Islam, M.[1†], J. Solis[2], S. Earl[3], and P. Westerhoff[1]. *Decennial Phosphorus Dynamics in Central Arizona Phoenix – Long-Term Ecological Research (CAP- LTER) Site.*

This study investigates phosphorus dynamics over a decade within the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) site, offering insights into how urbanization affects nutrient cycling in a semi-arid environment. By updating phosphorus flow diagrams (2000–2020), we analyzed datasets on population growth, land use, and wastewater management obtained from sources such as the Environmental Data Initiative, USDA, and EPA discharge reports. Employing a Python data analysis framework alongside STAN mass balance modeling, we quantified phosphorus inputs, transformations, and outputs across urban, agricultural, and natural systems. Key findings reveal declining agricultural fertilizer application due to reduced farmland and urban expansion, alongside increasing food-related phosphorus inputs driven by rapid population growth. Wastewater effluent phosphorus levels have remained stable, suggesting potential accumulation in biosolids. Additionally, a shift from cotton to alfalfa production for local dairy farms has reshaped phosphorus cycling, reflecting increased demand for livestock feed. These dynamics underscore the intricate interactions between urbanization and nutrient management, particularly in the arid Southwest where water scarcity and phosphorus dynamics are tightly coupled. This work highlights the importance of integrating urban, agricultural, and ecological systems to manage phosphorus sustainably. It also emphasizes the need for data-driven policies to address the challenges of resource scarcity and climate change in rapidly urbanizing regions. By improving our understanding of nutrient cycles in desert cities like Phoenix, this study contributes to developing resilient and sustainable phosphorus economies capable of adapting to future environmental challenges.

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