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Effects of urbanization on food-energy-water systems in mega-urban regions: a case study of the Bohai MUR, China

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The security of food-energy-water systems (FEW systems) is an issue of worldwide concern, especially in mega-urban regions (MURs) with high-density populations, industries and carbon emissions. To better understand the hidden linkages between urbanization and FEW systems, the pressure on FEW systems is quantified in a typical rapid urbanizing region—the Bohai MUR. The correlation between urbanization indicators and the pressure on FEW systems is analyzed and the mechanism of the impact of urbanization on FEW systems is further investigated. Results show that approximately 23% of croplands is lost, 61% of which is converted to construction lands and the urban areas expand by 132.2% in the Bohai MUR during 1980-2015. The pressure on FEW systems has an upward trend with the stress index of the pressure on FEW systems (FEW_SI) exhibiting ranging from 80.49 to 134.82% and dominant pressure consisting of that has converted from water system pressure to energy system pressure since 2004. The FEW_SI in the Bohai MUR is enhanced with cropland loss and the increase in urbanization indicators. Additionally, land use, populations, incomes, policies and innovation are the main ways urbanization impacted FEW systems in MURs. This study enhances our understanding of the pressure variation on FEW systems in MURs and the effects of urbanization on FEW systems, which helps stakeholders to enhance the resilience of FEW systems and promote sustainable regional development.

Keywords: urbanization, food-energy-water system pressure, linkages, MURs