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**Title:** Modeling Metropolitan Food Systems in the Midwest US: Life Cycle Assessment of Current and Local Scenarios

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Food systems are energy intensive, causing approximately 25% of all anthropogenic global warming potential (GWP) and contributing to challenges across the food-energy-water nexus. One aspect of energy use in food systems is related to the distance between where food is produced and where it is consumed: A conservative estimate for the US is that on average food travels close to 2,400 km from the point of production (often California for fresh produce) to the point of consumption. The state of Iowa is of particular interest because it is in a rainfed agricultural region of the upper Midwest, and despite its highly productive landscape about 90% of human foods are imported. This study was focused on the Des Moines, Iowa Metropolitan Statistical Area (the DM-MSA), a six-county area in central Iowa with a human population of approximately 700,000 (in 2020). This area is considered representative of many metropolitan areas in the Midwest (e.g., Lansing, MI, Omaha, NE, Dayton, OH, Madison, WI) which have similar population sizes and are surrounded by rainfed agricultural landscapes.

We developed a metropolitan-scale LCA model to quantify environmental impacts (GWP, energy and water use) of the current DM-MSA food system and compared the current system to a localized scenario in which 50% of nutritional requirements for the population of the MSA is produced within its six-county area. These two scenarios were compared using the present population level and food system characteristics. We modeled 50% of current consumption by food groups (e.g., grains, proteins, and vegetables) to reflect nutritional requirements. We defined the functional unit of analysis as the environmental impact per kg of each food type consumed within the MSA each year. The system boundaries for both scenarios were cradle to grave; we excluded consumer energy use for storage and cooking. The food types and total amounts of consumption considered in both scenarios were held constant. Preliminary results indicated that compared to the baseline, the localized scenario for the DM-MSA required 13% less GWP, 16% less energy and 17% less water on an annual basis. The differences between the baseline and localized scenarios were smallest for the protein food group and largest for fruits and vegetables, for which GWP in the localized scenario was reduced by approximately 50%, energy input was reduced 65% and water was reduced 95%. This amounted to an estimated 86 billion L yr-1 reduction in water use for fruit and vegetables alone. A transition to 50% local consumption in the DM-MSA could lead to a large reduction in GWP emissions (approximately 58 million kg yr-1). However, this would require changes in diets based on seasonality of produce availability.

This study highlights the environmental impacts of local versus non-local food production and consumption at a metropolitan scale. A refined LCA model will be developed and used for co-simulation with other metropolitan-scale biophysical and social models to understand food system drivers and support effective decision-making that integrates social, economic, and environmental factors providing a pathway to sustainable urban food systems for the US Midwest.