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Modeling the Pollution Potential from Onsite Wastewater Treatment Systems: The Power of Data to Elucidate Nonpoint Sources of Water Pollution

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Abstract:

Onsite wastewater treatment systems (OWTSs), or septic tank systems, are commonly used throughout the United States and are generally effective at remediating wastewater. However, malfunctioning OWTSs can introduce excess nutrients (i.e., nitrogen and phosphorous) and pathogens (i.e., *E. coli*) into the environment. There is increasing evidence that OWTSs can be a significant, and potentially underestimated, nonpoint source (NPS) of pollution. Thus, the objectives of this research were to (1) develop a model to assess the pollution potential from OWTSs using GIS-based multi-criteria decision analyses (MCDA) and (2) evaluate the relationship between the pollution potential from OWTSs and water pollutants.

This study was completed in the Choccolocco Creek watershed, Alabama. The main tributary in this watershed, the Choccolocco Creek, is an impaired waterbody due to elevated *E. coli* concentrations. An MCDA was developed to model the pollution potential from OWTSs using environmental and OWTS variables. Similarly, an OWTS site unsuitability analysis, that only included environmental variables, was used to predict where OWTS may poorly perform, if OWTS data are not accessible in other areas. Water samples were taken along Choccolocco Creek to measure nitrogen, phosphorous, and *E. coli* concentrations. Pollutant concentrations were correlated to modeled pollution potential from OWTSs and OWTS site unsuitability, to compare how the exclusion of OWTS data changes the results. Additionally, land cover distribution was correlated to pollutant concentrations to account for other potential NPSs of water pollution.

All water pollutants were significantly, positively correlated to OWTS count. Additionally, *E. coli* and nitrogen concentrations were significantly, positively correlated to pollution potential from OWTSs. This suggests that OWTSs may contribute to water pollution within the watershed. Furthermore, the location of areas most probable to have OWTS pollution varied between models, highlighting the importance of accounting for OWTSs as a NPS of water pollution. The methods presented could be adapted for other watersheds and used to guide best watershed management practices.