Study on the Impact of Digital Economy on Green Development

Dantong He [1, *], Weichen Xu [2]

[1] Economics School, Anhui University, Hefei, China

[2] Economics School, Santa Monica College, Santa Monica, United States

* Corresponding Author Email: I02114282@stu.ahu.edu.cn

Abstract. Green development is a crucial tactic for attaining sustainable development since, in the setting of the world economy's rapid expansion, environmental challenges are playing a bigger role in human development. Since the advent of the digital era, green economic development and digital technology have been progressively integrated. It is not only important to save the environment and maintain ecological balance, but it's also a crucial step in advancing economic modernization and transformation and attaining sustainable development. It is a significant factor propelling China's economic expansion. China, with the second largest economy in the world, needs to promote a green economy to support long-term development goals. The importance of the digital economy on green development is examined in this research. Through literature review methods, this article investigates how the digital economy can improve resource efficiency and reduce energy consumption and emissions through technological innovation and management optimization. The study found that the digital economy significantly contributes to the green development of various industries, but it also faces challenges such as increasing energy consumption and data security. In the future, to create a situation where the economy and the environment benefit from each other, it will be required to further integrate the digital economy with green development, foster technological innovation, and enhance the legislative framework.

Keywords: Green development, digital economy, digital industrialization, industrial digitalization.

1. Introduction

While the global economy is developing rapidly, environmental problems are becoming increasingly severe. Green development has been elevated to an unprecedented strategic height, and countries are competing to introduce policies and measures to respond to environmental challenges and encourage the peaceful coexistence of the environment and economic. As the world's second-largest economy, China is currently experiencing a crucial phase of superior economic development. Not only is the growth of the green economy urgently needed, but it is also essential to the long-term prosperity of the nation. The theoretical connotation of China's green economic development includes two aspects. First, economic growth is decoupled from the demands placed on the environment and resources, that is, it must adhere to natural laws and promote the sustainability of the environment and resources. Second, green mountains and clear waters become gold and silver mountains, which essentially means the environment and sustainable resources are turned into productive forces that spur economic progress. In addition to being a strategic tool for achieving the second centennial goal and the objective of creating a socialist modern power, "promoting green development and promoting harmonious coexistence between man and nature" is also an essential component of China's modernization path, according to the report of the 20th National Congress of the Communist Party of China. Therefore, in the global landscape of the 21st century, green development has emerged as a key catalyst for the advancement of sustainable social and economic development. It is crucial to creating a community with a shared future for all people, in addition to being tied to the nation's long-term well-being. The Chinese government's emphasis on green development is reflected in top-level design and policy guidance, capital investment and project support, technological innovation and talent training, institutional guarantees and supervision and assessment, etc. It has established green development as one of the major strategies for national development, demonstrating its responsibility for global ecological governance.

The CPC Central Committee and the State Council issued the "Opinions on Accelerating the Comprehensive Green Transformation of Economic and Social Development". In addition to promoting the deep integration of industrial digitization, intelligence, and greening, the research made recommendations for accelerating the coordinated transformation and development of digitization and greening. with its high efficiency, intelligence, and flexibility, the digital economy has played an increasingly important role in promoting green development, and there is a mutually reinforcing and coordinated relationship between the two. Through innovative technical means and management models, the digital economy has effectively optimized resource allocation, improved production efficiency, and significantly reduced energy consumption and emissions, opening a new path for economic restructuring and upgradation, and sustainable development.

The "G20 Digital Economy Development and Cooperation Initiative" clearly outlines the definition of the digital economy. The term "digital economy" describes a range of business endeavors that leverage contemporary information networks as vital conduits, digital knowledge and information as critical production inputs, and the efficient application of ICT as a catalyst for increased productivity and optimized economic structures. Under the guidance of the "14th Five-Year Plan for Digital Economy Development", China's digital economy has clarified its development blueprint, aiming to advance top-level design-driven green industrial structure transformation.

This study uses the method of literature review to deeply analyze the relevant theories of digital economy and green development and the research progress at home and abroad. This article focuses on the impact of the digital economy on the green development of the service industry, enterprises, agriculture, and industry, which helps to explore the important role and potential of the digital economy in promoting green development. This article analyzes the path, results, challenges, and opportunities faced by green development under the promotion of the digital economy, as well as future research directions. At the same time, combined with China's practice, it provides experience and inspiration that can be used as a reference to jointly explore the path of environmentally friendly and resource-saving sustainable development.

2. Digital industrialization affects green development

2.1. Digital product manufacturing industry and green development

As an important part of the digital economy, the green transformation of the digital product manufacturing sector in its production process has a direct driving effect on green development. With the enhancement of environmental awareness and the advancement of science and technology, digital product manufacturing companies are focusing more and more on energy conservation, emission reduction, and resource recycling in the production process. Examples of these efforts include the use of intelligent manufacturing technology to increase production efficiency, lower energy consumption and waste emissions, and optimize supply chain management through the use of big data and the Internet of Things, thereby reducing environmental pressure. These measures not only boost the financial gains of businesses but also encourage green and sustainable development.

For the manufacturing industry, green development refers to the process in which enterprises implement relevant policies and guidelines for green development, consider both the economy and the environment, and through green innovation, make sustainable resources and the environment productive forces, improve resource utilization, promote economic growth, and ultimately achieve a win-win situation for enterprises and the ecological environment [1-2]. The impact of China's digital product manufacturing industry on green development can be roughly divided into two levels: macro and micro [3].

In terms of the macro aspect, the effects of various environmental regulations and geographic locations vary in how they affect the green development of the industry. While command-and-control environmental regulations have no effect on the green development of the manufacturing industry, the central and western regions are negatively impacted by them, and the effects of voluntary consciousness and economic incentive environmental regulations are not readily apparent. The

eastern region is affected by command-and-control environmental regulations in terms of green technology innovation and industrial green transformation, but the central and western regions can benefit greatly from the enhancement of economic incentive and voluntary consciousness environmental regulations [4]. Secondly, the level of green development of the digital economy varies greatly throughout industrial parks in different regions. The economic foundation of industrial parks in the eastern region allows for a higher degree of green growth, while certain industrial parks in the central and western regions are relatively lagging [5]. Building a green industrial chain, clean production and manufacturing, green transformation and infrastructure upgrades, and sophisticated and intelligent environmental management of industrial parks are some of the initiatives that have been implemented to support China's industrial parks' green development [6]. These initiatives have had a positive effect.

At the micro level, the impact of policies such as CSR disclosure [7] and green credit [8] on the green transformation and development of enterprises. Mandatory CSR disclosure policies drive the green transformation and development of enterprises by strengthening corporate regulation and legitimacy motivation while improving corporate performance. Green credit policies have significantly promoted corporate innovation transformation, and the role of green credit policies in promoting innovation transformation of heavily polluting enterprises is weaker than that of non-heavily polluting enterprises.

2.2. Digital product service industry and green development

The digital product service industry has indirectly promoted green development by providing green and efficient digital products and services. For example, the application of technologies such as cloud computing, big data, and artificial intelligence enables enterprises and individuals to obtain and process information more conveniently, thereby optimizing resource allocation and reducing unnecessary waste. In addition, the digital product service industry has also promoted information sharing and knowledge dissemination, enhanced society's awareness of the importance of green development, and provided strong support for the promotion and application of green technology.

First, take the Huaihe River ecological economy as an example [9]. The establishment of a regional green economy is significantly aided by the diversified agglomeration of productive services. From the perspective of different industrial levels, the diversified agglomeration of high-end, medium-end, and low-end productive services promotes the improvement of the level of green economic development, and high-end productive services play a significantly larger role in improving the level of regional green economic development than do medium- and low-end productive services. Second, it can be seen from Beijing Daily that the 2024 CIFTIS Environmental Services Special Exhibition will be organized into four sections: "Green Energy", "Carbon Neutral Technology", "Circular Economy" and "Ecological Mines", to promote the green transformation and upgrading of industrial structure and trade structure.

2.3. Digital Technology Application and Digital Factor Drive and Green Development

The digital economy's promotion of green development is largely dependent on the deployment of digital technologies and the digital factor drive. On the one hand, digital technologies such as block chain, the Internet of Things, and artificial intelligence offer strong technological support for green development and have demonstrated enormous potential in resource scheduling, energy conservation, environmental monitoring, and emission reduction. On the other hand, digital elements such as data, algorithms, and computing power have emerged as new forces behind the green economy's development, helping it to expand quickly by maximizing resource allocation, enhancing production efficiency, and lowering transaction costs.

First, the beneficial effects of digital technology innovation on regional green development under the "dual carbon" goal [10]. Digital technology applications and innovation can help increase the effectiveness of green development. Digital technology application in the region has a promoting effect on green development efficiency. Influenced by the spatial spillover effect, the enhancement

of green development efficiency can be greatly aided by digital technology innovation in nearby regions. Second, the development of digital technology can trigger a full-scale transformation of green industries from production, and distribution to circulation and consumption. This shift would be extremely beneficial to the growth of the green industries. Data elements have been incorporated into the development of green industries from the standpoint of theoretical logic. Value logic provides complete support for the superior development of the green economy. From the perspective of technical logic, the "green content" of the industry has been significantly improved [11]. Third, the degree of digitization has greatly boosted the level of urban green development. The beneficial influence of digitization on the degree of urban green development varies depending on the locale. Digitization has a greater impact on the level of urban green development in eastern and "broadband" pilot cities. At the same time, data demand factors and data supply factors significantly promoted the efficiency of urban green development, but there were regional differences. The promoting effect of factors in large cities such as the eastern region was more significant [12].

3. Industrial digitalization affects green development

3.1. Intelligent manufacturing and green development

The 20th report of the Communist Party of China pointed out that it is necessary to accelerate the green transformation, develop green and low-carbon industries, promote new industrialization, accelerate the construction of manufacturing power, and drive the high-end, intelligent and green development of manufacturing [13]. As a profound integration of next-generation information technology, digital technology, and advanced manufacturing technology, intelligent manufacturing, optimized through industrial internet, artificial intelligence, big data analysis, and other technological means, has streamlined production processes and established efficient and environmentally friendly production models [14]. Amidst the continuous global economic development, the widespread application of intelligent manufacturing has not only significantly enhanced production efficiency but also promoted the optimal allocation and recycling of resources, laying a solid foundation for green development. Nowadays, intelligent manufacturing has emerged as a strategic high ground fiercely contested by countries worldwide, leading the new trend of industrial transformation and upgrading.

3.2. Digital finance, digital commerce and green development

As a resource-saving and environment-friendly innovative financial service, digital finance has strong green attributes, which can reduce the pollution of industrial development by making traditional financial services online, achieve low-carbon financial services, promote green consumption of residents, and promote green and low-carbon development [15]. The introduction of innovative financial instruments such as green credit and green bonds has not only attracted significant social capital towards green industries, including environmental protection, energy conservation, and clean energy, providing solid financial support for these sectors, but also leveraged cutting-edge technologies like big data and block chain to enhance the accuracy of risk assessment and pricing efficiency of green financial products. This has significantly reduced the financing costs of green projects and accelerated the vigorous development of the green economy.

At the international level, countries are actively exploring new paths for deep integration of digital finance and green development. The Monetary Authority of Singapore (MAS) has proposed a strategy to promote sustainable development through digital finance and established a national green finance data platform. Switzerland has launched the world’s first green financial technology taxonomy. The G20 TechSprint 2021 Global FinTech Challenge has demonstrated the huge potential of financial technology innovation in addressing global environmental challenges [16].

Digital trade and commerce likewise play a pivotal role in advancing green development. It not only expands international cooperation in emerging fields but is also crucial for maintaining the resilience and stability of global industrial and supply chains, as well as enhancing interconnectivity and quality upgrades [17]. Chinese foreign trade enterprises have actively responded to the call for

green and low-carbon initiatives by implementing product emission reduction strategies, adopting recyclable and biodegradable materials, thereby effectively reducing the carbon footprint of their foreign trade products. Simultaneously, these enterprises actively participate in green electricity and green certificate trading, strengthen energy-saving and carbon reduction management, and conduct green transformations of production processes, contributing Chinese wisdom and strength to the construction of a global green trade system.

3.3. Digital society, digital government and green development

By building infrastructure platforms such as smart cities and smart communities, the digital society actively advocates and promotes green lifestyles, guiding society towards a more environmentally friendly and sustainable direction. Concurrently, digital government has achieved precise and efficient policy formulation and implementation, injecting robust momentum into green development. Thus, the construction of efficient and intelligent digital societies and digital governments serves as a significant driving force for promoting green development. The Fifth Plenary Session of the 19th CPC Central Committee identified "strengthening the construction of digital societies and digital governments, and enhancing the digital and intelligent levels of public services and social governance" [18] as one of the important directions for accelerating digital development during the “14th Five-Year Plan” period. This decision not only charts a clear path for China's green development journey but also showcases China's wisdom and determination in this field to the world.

In the specific practice of green development, digital government provides robust support for formulating more scientific and reasonable green policies through real-time monitoring of environmental data and analysis of policy effects. For example, Shanghai in China tracks air quality in real time through an intelligent environmental monitoring system and uses data analysis to predict air pollution trends, thereby adjusting policy measures in a timely manner to reduce pollution. The Swedish city of Stockholm u utilizes smart grids and green energy technologies to optimize energy usage and reduce carbon emissions. These measures not only enhance the scientificity and rationality of the policy, but also enhance the transparency of policy implementation through information disclosure and enhance public trust and support for the policy. The coordinated development of digital society and digital government has effectively promoted sustainable development and green development.

4. Summary and outlook

Despite showcasing numerous advantages in driving green development, the digital economy also confronts several issues and challenges. Firstly, the rapid expansion of the digital economy may lead to increased energy consumption. In particular, the pressure on the environment from high-energy-consuming facilities such as data centers cannot be ignored. Second, the digital divide may exacerbate imbalances in green development among different regions and groups. Third, data security and privacy protection issues are also a major challenge.

To address these issues and harness the full potential of digital economy for green development, future efforts should focus on deepening their integration. First, technological innovation and model exploration must be intensified to develop energy-efficient digital technologies. The adoption of renewable energy in critical facilities like data centers can help mitigate environmental impacts. Moreover, policy frameworks need to be refined to incentivize enterprises and financial institutions to invest more in green projects, thereby facilitating optimal resource allocation. Simultaneously, enhancing data security and privacy protection is crucial for fostering a secure and trustworthy digital environment, which underpins the healthy development of the digital economy. Furthermore, attention must be paid to bridging the digital divide by increasing investments in information infrastructure in central and western regions, thereby narrowing development gaps and promoting balanced development of the digital economy across a broader spectrum.

International cooperation and exchanges also require enhancement. It is imperative to actively advance green development and technological cooperation among nations, share experiences and technologies, and collaboratively address global environmental challenges. Finally, improving public participation is also an important link, increasing public participation in green lifestyles through digital platforms and intelligent systems, improving overall environmental protection awareness, and the public's emphasis on data security and self-protection capabilities.

In conclusion, the digital economy holds a pivotal role in advancing green development yet confronts numerous issues and challenges. Moving forward, comprehensive policies must be implemented to strengthen the integration of the digital economy and green development, thereby contributing to global sustainable development.

References

[1] Guo Kesha, Peng Jizong. The manufacturing sector's strategic position and role in china's new stage of development. Social Sciences in China, 2021, (05): 128 - 149.

[2] Wan Panbing, Yang Mian, Chen Lin. How do environmental technology standards affect the green transition of China's manufacturing industry-a perspective from technological transformation. China Industrial Economics, 2021, (09): 118 - 136.

[3] Jian Guanqun, Feng Haowen. The logic and practice of digital high-end enabling the green development of the manufacturing industry: exploratory case study on the multiple heterogeneity of the yellow river basin. Journal of Management, 2024, 37 (03): 43 - 59.

[4] Peng Xing, Li Bin. On green industrial transformation in China under different types of environmental regulation. Journal of Finance and Economics, 2016, 42 (07): 134 - 144.

[5] Tian Jinping, Zang Na, Xu Yang, et al. green development index of the Chinese national economic-technology development area. Acta Ecologica Sinica, 2018, 38 (19): 7082 - 7092.

[6] Lv Yizheng, Tian Jinping, Chen Lvjun. Practice and inspiration of promoting green development of china's industrial parks and realizing industrial ecology. Chinese Journal of Environmental Management, 2020, 12 (03): 85 - 89.

[7] Wang Xiaoqi, Ning Jinhui. Can mandatory social responsibility disclosure drive corporate green transformation? Evidence based on green patent data of listed companies in china. Journal of Audit & Economics, 2020, 35 (04): 69 - 77.

[8] Xie Qiaoxin, Zhang Yu. Green credit policies, supporting hand and innovation transformation of enterprises. Science Research Management, 2021, 42 (01): 124 - 134.

[9] Zhang Guangzhong, Wang Qingying, Ouyang Huasheng. The impact of producer services agglomeration on the development of green economy: based on the urban data of Huaihe ecological economic belt. Journal of Neijiang Normal University, 2023, 38 (02): 73 - 78.

[10] Jiang Hang, Sun Taipeng. The impact of digital technology innovation on regional green development under the goals of carbon peaking and carbon neutrality——based on the perspective of spatial spillover effect. Commercial Science Research, 2023, 30 (03): 42 - 53.

[11] Xi Min, Wang Dan. Digital technology empowering the realistic dilemma and targeted strategy of the green development of the industry. Fujian Finance, 2024, (05): 27 - 32.

[12] Ouyang Wanhua. Research on the impact of digital economy on urban green development from the perspective of innovation driven. Jiangxi University of Finance and Economics, 2023.

[13] Zhu Kechun. Promoting high-end, intelligent and green development of manufacturing through digital transformation. Decision-making, 2022, (11): 62 - 63.

[14] Li Jinhua. Development status and future path of green manufacturing and intelligent manufacturing in China. Economic and Management Research, 2022, 43 (06): 3 - 12.

[15] Huang Yongchun, Huang Yushan, Hu Shiliang, et al. Can digital finance promote green and low-carbon development? Journal of Nanjing University of Finance and Economics, 2022, (04): 88-97.

[16] Wang Xin. Further strengthen financial support for green and low-carbon transformation. China Finance, 2024, (11): 16 - 18.

[17] Shu Chaopu, Cui Ying. Digital economy and green development international economic and trade cooperation framework initiative released. Service Outsourcing, 2023, (11): 46 - 47.

[18] Recommendations of the Central Committee of the Communist Party of China on formulating the 14th Five-Year Plan for National Economic and Social Development and the Long-term Goals for 2035. People's Daily, 2020.