



Green development and environmental policy in China: past, current and future

Hong-Xing Wen¹ · Pu-Yan Nie¹ · Peng Sun² · Chan Wang¹ · Henry Wang³

Published online: 30 December 2023

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2023

Building a sustainable, cleaner and pollution-free planet is a global challenge for human reproduction and prosperity, now and into the future, which urgently calls for action by all countries — developed and developing countries — in a global partnership (UN 2015). As the world's largest developing country, accounting for about one fifth of the global population, China's environmental status has attracted worldwide attention. Over the past few decades, China has experienced rapid economic growth for many years, but this extensive growth model has inevitably caused serious environmental pollution and ecological damage. Due to the large scale of energy consumption and carbon emissions (Wen et al. 2022), China is suffering from severe air pollution and associated public health impacts (Wen et al 2023). According to an early report published by WHO, nearly one-third of the 7 million premature deaths worldwide from exposure to environmental (outdoor) and indoor air pollution every year comes from China. To cope with the above challenges, the Chinese government recently announced two ambitious goals, namely achieving carbon peak before 2030 and carbon neutrality by 2060 (Wen et al. 2022). The 14th Five-Year-Plan for China's National Economic and Social Development clearly defined the goals, tasks, timetable and road-map of carbon peak and carbon neutrality. From extensive growth to sustainable development and now to green development, the change in China's development concept is not only a response to the international pressure of climate change, but also the internal requirement of China's economic transition and structural adjustment. However, it should be noted that the

pressure on China's ecological and environmental protection has not been fundamentally alleviated, and the task of achieving carbon peak and carbon neutrality is becoming increasingly challenging (Wen et al. 2022).

Therefore, this special issue focused on the theme of *Green Development and Environmental Policy in China: Past, Current and Future*. After a meticulous peer-review process, 14 high scientific-level articles selected from nearly 50 submissions have been accepted for publication. They mainly concerned 3 topics: low-carbon development and carbon trading market, green finance and green innovation, and population, environment and health.

Low-carbon development and carbon trading market

Over half of the 14 published papers extensively discussed China's low-carbon development practices, policies, and their impacts. Carbon emission trading scheme (CETS), as a typical market-based environmental regulation tool, is an important measure to promote China's low-carbon transition (Wen et al. 2021). Since 2011, China has launched several CETS pilot projects in Beijing, Tianjin, Shanghai, Chongqing, Hubei, Guangdong, and Shenzhen. By 2017, the national carbon trading market had been officially established. Based on these CETS pilot projects, two published articles in this special issue evaluated the performance of China's carbon trading market using differences-in-differences (DID) estimation strategy. The article, entitled *Have carbon emission trading pilot policy improved urban innovation capacity? Evidence from a quasi-natural experiment in China*, analyzed the impact of CETS on urban innovation capacity. They concluded that CETP not only improves the innovation capacity of pilot cities, but also has a positive spillover effect on innovation in surrounding cities. By focusing on collaborative reduction of carbon and air pollutants, the article entitled *Evaluating China's pilot carbon Emission Trading Scheme: collaborative reduction of carbon and air pollutants* pointed out that China's CETS exerts an effect of roughly 24.7%

Responsible Editor: Philippe Garrigues

✉ Pu-Yan Nie
pynie@gdufe.edu.cn

¹ School of Economics, Guangdong University of Finance & Economics, Guangzhou, China

² International Business School, Hainan University, Haikou, China

³ Department of Economics, University of Missouri, Columbia, MO, USA

on reducing carbon, roughly 10.1% on reducing air pollutants, and roughly 22.0% on the collaborative reduction of carbon and air pollutants.

Due to the long-term extensive resource development, resource-based cities have become an important region constraining China from achieving low-carbon development. Four articles published in this special issue have focused on low-carbon development of cities. The article entitled *Low-carbon development pathways for resource-based cities in China under the carbon peaking and carbon neutrality goals* discussed the low-carbon transition pathways of resource-based cities. Using the low-carbon city (LCC) pilot programs in China as the policy shock, the article entitled *Low carbon city and FDI inflows: evidence from China* stated that LCC can significantly attract FDI through reducing compliance costs and promoting technological innovation. Also, LCC plays a positive spillover effect on FDI inflows to surrounding cities. The article entitled *Can environmental protection and banking development be synergized?—An analysis based on the low-carbon city pilot in China* examined the impact of LCC on the growth of the banking sector and the underlying mechanisms. Their results demonstrated that LCC produces credit risk at enterprises and conveys it to banks, resulting in a retarding effect on banking development. The article entitled *Influencing factors of environmental efficiency of strategic emerging industries and their power cooperation mechanism design* contributed to prior works by focusing on environmental efficiency of various policy tools into the same econometric model framework.

Compared to urban and industrial sectors, low-carbon development in the agricultural sector has not received wide attention in China. In this special issue, two articles made significant contributions in this regard. The article entitled *Effect of agricultural fiscal expenditures on agricultural carbon intensity in China* stated that agricultural fiscal expenditure can reduce local agricultural carbon intensity by stimulating technological progress and structural adjustment, but neighbor regions' carbon intensities are increased due to fiscal rivalry. From a technical perspective, the article entitled *Energy flow analysis of grass carp pond system based on Ecopath model* compared the differences of ecological structure and energy flow between two breeding ponds. They claimed that compared to the traditional monoculture model that are prone to result in problems such as poor water quality and frequent diseases, polyculture could improve energy utilization, increase transfer efficiency, and raise the stability of the ecosystem.

Green finance and green innovation

Green finance innovatively connects environmental regulations and the development of the financial sector, which has emerged as a promising tool to support and promote green development in both developed and developing

economies (Wang et al. 2021). As technological innovation is one of the key foundations to achieving low-carbon transition, the relationship between green finance development and green innovation has been extensively discussed in three published articles. In the first article titled *Coordinated development of green finance and green technology innovation in China: from the perspective of network characteristics and prediction*, the coordination between green finance and green innovation was evaluated at the provincial level, including the evolution of their core network, spatial structure characteristics, and the general prediction of future network. Using a quasi-natural experiment of the launch of China's green bond market in 2016, the second article, entitled *Can green bonds empower green technology innovation of enterprises*, argued that green bonds can significantly empower enterprise's green technology innovation, but which is mainly reflected in the green utility patents rather than green invention patents. The third article, entitled *ESG ratings, monetary policy uncertainty, and bond issuance premium*, made a contribution to the knowledge gap about the role of ESG information disclosure in the correlation between macro monetary policy uncertainty and micro bond issuance premiums.

Population, environment and health

Addressing the complex conflict between population, environment, and health is another challenge currently facing China (Wen et al. 2023). Therefore, we organized three high-quality articles to rigorously discuss this topic. The article, entitled *Population agglomeration in Chinese cities: is it benefit or damage for the quality of economic development*, found that population agglomeration significantly contributes to the improvement of urban green productivity by increasing population diversification, promoting knowledge spillovers, and reducing pollution emission intensity. Currently, the population of most big cities in China has not yet reached saturation, and there is still a large demographic dividend space. However, in the metropolises and mega-cities, excessive population agglomeration also brings about "urban diseases" such as population congestion and traffic congestion. The article, entitled *The impact of population characteristics on transportation CO₂ emissions—does population aging important*, proved that population aging and the improvement of population quality can restrain transport carbon emissions. However, with the aggravation of population aging, transport carbon emissions would present a U-shape trend. In the article entitled *Prediction and early warning model of mixed exposure to air pollution and meteorological factors on death of respiratory diseases based on machine learning*, the author established a comprehensive

climate-health model by integrating the machine learning methods such as XGBoost, support vector machine, and generalized additive model. Through multi-scenario simulations, this study concluded that if the low temperature and high environmental pollutants (PM_{2.5}) continue to influence for a long time, the global death risk of respiratory diseases will continue to rise.

The guest editors would like to express their heartfelt gratitude to all the authors of this special issue for their valuable contributions and the reviewers for their valuable comments and suggestions that greatly helped to enhance the quality of the papers. Special thanks to Dr. Philippe Garrigues, Editor-in-Chief and Giulia Marinaccio, Editorial Assistant, Environmental Science and Pollution Research for generously providing this opportunity to compile this special issue. Also, we extend our heartfelt thanks to the funding support provided by the National Natural Science Foundation of China (72003044; 72003045), the Guangdong Natural Science Foundation (2022A1515011903), and the Guangdong Philosophy and Social Science Foundation (GD23CYJ09).

Data availability Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

References

- United States (2015) Transforming our world: the 2030 agenda for sustainable development. Available from <https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981>. Accessed 12 Dec 2023
- Wang C, Li XW, Wen HX, Nie PY (2021) Order financing for promoting green transition. *J Clean Prod* 283:125415
- Wen HX, Chen Z, Yang Q, Liu JY, Nie PY (2022) Driving forces and mitigating strategies of CO₂ emissions in China: a decomposition analysis based on 38 industrial sub-sectors. *Energy* 245:123262
- Wen HX, Chen ZR, Nie PY (2021) Environmental and economic performance of China's ETS pilots: new evidence from expanded synthetic control method. *Energy Rep* 7:2999–3010
- Wen HX, Nie PY, Liu M, Peng R, Guo T, Wang C, Xie XB (2023) Multi-health effects of clean residential heating: evidences from rural China's coal-to-gas/electricity project. *Energy Sustain Dev* 73:66–75

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



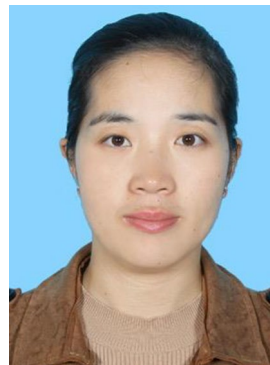
Dr. Hong-Xing Wen is currently working as an Associate Professor at the School of Economics, Guangdong University of Finance & Economics, Guangzhou, China. He received his Ph.D. from China Agricultural University, China, in 2019. His interest currently lies in the field of environmental innovation and management.



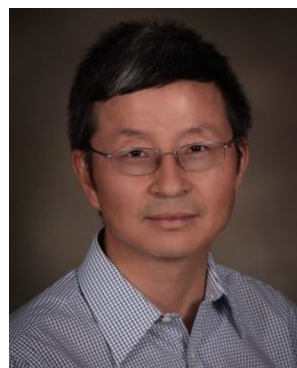
Dr. Pu-Yan Nie is currently working as a Professor and the Dean of the School of Economics, Guangdong University of Finance & Economics, Guangzhou, China. He received his Ph.D. from the Chinese Academy of Sciences, China, in 2003. His interest currently lies in the field of game theory and industrial economics.



Dr. Peng Sun is currently working as an Associate Professor at the School of Economics, Hainan University, Haikou, China. He received his Ph.D. from Jinan University, China, in 2015. His interest currently lies in the field of environmental management.



Dr. Chan Wang is currently working as a Professor at the School of Economics, Guangdong University of Finance & Economics, Guangzhou, China. She received her Ph.D. from Jinan University, China, in 2017. Her interest currently lies in the field of game theory and industrial economics.



Dr. Henry Wang is working as a Full Professor at the Department of Economics, University of Missouri, MO, United StatesUSA. He received his Ph.D. from The University of Iowa, United StatesUSA, in 1990. His interest currently lies in the field of game theory and industrial economics.