovation highlands, and is the province with the highest level of scientific and technological innovation development in the lower reaches of the Yellow River. Therefore, the provinces with more innovation platforms and innovation highlands have higher development levels of science and technology innovation [7].

4.4. The Development Level of Science and Technology Innovation in Shandong Province Shows an Upward Trend

The economic development of Shandong Province is basically consistent with the change of scientific and technological innovation development, showing a steady upward trend as a whole. The development level of science and technology innovation in Shandong Province remained basically stable from 2011 to 2016, and continued to grow from 2011 to 2021, and the growth rate was obvious after 2016. The government has issued a series of policies and measures to support scientific and technological innovation, such as increasing support for the transformation of scientific and technological achievements, improving the independent innovation capacity of scientific research institutions, and encouraging enterprises to strengthen R&D investment. Shandong Province has rich talent and scientific and technological resources. Under the guidance of the government, universities, research institutes and enterprises cooperate with each other to form scientific research and innovation groups with their own characteristics, and constantly integrate and optimize the structure of innovation resources, which provides a continuous power for regional scientific and technological innovation. For key industries such as clean energy, high-end equipment and life and health, Shandong province has strengthened technological breakthroughs, promoted new technologies and new materials, and a number of new enterprises and technology-based small and medium-sized enterprises have emerged, constantly meeting market demand and driving regional industrial upgrading. The provinces along the Yellow River Basin actively build a green, low-carbon, economical and intensive sustainable development model, pay attention to the overall coordination of economy, society and environment, improve economic and ecological benefits through industrial transformation, technological progress and other ways, and contribute to the comprehensive development of regional economy. In short, the interaction of factors such as government attention, gathering of high-quality resources, leading technological innovation, the gradual development of innovative ecology and sustainable development leads the continuous improvement of scientific and technological innovation level in Shandong Province.

5. Suggestions on Science and Technology Innovation Development in Shandong Province

5.1. Further Strengthen Regional Linkage and Expand the Overall Opening up Level of Shandong Section of the Yellow River Basin with the Help of Policy Dividend Superposition.

Shandong Province is rich in human, material and natural resources, but the distribution is uneven. By strengthening regional linkage, optimizing resource allocation and realizing complementary advantages, we can better promote regional coordinated development and efficient utilization of resources. With the help of policy dividend, we can not only improve the regional core competitiveness, but also strengthen the cooperation and linkage among provinces and cities in the Yellow River basin to promote the integrated development of the basin economy, better play the comprehensive benefits of the whole basin, and enhance the overall economic strength. Through the superposition of policy dividends, the provinces and cities in the Yellow River basin can strengthen customs clearance cooperation, reduce trade costs, further strengthen the trade and investment links between provinces and cities, expand the international market of enterprises in the river basin, and enhance the international competitiveness. Policy dividends and the expansion of basin opening to the outside world can provide more opportunities for regional scientific and technological innovation cooperation in the Yellow River Basin. This will help optimize the allocation of resources between different provinces and cities, coordinate the development of industries and jointly promote infrastructure construction, and improve the level of economic development and scientific innovation in Shandong Province [8].

5.2. Increase Investment in Innovation and improve Innovation Capacity.

In studying the problems existing in the development level of science and technology innovation in other provinces, we find that the provinces with more internal R&D expenditure have higher GDP. Therefore, the government should increase financial support for scientific research institutions and scientific and technological enterprises, encourage enterprises to independently develop new technologies and products, and strengthen the cooperation between the government and scientific research institutions to provide more research opportunities for scientists. Local governments should promote the transformation and upgrading of relevant industries and guide enterprises to increase the development of new products and technologies. The government can give priority to technological innovation in key areas and encourage enterprises to realize the combination of production and technology, so as to continuously promote industrial innovation and upgrading. With the help of the Yellow River Basin, Shandong Province can strengthen the transformation and promotion of scientific and technological achievements, establish professional scientific and technological innovation incubation bases, technology transfer centers and other institutions, provide necessary policy and financial support, and create more opportunities for inventors and entrepreneurs to innovate and develop [9].

5.3. Attracting Talents is the Key to Scientific Innovation Construction in Shandong Province.

Talents are the key element of innovation, and scientific and technological innovation needs the participation and support of high-level talents. Shandong Province has gathered many research institutions, high-tech enterprises and various experts and scholars, who constantly contribute new ideas, new technologies and new achievements to promote the continuous development and progress of science and technology. Scientific and technological personnel have high comprehensive quality and professional experience in the industry, and are able to carry out strategic planning and technical research in the industry. By introducing new knowledge, new thinking and new technology, the core competitiveness of the industry will be improved, and industrial restructuring and upgrading will be driven. Talents can not only find their own space in scientific research institutions, schools, governments and other departments, but also realize their value in enterprises, injecting fresh blood into the innovation and development of enterprises. Enterprises in Shandong Province continue to introduce talents, set up professional research and development teams, and enhance their own visibility and market competitiveness through technological innovation and product innovation. Talents are the basis for promoting regional economic and social development. The government, enterprises and institutions of higher learning actively invest in talents to attract and cultivate talents at all levels with global vision, innovative thinking and entrepreneurial spirit from various professional fields such as education, medicine and engineering. The participation of talents can drive the improvement of local economy and social progress [10].

5.4. Build an Innovation Platform and Give Full Play to the Supporting Role Of Scientific and Technological Innovation.

The Yellow River Basin is a national key development and support region, and the construction of innovation platform is of great significance to Shandong Province. The construction of innovation platform can promote technological innovation and the industrialization transformation of R&D results, and promote the development of Shandong Province. The establishment of an attractive innovation platform can provide better services and support for excellent talents, cultivate more entrepreneurs and talents with high-level innovation ability for Shandong Province, and enhance its competitiveness in the global scope. The innovation platform can provide Shandong Province with

better project incubation, technical consulting and other services, improve the support for innovation projects and teams, and help the development and application of new products. The construction of innovation platform is helpful to form a good situation of industry-university-research cooperation, promote the rapid development of high-tech industries, and promote the economic growth of Shandong Province. The development of science and technology innovation plays an important role in promoting regional industrial upgrading and optimizing the business environment. The construction of innovation platform can improve the popularity and brand influence of science and technology innovation in Shandong Province, and promote the high-quality development of Shandong Province [7].

6. Conclusion

Scientific and technological innovation is one of the important driving forces for economic development. Science and innovation activities in the Shandong section of the Yellow River Basin can promote technological progress and industrial upgrading, and promote the sustained growth of the local economy. It is helpful to optimize the industrial structure and improve the industrial competitiveness of Shandong section. Through the introduction of high-tech and innovation models, we can speed up the transformation and upgrading of traditional industries, cultivate emerging industries, and realize the optimization and upgrading of economic structure. Scientific and technological innovation is often accompanied by the formation of new industrial chains and value chains, which can create more local employment opportunities. The promotion of science and innovation activities can drive the demand for talents, attract high-quality talents to stay in the local work, and promote employment growth. Science and innovation activities often require cross-border cooperation and resource sharing, which can promote cooperation and exchanges between the Shandong section of the Yellow River Basin and other regions. Through regional coordinated development, resources can be optimized and complementary, and the overall competitiveness of regional economy can be strengthened. The scientific and technological innovation activities in the Shandong section of the Yellow River Basin not only play an important role in local economic development, but also promote regional coordinated development.

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