# Rising seas are causing septic systems to fail, finds researcher

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Lamis Amer, a fourth-year industrial engineering doctoral student, has spent the past three years developing a decision-making model that could help communities adapt septic systems in response to climate change. Credit: Joshua Prezant/University of Miami

A University of Miami industrial engineering graduate student has conducted research that shows which sites in Miami-Dade County are at risk and proposes strategies to make those systems more resilient to sea

level rise.

It is a scenario that plays out at least three times a year at Matthew Lawrence's Central Broward County home: torrential rains saturate the drain field in his backyard, causing his septic system to operate inefficiently.

"It's never gotten to the point where sewage comes to the surface, and that's owing to the fact that I maintain my system well and take proper precautions," said Lawrence, a commercial and residential developer. "But what's going to happen when storms get worse and the rains heavier?"

For many residents in coastal areas impacted by climate change, that question already has been answered. As prolonged rains and rising seas continue to raise water table levels, their septic systems are failing, causing wastewater to back up into their homes and creating risks to clean water, ecosystems, and public health.

The solution, according to a University of Miami College of Engineering graduate student, lies not solely in connecting existing septic systems to public sewer lines but also in finding alternative adaptation strategies to make those systems more resilient to the effects of climate change.

"Connecting to a municipal sewer line is not always a feasible option, especially for residents who live outside city service areas, so they need to rely on septic to dispose of their home's wastewater," said Lamis Amer, a fourth-year industrial engineering doctoral student.

"But today, with more precipitation and flooding raising groundwater levels, some septic systems aren't functioning as they should. So, we need to look at adaptation strategies like mound systems and micro sewer treatment plants to mitigate the risks climate change poses to

septic systems."

Amer has spent the past three years studying those risks and developing a decision-making model that could help communities adapt septic systems in response to climate change.

Her research is part of a study led by her faculty mentor, associate professor Murat Erkoc, who is applying principles of systems engineering to help coastal communities in Florida and elsewhere deal with and mitigate the effects of sea level rise.

With about 2.6 million septic tanks in Florida—120,000 in Miami-Dade County alone, according to the environmental nonprofit Miami Waterkeeper—Amer's research couldn't be timelier, she noted.

Using records from Miami-Dade's Open Data Hub as well as other publicly available sources, she identified properties in the county that have active septic systems, then designed a resilience index scale of 0 to 1 to determine how resilient those septic systems are to the effects of rising groundwater. She eliminated septic systems that had been abandoned.

She used current sea levels rates and examined other data such as a property's proximity to flood-risk zones, finding that nearly 32% of the existing sites in her study have a resilience index below 0.5 and that approximately 18% have a resilience index less than 0.1.

"A resilience index of 1 means that the system is not subject to failure; or if it did malfunction, the likelihood of polluting other freshwater sources would be minimal," Amer explained. "Lower resilience values mean that those systems are not meeting the minimum operating requirements for septic and could already be contaminating groundwater."

As sea levels continue to rise, septic sites that are currently resilient could be compromised, she warned.

Amer said her results, which she plans to share with Miami-Dade and EPA officials, can help inform decisions about which septic sites should be prioritized for adaptation measures.

She also hopes to expand her study to examine how climate change is contributing to higher rates of septic system failures in poorer, underserved communities.

In a move to safeguard public health and natural areas such as Biscayne Bay, Miami-Dade is already addressing the problem of failing septic systems, implementing its Connect to Protect program aimed at extending sanitary sewer service to residents with septic systems. Miami-Dade County Mayor Daniella Levine Cava recently detailed that program at the University's Climate and Health Symposium, where Amer's study won first place in a student research competition.

For properties that cannot connect to sewer lines, adaptation strategies proposed in her study would be beneficial, she pointed out.

The mound system Amer describes is an option for areas with shallow soil depth and high groundwater. Waste from the septic tank flows to a pump chamber, where it is pumped to a mound. Treatment of the wastewater occurs as it is discharged to the trench and filtered through the sand, then dispersed into the native soil.

"Micro sewer treatment systems, also known as community sewer systems, are compact, self-contained wastewater treatment plants that serve a limited number of residences," Amer explained.

The graduate student, who also has conducted research on mitigating

greenhouse gas emissions from coal supply chain networks, said industrial and systems engineers can be valuable assets in helping to combat climate change. "We develop decision models to optimize solutions to problems," she said. "So, our skill set can certainly be applied to tackle problems of a changing climate."

Provided by University of Miami

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