

Prediction of Co-Reduction Potential of Agricultural Greenhouse Gas and Air Pollutants in Beijing-Tianjin-Hebei Region, China

Guo Xiurui^{*}, Zhang Yiling, Bai Yujuan, Chen Dongsheng, Cheng Shuiyuan

Key Laboratory of Beijing on Regional Combined Air Pollution Control, Beijing University of Technology, Beijing, China

Email address:

guoxiurui@bjut.edu.cn (Guo Xiurui)

^{*}Corresponding author

Abstract

Agricultural production contributes significantly to greenhouse gas (GHG) and air pollutant emissions, playing a critical role in China's "dual carbon" strategy and rural development. This study systematically evaluated the co-reduction potential of agricultural sources in the Beijing-Tianjin-Hebei region using refined inventory methods and scenario analysis. *Methods:* Direct/indirect emissions of CO₂, N₂O, CH₄, NO_x, SO₂, NH₃, and PM from eight agricultural activities (e.g., fertilizer application, rice cultivation, livestock, farm machinery) were quantified for 2020. Emission trends under baseline and integrated control scenarios (2021-2035) were projected, with synergistic effects analyzed via reduction metrics. *Results:* In 2020, total agricultural GHG emissions reached 48.35 million tons (Hebei: 91.5%), dominated by crop production (37%) and livestock enteric fermentation (33%). Pollutant emissions included 268 kt NO_x, 594 kt NH₃, and 37 kt PM, primarily from machinery fuel (46% NO_x), fertilizer loss (53% NH₃), and straw burning (34% PM). Under the baseline scenario, GHG emissions are projected to rise 14.7% by 2035 (Hebei: +16.2%), while pollutants increase 94-169%. The integrated control scenario achieves 17.9% GHG reduction by 2035, with Hebei showing the highest mitigation potential. Key measures include nitrification inhibitor fertilizers (22% NH₃ reduction), biogas power generation (18% CH₄), and photovoltaic agriculture (15% CO₂). Pollutant reductions under coordinated strategies reach 21.3% (NO_x), 26.5% (NH₃), and 17.5% (PM), driven by machinery upgrades, water-fertilizer integration, and no-till practices. *Conclusion:* Synergistic measures like organic fertilization, deep tillage, and energy optimization demonstrate the highest co-benefits. The study provides a scientific basis for precision emission reduction strategies in the region.

Keywords

Agricultural Sources, Greenhouse Gases, Air Pollutants, Co-Reduction Potential, Beijing-Tianjin-Hebei