

Drivers of Carbon Emissions Induced by Ageing Household Consumption: Urban–Rural Differences across Chinese Provinces

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Population ageing represents a profound demographic transformation in China, unfolding under increasing pressure for carbon mitigation. While rural areas are ageing more rapidly than the urban, existing studies typically treat elderly households as homogeneous and overlook urban–rural differences in consumption-induced carbon emissions.

This study integrates age-specific household consumption data from micro-level surveys with a 31-region, 42-sector multi-regional input–output framework to estimate carbon emissions induced by urban and rural elderly households of China. Using benchmark tables for 2005, 2010, 2015, and 2020, we conduct structural decomposition analysis for three sub-periods (2005–2010, 2010–2015, and 2015–2020). A seven-factor decomposition framework is constructed, explicitly distinguishing the consumption structure of the elderly, per capita consumption expenditure of the ageing population, and population ageing ratio. This design enables the ageing effect to be analytically separated from changes in population size and overall consumption levels.

Between 2005 and 2020, emissions induced by urban elderly consumption increased at an average annual rate of 11.7%, exceeding the 9.3% growth of rural elderly emissions. However, during 2010–2015 and 2015–2020, rural elderly-induced emissions grew faster than urban emissions, primarily reflecting higher rural ageing ratios, despite declining rural population size and lower absolute emission levels than in urban areas. Across all periods, increases in ageing ratios gradually exert a positive contribution to emission changes.

Taking 2015–2020 as a representative recent stage, pronounced provincial heterogeneity is observed. Urban ageing ratios increased emissions by 3.2 Mt in Henan and 3.0 Mt in Inner Mongolia, while rural ageing ratios reached 4.9 Mt in Henan and 3.6 Mt in Hebei. Urban elderly per capita consumption reduced emissions in Jiangsu, Shanghai, Zhejiang, Liaoning, Inner Mongolia, Henan, and Hubei, in contrast to most other provinces. Meanwhile, elderly consumption structure effects substantially increased emissions in resource-intensive provinces such as urban areas of Xinjiang and Inner Mongolia (11.6 Mt and 9.0 Mt, respectively), as well as in economically developed provinces such as Jiangsu (9.0 Mt).

By distinguishing urban and rural elderly households within a provincial seven-factor decomposition framework over 2005–2020, this study provides new evidence on the spatially differentiated demographic drivers of carbon emissions and contributes to a more refined understanding of ageing-related emission dynamics in China.