

Climate Fintech and Its Contribution to Green Finance: Evidence from China's Experience in Environmental Sustainability

Lina BOUGOUFFA^{1*}, Ahmed GHERIBI²

¹ Sustainable Local Development Laboratory, University of Yahia Fares, Medea (Algeria), bougouffa.lina@univ-medea.dz

² Macroeconomics and International Finance Laboratory, University of Yahia Fares, Medea (Algeria), Gheribi67@yahoo.fr

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Abstract:

This study highlights the role of climate fintech in supporting green finance, focusing on China's experience in achieving environmental sustainability. It aims to highlight the importance of Climate Fintech technologies in financing renewable energy projects and the green economy. The study was based on the descriptive-analytical approach using the reports of the World Bank (2023), the Central Bank of China, and the Statista platform... The results indicate that investments in climate fintech exceeded 10 billion dollars in 2022, with about 250 startups in China. The study recommends strengthening digital environmental legislation in developing countries, such as Algeria, and encouraging green financial innovation.

Keywords: *Climate Fintech; Green Finance; Environmental Sustainability; Green Financial Innovation; Sustainable Digital Transformation.*

1. INTRODUCTION

Climate Fintech is one of the most prominent recent developments in the global financial arena, as it represents the integration of Fintech with the Sustainable Development Goals and green finance (Jiaheng, 2022, p. 660). Studies have shown that environmental and climate challenges require innovative financial solutions that contribute to mobilizing financial resources in more effective and transparent ways (Qian & Chuang, 2023, p.

* *Corresponding author*

78). Green fintech, as mentioned by OECD (2022), is officially termed as a strategic tool that promotes sustainable finance and an instrument in support of environmental innovation, particularly in renewable energy and green infrastructure. The reports of the World Bank (2023) claim that countries like China have tapped climate fintech to narrow the gap in financing and push for investment in more green-inflected projects. This added support, as clarified, goes towards circular economy projects and sustainable development. From this point, it becomes very relevant to explore the staircase experience of China and the level to which developing countries can gain from it. Therefore, based on the preceding discussion, the main research question arises: **What are the contributions of climate fintech to green finance, particularly in the context of China's experience in promoting environmental sustainability through green financial solutions?**

This question will help determine how climate fintech can be an ally to China's efforts towards environmental sustainability. It will primarily discuss the principal strategies or innovations applied to fintech to augment the green finance space in China, such as investments in renewable energy, circular economy kind of initiatives, and green infrastructure. Other crucial aspects will contemplate how these strategies could be replicable in other developing countries with knowledge on addressing environmental challenges through climate fintech and promoting sustainable development all over the world.

2. Literature Review

A significant body of research has thoroughly examined the intersection of climate fintech and green finance, focusing primarily on its potential to enhance environmental sustainability. While these studies share common themes, they differ substantially in their focus and findings. (Li, et al., 2021) relate China's digital economy to carbon emissions, focusing on the contribution made by fintech platforms in limiting carbon footprints. This research bears similarities to the current study in its focus on fintechs and their being environmentally sustainable, but with a major focus on carbon emission reduction rather than green finance.

In a related study,(Yang, Haitao, & Jinning, 2021) analyzed how internet technologies, including fintech, assist in controlling air pollution. Their findings underscore fintech as being active in ensuring environmental

management, which aims to use technology in environmental sustainability. However, in contrast to the present study, which deals with financing green projects, this study concerns pollution control.

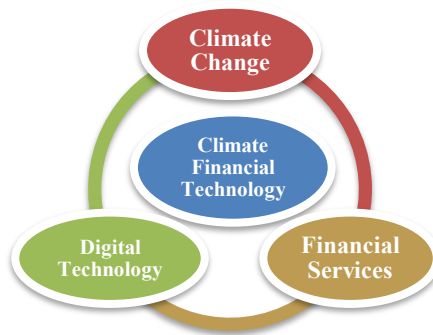
(Debao, Zhao, & Fujun, 2022) examined some of the risks in green finance with the involvement of fintech, especially risks for commercial banks. This study not only highlights the positive contributions of fintech but also gives emphasis to its risks. In contrast, this study focuses on the positive aspects of fintech in supporting sustainable projects and does not consider any associated risks.

Lastly, in a broader general approach, (Cao, 2023) historically analyzed the interconnection between financial development, technological innovation, and green growth in China. The findings provide insight into how fintech can stimulate green investments very much related to the current study's focus. However, this study speaks more broadly regarding overall financial development, while the present study speaks very particularly about fintech in green finance.

2.1 Climate Financial Technology Concept

Climate FinTech represents the intersection of climate change, financial services, and digital technology (Kshetri, Loukoianova, & Jeffrey, 2024, p. 160) (Figure 1). It leverages digital technology to support climate change mitigation and adaptation through financial services, enabling individuals and corporations to make more environmentally sustainable financial decisions (McCreary, Zhao, & Chang, 2021, p. 3). It is also defined as an emerging sub-sector of financial technology that integrates financial solutions with climate technology (Climatig, 2022). The latter, as defined by the United Nations Climate Change, refers to “technologies used to combat climate change by reducing greenhouse gas emissions (GHGs), including renewable energy sources such as wind, solar, and electrical energy.” These technologies are employed to enhance climate resilience and mitigate adverse environmental impacts (United Nations Climate Change, 2022).

Fig N⁰(01): Climate Fintech formula.



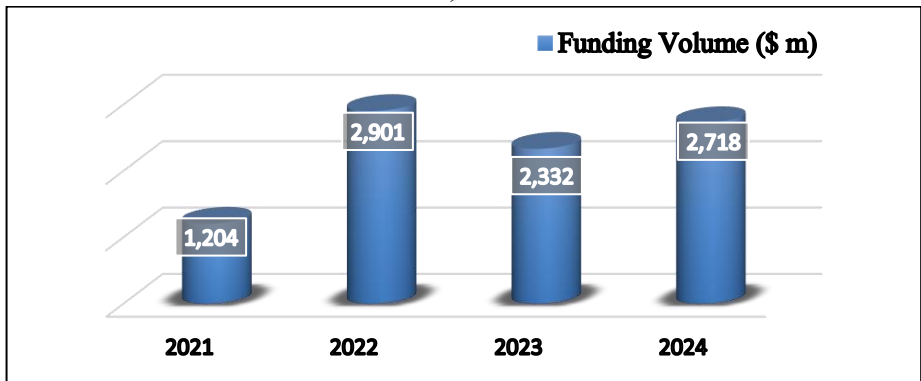
Source: Author elaboration.

Climate FinTech recognizes the place of digital technologies in bringing environmental sustainability and climate change into the fold of concern for the financial sector. It enhances awareness through consumer incentives (Globallogic, 2023, p. 3), bridges the gaps related to risk assessments through AI (Omeragica, Zaimovica, & Zaimovica, 2024, p. 278), and fosters financial inclusion through innovation (Orkun, Isilay, & Feridun, 2022, p. 2). In addition, the sector helps stakeholders with easy, efficient, transparent, and accountable decision-making opportunities. It also provides an avenue for consumers to make sustainable financial choices and adds a layer of financial support to underserved communities aimed at inclusive growth and sustainable investments (McCreary, Zhao, & Chang, 2021, p. 17).

The metamorphosis in climate fintech continues as this gears up towards evolving global economy changes and shifts in technology. That pledge turns into \$100 billion each year to developing countries to accommodate climate change mitigation and emission reduction (United Nation, 2023, p. 5). In 2015, the Green Climate Fund came into being to put resources equally between mitigation and adaptation measures. Climate finance hit \$83.3 billion in 2020, a far cry from the \$100 billion annual target (United Nation, 2024). Climate technology investment would be expected to reduce emissions by as much as 90% by 2050 (McKinsey, 2024, p. 2), and in 2023, the amount that start-ups raised in venture financing fell to \$2.3 billion, emphasizing carbon markets and energy management. Investments reached \$2.7 billion in 2024, representing a 17 percent increase, with energy technologies, carbon markets, and climate risk technologies leading the charge in the sector (Commerz Ventures, 2025, p. 3). The following figure

illustrates this development:

Fig N⁰(02): Annual Climate Financial Technology Funding Volume (2021-2024).



Source: It has been prepared based on the format provided in the report (Commerz Ventures, 2025, p. 7).

2.2 Climate FinTech Technologies

Modern Financial Technology contributes to reshaping climate financing by enhancing efficiency, transparency, and accountability. Notable technologies in this context include:

2.2.1 Blockchain technology

Blockchain technology is said to enhance investor confidence due to its decentralized structure and transparency, as it provides immutable data (Dominique, 2017) (Amy, 2019, p. 22). For carbon markets, it has increased efficiency by providing assurances that tracking and trading of carbon credits can be depended upon (Omeragica, Zaimovica, & Zaimovica, 2024, p. 275). Green financing, for example, may become feasible through automated consultants, crowdfunding, and blockchain, facilitating access to new financial resources, especially from private sector investors (Gregor & Braun, 2019).

Additionally, it helps provide monitoring, reporting, and verification of financial activities (Castilla, Juan, Simon, & Nick, 2016). For sustainable energy, specific applications of blockchain are used in carbon credits, climate financing, and decentralized energy systems, thereby improving carbon trading systems and fast-tracking climate financing transfers (Livingston, Varun, Madison, & Maximilian, 2018) (Alastair, 2018).

2.2.2 Artificial intelligence and machine learning

Artificial intelligence and machine learning make it possible to process huge amounts of data quickly and accurately, with the ability to continuously learn from new data (Ho, Chorng-Guang, Chung-Shing, & Thanh-Thao, 2020). In climate finance, these technologies are employed to assess risks and predict market trends, thereby assisting investors in making informed decisions. AI and ML can also forecast potential returns from renewable energy projects and estimate the future prices of carbon credits, enhancing investment strategies (Qingyang, 2024). Financial institutions also rely on artificial intelligence and automated advisors to improve portfolio management and address the challenges associated with opaque carbon accounts (Chatterjee, 2022).

2.2.3 The Internet of Things (IoT)

The Internet of Things provides the ability to connect devices and networks to collect data in real time, enhancing the accuracy of monitoring and analysis (Dian, 2022). In the climate finance sector, it is used to monitor the performance of renewable energy installations such as solar panels and wind turbines. Furthermore, IoT helps track industrial emissions and improve agricultural practices to reduce environmental impact and increase productivity (Loukoianova E. , Natalucci, Wang, & Kanada, 2024).

2.2.4 Digital twins

Digital twins are virtual replicas of physical systems that simulate and analyze the effects of various factors over extended periods (Attaran & Celik, 2023). These systems leverage big data technologies to extract valuable insights, improving the intelligence and applicability of digital twins, especially for quickly identifying and assessing design flaws (Guo, Zhao, Lin, & Saipeng, 2019). In climate finance, digital twins can simulate climate-related disasters and aid in the planning of sustainable infrastructure, helping to design projects that adapt to climate changes and mitigate associated financial risks (Loukoianova E. , Natalucci, Wang, & Kanada, 2024).

2.2.5 Geospatial Technologies

These technologies include satellite imaging and geographic information systems, which provide accurate data on environmental changes. They are used to monitor deforestation, measure changes in land use, and

analyze the environmental impacts of projects (Gargano & Rossi, 2024). Such data allows investors and policymakers to evaluate the environmental impact of their investments and ensure compliance with environmental objectives (Sachdeva & Zhao, 2021).

2.3 Areas of Climate Fintech

A sustainable future can only be built on a financial system that allows and enables the rapid transformation of the key industries that it has. Among the large-scale financial services landscape, the following areas have shown tremendous potential for accelerated growth through environmentally friendly business models:

2.3.1 Digital Banking Services

Banks serve as crucial intermediaries in the financing of sustainable projects. They encourage green finance. Climate fintech is about transforming banking, regarding both transparency and carbon footprint. Some of the green neobanks, like Aspiration, have begun offering sustainability-focused services such as Aspiration Impact Measurement (AIM), which tracks the environmental impacts-as well as Plant Your Change™, which funds tree planting using purchase transactions (Aspiration, 2020). Furthermore, the rise of mobile platforms like EcoCash in Zimbabwe has reduced the environmental footprint by minimizing paperwork and branch visits (Globallogic, 2023). Digital banking's rapid expansion, with over 3.6 billion users in 2024, highlights the growing commitment to sustainable finance (Maynard, 2020).

2.3.2 Digital payments

Climate-conscious fintech solutions are advancing digital payments, particularly in sectors like agriculture and forestry. Transitioning to cashless transactions promotes sustainability by reducing the need for physical banknotes, ATMs, and plastic cards (El Sayed Rady, Mohamed Badr, & Abdel Hadi, 2023). Platforms like EcoCash and Alipay encourage eco-friendly financial practices through mobile payments, reducing emissions (Paulson Institute Green Finance Center, 2020). Digital tools, such as TripIt, enable consumers to track and offset their carbon footprints, demonstrating the link between digital payments and environmental sustainability

(Soderlund, 2020).

2.3.3 Digital investment

Fintech is revolutionizing sustainable investments by providing innovative financial products and improving investor trust through data analytics. With ESGs (Environmental, Social, and Governance) gaining traction, Fintech eases green investments by virtue of enhanced efficiency and transparency (Globallogic, 2023). Platforms like OpenInvest allow individuals to customize portfolios along climate and social criteria, thereby enabling sustainable investments for the retail minion for as little as \$3,000 (Varlamos & Ravi, 2020). The climate fintech, which aided in promoting sustainable opportunities, saw responsible investing outshine traditional investing (Sophie, 2020). By 2021, it was analyzed that on a global scale, more than \$90 trillion worth of responsible investments were active, while Fintech tools like Blockchain and AI came to the fore enhancing the sustainable investment space (BloombergNEF, 2021).

2.3.4 Digital Lending

Green Loans are earmarked for financing climate-related projects, to enhance sustainable activities. Climate Fintech takes advantage of cutting-edge technologies- blockchain, AI, and peer-to-peer lending- to spur growth in sustainable loans (Globallogic, 2023). For example, Blockchain technology enhances transparency and lowers brokerage charges in the issuance of green bonds as evidenced from BBVA's 2019 issuance of EUR 35 million green bonds on the Blockchain (BBVA, 2019). Crowdfunding platforms like Ecologico Investments are another vital mechanism of financing decarbonisation projects given that the global crowdfunding market has grown from USD 100.32 billion in 2019 to an estimated USD 224.67 billion by 2024 (Statista Research, 2020). AI and IoT should greatly assure the success of green finance by automating loan disbursements and impact reporting, thus speeding up global decarbonisation processes (BloombergNEF, 2021).

2.4 Challenges and proposed solutions to enhance the role of fintech in climate finance

The main challenges in enhancing the role of fintech in climate finance include:

- **Data Challenges:** The lack of quality and standardized data hinders effective environmental risk assessment and financial reporting. This is compounded by poor data sharing (Berriche & Hamla, 2022). Solutions include using blockchain for transparent data, IoT and digital twins for real-time monitoring, and AI for big data analysis and predictive trends (Loukoianova E. , Natalucci, Wang, & Kanada, 2024);
- **Weak Digital Infrastructure:** Developing countries often lack the technical systems to support fintech, making climate risk analysis tools insufficient (Mahmoud Allam & Ali Khalil, 2022). Solutions include using digital twins for project optimization and blockchain for secure, transparent fund transfers (Loukoianova E. , Natalucci, Wang, & Kanada, 2024);
- **Shallow Financial Markets and Weak Liquidity:** Limited liquidity and awareness reduce interest in green financial instruments (McKinsey, 2024). Crowdfunding platforms, green bond technologies, and AI can help increase investment flow into sustainable projects (Loukoianova E. , Natalucci, Wang, & Kanada, 2024).

3. China's experience in climate fintech and its role in supporting green finance

Despite China's rapid development in the field of fintech, the spread of startups specializing in climate fintech is still limited compared to other regions (Europe, the United States). According to a preliminary analysis of this sector, there are about 250 global companies that match the definition of climate fintech, which use digital solutions in sustainable financing and reducing carbon emissions. However, only 20 of these companies are based in China, representing only 8% of the global ecosystem.

This limited spread is partly due to the Chinese market's focus on institutional investments in green finance via banks and regulators, rather than relying on startups. However, encouraging government policies may prompt an expansion of the role of fintech in supporting the transition towards a low-carbon economy, especially as the need for sustainable

financial innovations in the face of climate change escalates (McCreary, Zhao, & Chang, 2021).

3.1 China's climate fintech regulatory framework: from legislation to implementation

Since 2012, China has committed to combating climate change by adopting a national strategy to build an "ecological civilization". In 2015, the central government issued the integrated reform plan to promote environmental progress to establish a comprehensive institutional framework to promote environmental development (Xinhua, 2015). In 2016, guidelines for the creation of a green financial system were issued, which established additional rules for the development of green bonds, insurance, lending, sustainable financial products, and services (The Central Bank of the People's Republic of China, 2016).

Recent years have seen the popularization of President Xi Jinping's philosophy of "clean water and green mountains," prompting officials at all levels of government to adopt the concept. In 2017, green finance reform pilot zones were established, which now include nine cities in six provinces, providing additional opportunities for sustainable and digital innovation in the financial sector.

At the UN General Assembly in September 2020, the Chinese President pledged to achieve peak greenhouse gas emissions before 2030 and reach carbon neutrality by 2060. The Fourteenth Five-Year Plan is also being developed, which is expected to focus heavily on sustainable financing and infrastructure. In addition, various stock exchanges in China have imposed stricter disclosure requirements for environmental, social, and corporate governance (ESG) standards, forcing public companies to comply with these changes and encouraging investors to improve their sustainable investment practices (McCreary, Zhao, & Chang, 2021).

The following is a timeline of the most important regulatory guidelines on environmental, social, and corporate governance (ESG) in China (Ping An Digital Economic Research Center, 2020):

- February 2015: The People's Bank of China and the Shenzhen Stock Exchange issued guidelines regulating the operations of listed companies, requiring them to immediately disclose the causes of serious

environmental pollution, their financial and environmental impact, and countermeasures;

- 2015: The Hong Kong Stock Exchange issued the second version of the "environmental and social governance reporting guidelines", requiring companies to disclose 11 public indicators in their 2016 Annual Report, and 12 key environmental indicators in the 2017 report;
- December 2017: The China Securities Regulatory Commission issued the "Information Disclosure Content and coordination guidelines for listed companies", encouraging companies to voluntarily disclose information that contributes to environmental protection and Pollution Prevention;
- September 2018: The China Securities Regulatory Commission issued updated guidelines for the governance of listed companies, which set a basic framework for the disclosure of environmental and Social Governance information;
- September 2019: China issued the "fintech development plan (2019-2021)", which aimed to strengthen support and reduce risks in the fintech sector by regulating it more, as well as encouraging data-related investments (Jia, 2019).

3.2 The role of fintech in promoting climate innovation in China

Under the transition towards a low-carbon economy, China has become one of the world's leading countries in research and development related to climate fintech. China's share of global R&D spending increased from 4.9% in 2000 to 26.3% in 2018 (John & Sargent, 2022), with USD 321.3 billion invested in R&D during 2019, making it the second largest country in the world after the United States (Xinhua, 2020).

Fintech-enabled climate innovations are concentrated in major cities such as Beijing, Shanghai, and Shenzhen, where digital financing platforms for environmental projects and green credit management systems are being developed, as in the city of Huzhou, which is a model in using green fintech to finance low-carbon projects (Deloitte, 2019).

3.3 The importance of foreign investment in supporting climate fintech in China

In recent years, China has witnessed an increasing influx of foreign capital into financial markets, which has contributed to strengthening the criteria for Sustainable Investment. In 2019, MSCI raised the percentage of Chinese companies' shares in its index from 15% to 20%, and restrictions on foreign investors were lifted in 2020, allowing the largest amount of foreign capital to flow into the domestic stock market. This openness has led to the strengthening of international practices in green and sustainable investment within the Chinese market, as an analysis of MSCI ESG data showed that the MSCI China ESG Leaders Index outperformed the MSCI China Index by 4.7% between 2013 and 2019. This reflects the interest of global investors in Sustainable Finance, which may be an impetus for the growth of climate fintech in China (Principle for Responsible Investment (PRI), 2020).

3.4 The role of climate fintech in the development of green finance in China

3.4.1 The shift towards green credit management systems

Climate fintech is stimulating more efficient capital mobilization in the green lending sector. The growth of the two main models was observed in the market:

- Building green credit management systems;
- Application of blockchain technologies to finance renewable energy assets.

For example, Huzhou Bank, with the support of startups specializing in climate fintech, has upgraded its credit management system to a cloud-based intelligent one. This system makes it possible to accurately assess, classify, and monitor the environmental impact of green projects with a higher frequency, which enhances the efficiency of green lending. This is part of the comprehensive green finance reform plan, which aims to expand these systems to more Chinese cities (Green Finance Center, Paulson Institute, 2020).

3.4.2 Promoting transparency and sustainability through big data analysis and artificial intelligence

Climate fintech companies are a major provider of alternative data and

technology, helping to address challenges related to environmental, social, and governance data integrity (ESG). Although the disclosure of Environmental Information in China is still limited, as statistics show that as of June 2020, only 27% of companies listed on Chinese stock exchanges were issuing sustainability reports, some startups such as Mile Tech and SM Securities have developed their data sources via Regulatory websites and social media. These companies are also working on using artificial intelligence to analyze data quickly and accurately, which reduces costs and increases the efficiency of financial assessment and environmental sustainability (SynTao Green Finance, 2020).

3.4.3 Blockchain applications in supporting green assets

Blockchain startups are contributing to the promotion of the green finance market, recording the performance of green assets in a transparent and unchangeable manner. This contributes to reducing the inspection and tracking costs of distributed environmental assets, making it easier for financial institutions to monitor the performance of green loans and bonds (GDFA, 2018).

For example, China has managed to issue more than CNY 10 trillion (USD 1.47 trillion) in green assets, with more than one million green loans and bonds issued annually. Efficiency improvements in green credit management can free up hundreds of billions of new capital for sustainable projects (McCreary, Zhao, & Chang, 2021, p. 65).

3.4.4 The impact of climate fintech on financial markets and regulatory policies

Climate fintech has a significant impact on Chinese financial markets, helping to promote transparency in carbon trading and renewable energy, making it an effective tool to support decarbonization strategies. Regulatory technology companies (RegTech) are also playing an increasing role in helping regulators monitor climate finance, enhancing the efficiency of environmental and financial policies (Meihui & Chi, 2024, p. 5).

In addition, changing consumer behavior is playing an important role in accelerating the adoption of green finance, especially through financial incentive programs offered by fintech companies. Some companies are

incentivizing environmental behavior by awarding digital credit points in exchange for environmentally friendly behaviors, which can be used to purchase low-carbon products, creating direct financial incentives that support green transformation (McCreary, Zhao, & Chang, 2021, p. 64).

3.5 The challenges facing China's climate fintech

Despite the promising opportunities offered by climate fintech in China, it faces many challenges that hinder its expansion and development. One of the most prominent of these challenges is the dominance of large companies such as Alibaba, Tencent, and GD over the market, which reduces the competitiveness of startups and limits their opportunities for innovation and growth. Slow regulatory reforms, especially in the energy and carbon trading sectors, are also hindering the accelerated adoption of sustainable digital financial solutions, while legal tightening resulting from past problems in crowdfunding and peer-to-peer lending (P2P) is narrowing the scope of scalable business models (McCreary, Zhao, & Chang, 2021, p. 65).

However, the Chinese government is moving towards promoting green finance by offering incentives to companies that adhere to environmental standards, which may create a more favorable environment for the growth of climate fintech. The growing interest of international investors in sustainable investments also enhances the opportunities for startups to obtain financing and strategic support. In this context, large companies themselves have begun to expand their business to include digital solutions for sustainability, which may open the way for new partnerships with startups and financial institutions, contributing to enhancing innovation and pushing climate fintech to more advanced levels in China (Xiuping & Yiping, 2020).

4. Conclusion

Climate fintech represents one of the most important tools of the digital age in achieving the Sustainable Development Goals, as the Chinese experience has proven its ability to employ financial innovation to achieve green finance and meet environmental challenges through advanced digital tools.

Based on what was analyzed in the study, the most striking results can be summarized as follows:

- The size of the climate fintech market in China has reached more than

250 specialized startups by the end of 2023;

- Green loans in China exceeded 30.08 trillion yuan (about 4.25 trillion dollars), with an annual growth of 36.5%;
- Green bonds worth 1.3 trillion yuan (about 183 billion dollars) were issued in 2023, and China ranks first globally in this area;
- China relies on a range of modern technologies such as artificial intelligence, blockchain, the Internet of Things (IoT), digital twin, and geo-technologies in financing sustainable projects;
- These technologies have contributed to reducing financing costs, enhancing transparency, and improving the monitoring and tracking of environmental projects;
- China has taken advantage of artificial intelligence, blockchain, and IoT technologies to improve the efficiency of financing green projects;
- China's advanced digital infrastructure has contributed to enhancing investor confidence and facilitating access to green finance.

The study recommended that developing countries, especially Algeria, should benefit from China's experience in this field by:

- Development of advanced digital infrastructure in the financial sector;
- Encouraging innovation and entrepreneurship in the field of green financial technology;
- Developing a regulatory framework for environmental financial technology to increase the attraction of green investments;
- Strengthening international partnerships with global platforms specialized in financing sustainable projects.

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