

Commentary

Addressing Environmental Health Challenges for Sustainable Development in China

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On May 5, 2023, the World Health Organization (WHO) declared that the coronavirus disease 2019 (COVID-19) no longer posed a public health emergency of international concern (1). As restrictions associated with the epidemic are relaxed and a fresh policy cycle commences, China's economy is expected to serve as a key driver of global economic post-pandemic recovery.

For over four and a half decades, China has witnessed rapid economic growth, positioning itself as the world's second-largest economy. Notably, from 2012 to 2022, the gross domestic product (GDP) of China expanded more than twofold, from 53.9 trillion Chinese yuan (CNY) [approximately 7.58 trillion United States dollars (USD)] to 121.02 trillion CNY (17.93 trillion USD). In the same period, the country had an average annual GDP growth rate of 6.2%, one of the highest globally (2).

Alongside this economic growth, China also achieved significant strides in environmental conservation. Specifically, energy consumption per unit of GDP reduced by 8.1%, and CO₂ emissions decreased by 14.1%. Furthermore, from 2018 to 2022, an improvement was observed in water quality in cities at or above the prefectural level, with the percentage of good-quality surface water bodies increasing from 67.9% to 87.9%. Air quality also improved, with the average particulate matter 2.5 (PM_{2.5}) concentration decreasing by 27.5% and severe air pollution days declining by over 50% (2).

However, simultaneous industrial expansion and rapid urbanization, coupled with an increase in energy consumption and a burgeoning vehicular population, have amplified environmental pollution issues. This situation presents a significant challenge to both socioeconomic development and public health in China, reflecting environmental health challenges often encountered by developing nations.

KEY ENVIRONMENTAL HEALTH ISSUES IN CHINA

In 2022, China emerged as the world's leading

consumer of electricity, accounting for 31% of the global demand (3). Projections for 2023–2025 anticipate an average annual growth of 5.2%, suggesting that by 2025 China will consume one-third of the world's electricity. Despite the increased uptake of renewable energy sources in recent decades, coal remains a pivotal part of the Chinese electricity landscape, contributing over 62% to power generation in 2022. Furthermore, coal consumption surpassed 4 billion tons, representing more than half of the world's total coal use. Additionally, China's aging population is a burgeoning issue; the country's seventh national population census in 2021 indicated that the proportion of people aged 65 or older reached 190 million (13.50% of the total population), reflecting a 4.63% increase since 2010. This exponential growth in the aging population not only precipitates demographic shifts, but also significantly impacts socioeconomic and technological changes (4). Urbanization trends show a rapid expansion of urban areas, with the number of cities increasing from 223 in 1980 to 687 in 2020. Now, 63.89% of the population resides in urban areas. China's urbanization process continues to evolve as over 10 million individuals transition from rural to urban areas annually (2). Lastly, the number of on-road civilian vehicles in China amplified more than threefold, growing from 93 million in 2011 to 319 million in 2022.

Despite the remarkable progress China has made in its economic and social development due to the implementation of reform and opening-up policies, the tension between swift socioeconomic growth, the availability of energy resources, and the ecological environment is becoming increasingly apparent (5). Multiple constraints are now impacting China's development, including pressures from ecological protection, limited energy support, and global climate change concerns, all of which are connected to its modernization process. At present, China is the world's leading producer of CO₂ and other greenhouse gases, aggravating worries about climate change and air pollution (6).

Even though significant strides have been made by the government to curb environmental pollution and conserve ecosystems, there are substantial improvements that need to happen. For instance, in 2021, out of 339 cities at the prefectural level or higher, 121 (35.7%) failed to meet the National Guidelines for Ambient Air Quality (7). Factoring in dust storms, the number of non-compliant cities rises to 146 (43.1%). The average land quality for farming was rated at 4.76 on a scale from 1 (best) to 10 (worst), with 31.24% of land falling into the higher quality (categories 1–3), 46.81% in the middle (categories 4–6), and 21.95% in the low quality (categories 7–10).

In terms of groundwater resources (inclusive of both the Yangtze and Yellow Rivers), among the 3,632 points monitored, 84.9% held Grades I–III water quality (signifying relatively higher quality), while Grades IV, V, and low V (indicating relatively lower quality) accounted for 11.8%, 2.2%, and 1.2% respectively. According to the Blue Book on Climate Change in China 2022, the average land surface temperature in 2021 rose 0.97 °C over the baseline average, making it the highest since 1901 (8). This rise in surface temperature in China, at a rate of 0.26 °C per decade, exceeds the worldwide average rate of increase, which sits at 0.15 °C per decade.

PUBLIC HEALTH IMPACTS OF ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE

The deleterious effects of environmental pollution and climate change on public health are increasingly evident. For instance, it was determined that in 2019, air pollution was implicated in roughly 1.85 million fatalities in China, with approximately 1.42 million of these attributable to particulate matter (9). The *Lancet* Countdown's 2022 report on health and climate change regarding China revealed escalating health risks stemming from climate change. This is illustrated by the occurrence of record-breaking average national temperatures and a rise in extreme weather events across the country (10). In 2021, compared to the average for 1986–2005, Chinese inhabitants faced on average an additional 7.85 heatwave days, leading to an increase of approximately 13,185 heatwave-related deaths. There was a loss of about 33 billion heat-related work hours, amounting to a 1.68% decrease in GDP. From 2017 to 2021, as compared to the 2001–2005 average, elevated temperatures

concurrently led to an average increase in wildfire exposure of 60.0%. A rising trend in dengue transmission has been noted since 2000 when compared to prior timeframes. Likewise, China's swift urbanization is yielding substantial impacts on both the environment and public health. Preliminary data indicates significant disparities among distinct urban groups in the realm of cardiovascular disease prevention and mortality risks (11).

CHINA IS TACKLING ENVIRONMENTAL HEALTH CHALLENGES SERIOUSLY

China grapples with significant challenges related to environmental pollution and population health protection. As the largest upper-middle income developing country, China's swift economic growth and industrialization complicate efforts to decrease carbon emissions and safeguard ecosystems. Undeniably, China, akin to other nations, carries an ethical right to development. However, increased energy consumption and industrial production inevitably lead to elevated carbon emissions and pollutant creation. The question of how to preserve the environment throughout the modernization process is of pivotal importance, with multiple lower- or upper-middle income developing countries striving to find a suitable solution. Nevertheless, the Chinese government is actively implementing measures aimed at curtailing carbon emissions, managing environmental pollution, and enhancing ecosystem protection.

The State Council executive meeting, held in December 2020, ratified a pollution control regulation aimed at monitoring and controlling pollutant discharge from enterprises and public institutions to maintain a robust ecological environment (12). The regulation, effective since March 2021, mandates that all enterprises involved in pollutant discharge secure a pollution discharge permit, with unpermitted discharges prohibited.

In October 2021, the Chinese Government published a white paper, "*Responding to Climate Change: China's Policies and Actions*." Recognized as the world's largest developing country and a significant contributor to carbon emissions, China announced ambitious goals of reaching peak carbon emissions before 2030 and carbon neutrality prior to 2060 (13). The government has prioritized climate change

response and has consistently lowered the intensity of its carbon emissions. It has put forth substantial efforts to fulfill its Nationally Determined Contributions (NDCs) and has maximally sought to mitigate climate change. China has embraced green, low-carbon strategies in its economic and social development agenda, striving towards the harmonious coexistence of humans and nature. With China's pursuit of carbon neutrality, aerosol reductions stemming from clean air actions and pollution control policies could potentially have a substantial impact on the climate (14–18).

In January 2023, China released another white paper, titled “*China's Green Development in the New Era*” (Table 1). China has firmly endorsed the concept of a global community with a shared future, demonstrating steadfast support for multilateralism. It has proposed both the Global Development Initiative and the Global Security Initiative, widened practical cooperation, and actively engaged in global environmental and climate governance (19).

China has aggressively addressed pressing pollution issues with ambitious objectives. For instance, in 2021 the mean concentration of PM_{2.5} in cities at or above the prefectural level registered at 30 µg/m³, a year-over-year reduction of 9.1% (7). Further, the percentage of surface water at or above Grade III rose by 1.5% year-over-year, reaching 84.9%. The emission of CO₂ per unit of GDP is projected to decrease by 18% from 2020 to 2025, illustrating China's

acceleration towards a low-carbon energy consumption transition. The share of renewable energy consumption is expected to increase to approximately 20% by 2025. Despite these advancements, China still faces significant challenges in reaching peak carbon dioxide emissions before 2030 and achieving carbon neutrality prior to 2060. Numerous plans, laws, regulations, and policies have been put into action, demonstrating China's unwavering commitment to its “dual carbon goals” — carbon peak before 2030 and carbon neutrality before 2060 — and to advancing towards a greener and healthier nation (Figure 1). China also plans to enact its green transition agenda, increasing its role in bilateral and multilateral green development initiatives, advocating for a fair and equitable global environment governance system, and contributing its unique perspective and efforts to global economic growth (19). These endeavors will contribute significantly to global sustainable development and may inspire other developing nations with rapid industrialization to follow suit.

SUMMARY AND OUTLOOK

The significance of environmental protection within the context of modernization is a pertinent concern for numerous nations, especially those undergoing transitional stages. Notably, the Chinese government

TABLE 1. Summary of key regulations implemented in China promoting high-quality and green development over the past decade.

Time	Document title	Content
April 24, 2014	The Revised Environmental Protection Law (Order of the President of the People's Republic of China No. 9)	(i) Protect and improve the environment in the course of socioeconomic development. (ii) Expand the number of items from 47 to 70. (iii) Put into practice on January 1, 2015.
June 27, 2018	Battle for Protecting Blue Sky Three-Year Action Plan (Order of the President of the People's Republic of China No. 22)	(i) The focus should be on controlling air pollution, especially in regions experiencing severe pollution. (ii) Substantially reduce emissions of air pollutants and greenhouse gases within three years. (iii) In comparison to the levels of 2015, there was a decrease in the levels of SO ₂ and NO _x by 15%, and PM _{2.5} by 18% in 2020.
December 26, 2020	The Yangtze River Protection Law (Order of the President of the People's Republic of China No. 65)	(i) Enhance ecological and environmental protection and restoration efforts in the Yangtze River basin. (ii) Facilitate the rational and effective use of resources. (iii) Safeguard ecological security and ensure harmony between humans and nature.
October 27, 2021	The White Paper on Responding to Climate Change: China's Policies and Actions	(i) China has elevated the response to climate change to a higher level of priority within state governance. (ii) The goal is to reach peak CO ₂ emissions prior to 2030, with an aim to attain carbon neutrality by 2060. (iii) China is taking pragmatic actions towards these goals.
January 19, 2023	The White Paper on China's Green Development In the New Era	(i) Promote harmonious coexistence between humans and nature. (ii) Optimize social and economic benefits with minimum resource costs and environmental impacts. (iii) Enhance sustainable and high-quality development.

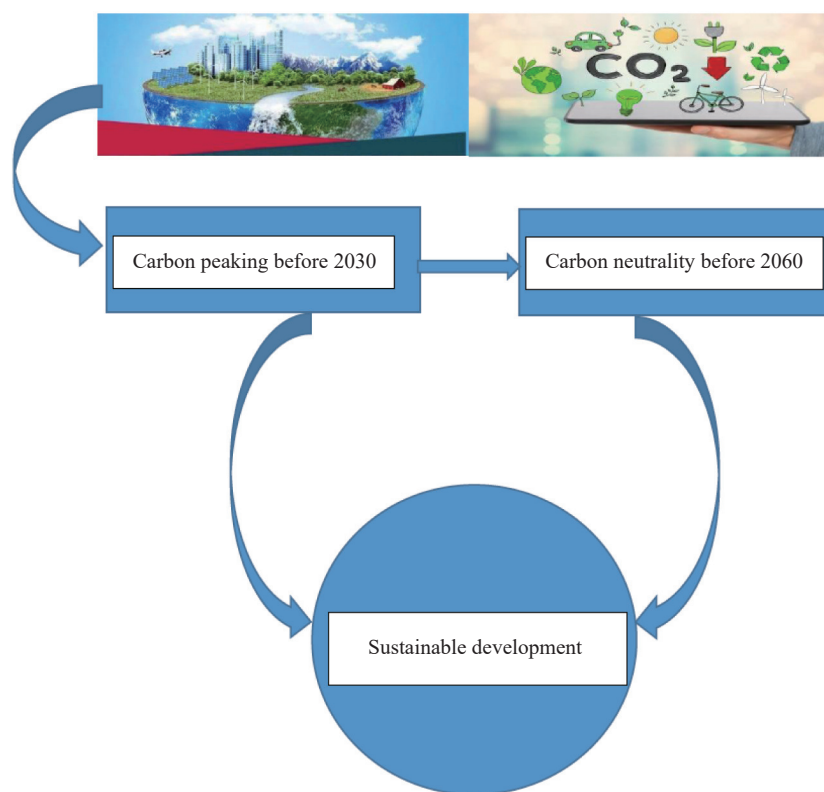


FIGURE 1. Conceptual diagram illustrating green development and “dual carbon” goals.

has implemented proactive strategies aimed at reducing carbon emissions, managing environmental pollution, and augmenting ecosystem protection. Recent enhancements to this positioning include the establishment of various plans, laws, regulations, and policies, indicating China’s resolve to enhance its environmental condition and bolster population health. Given the successful implementation of these measures, China’s envisioned image as a green, healthy, and sustainable country is likely to make substantial contributions to global socioeconomic development.

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