Postdoctoral Researcher Position
Solving Failing Water and Wastewater Infrastructure in the United States
Columbia University

Start date: ASAP
Duration: 1 year, but may be extended for a second year based on performance and funding

The successful candidate will join an exciting new initiative focused on the future of US water and wastewater infrastructure with an initial focus on the application of machine learning tools to national datasets to identify the state of the infrastructure, potential failures, and their impacts, and the development of optimization models that to identify the optimal scale of clustered water and wastewater treatment (including reuse) networks given a range of technology options and data on current network condition, housing, roads, soils and climate. The project will provide tools to allow communities to assess and price their options so that they can be better informed and prepared for competing for federal and private funds for infrastructure investment.

Many areas across the United States have been experiencing deterioration in water and wastewater services, with accompanying ecological and human health concerns. Aging infrastructure as well as poor choices for the architecture of the infrastructure are often a factor. The successful candidate will contribute to efforts to develop the first comprehensive identification of the water and wastewater infrastructure condition and needs across the United States so that efforts to remedy the situation can be properly directed. Minority and economically disadvantaged populations are of particular interest. In addition to the need identification, the candidate will contribute to the development of tools that allow an exploration of the financial and technical applicability of decentralized water and wastewater treatment and reuse systems as a function of scale. This would help identify a direction for the future.

Qualifications

- PhD in Civil & Environmental Engineering, Operations Research, Data Science or related fields
- Knowledge of wastewater and water treatment technologies useful but not essential. Knowledge of soils, climate, socio-economic and demographic, and EPA utility performance and water quality data sets, and statistical analysis preferred.
- Skills in network optimization, statistics and be adept in spatio-temporal data analytics
- Skills in smart systems, sensors and control a plus

Benefits
This position offers a competitive salary and excellent benefits, and remote working flexibility while Columbia University remains partially open

For more information, please contact Upmanu Lall (ula2@columbia.edu). Interested applicants should send a cover letter describing their interests and skills as they relate to the project, a CV, the contact information for three references, and an example of completed research.

Columbia World Project:
Transforming Wastewater Infrastructure in the United States

The Challenge: In 2017, the American Society of Civil Engineers gave the United States a D+ grade for its national wastewater infrastructure. Across our nation, wastewater and sanitation systems are failing, leading to contaminated water supplies, parasitic infections, and ecosystem impacts in regions as diverse as rural Michigan, New Hampshire, Vermont, Kentucky and the Hamptons in Long Island, NY.

In the rural Black Belt region of Alabama, the wastewater challenges are both particularly acute and well-recognized. Across much of the Black Belt there are limited public sewers or functional septic systems and many households opt for what is locally known as a "straight pipe" discharge, sending untreated wastewater from the toilet to a nearby pit, ditch, stream, waste ground, where it is uncontained and accessible by animals or people. In Wilcox County alone, an estimated 300,000 to 500,000 gallons of untreated sewage and pathogens are being discharged onto the ground and to local watersheds each day.

All of this has serious impacts on the natural environment and the health of individuals and communities – including troubling evidence of intestinal worm infections. In recognition of the severity of these issues, and the need for better coordination and communication, the Consortium for Alabama Rural Water & Wastewater (Consortium) was established in 2018, bringing together senior policymakers, regulators, and university experts to identify and implement new solutions.

Effective, single-home, wastewater management systems (typically different levels of septic tank-based systems) have a high cost and a short life span, creating a significant financial burden for poor, rural households.[1] Long-term maintenance is typically non-existent. Both the cost barrier and the lack of maintenance for onsite wastewater systems are recipes for widespread untreated sewage disposal. Leaders in industry, the EPA, and academia agree that the future of wastewater services requires new, innovative approaches, and a transition to a decentralized and distributed infrastructure.

[1] The cost of a single installation can be up to $3,000 to $30,000 per home, depending on the soil conditions and all require regular maintenance (residuals management, filter cleaning, pump servicing, etc.) to be effective.

The Project: This project aims to pilot a clustered, decentralized and spatially distributed approach to wastewater treatment in Alabama's Black Belt and demonstrate that these systems can yield health, economic and environmental benefits for rural communities in a manner that is equitable, technically feasible and financially sustainable for underserved, low-income communities in the United States and around the world.

The project team will engage with communities in rural Alabama and leverage newly emerging technologies to target wastewater treatment in collaboration with the Consortium and with the support of state and federal officials to:

- Investigate and quantify a range of negative health, environmental and economic impacts of wastewater systems failures in rural Alabama, expanding on current CDC-funded research.
- Design and pilot a clustered, decentralized wastewater treatment system based on new technology in up to 15 sites in rural Alabama, impacting some 300 households.
- Demonstrate that a clustered, decentralized wastewater treatment system can significantly reduce the sanitation-related health and environmental burdens in the pilot area, and provide a cost-effective and manageable solution for communities.
- Develop new models and analytical tools to enable similar communities and other stakeholders to identify appropriate solutions for wastewater depending on the site attributes.
- Produce a best-practice guide for adopting new financial and operational models for wastewater treatment.

If successful, the project will provide sustainable solutions to wastewater challenges for a set of 15 clusters of homes (approximately 300 households) and lead to immediate benefits to households at our sites – including demonstrable improvements in public health and a reduction in pollutant discharges to the environment. It will also lay the groundwork for a 21st century transition to a more resilient, distributed wastewater infrastructure, which could be deployed throughout Alabama, the United States and globally. By bringing state of the art technologies to this setting and demonstrating their economic and physical viability, the project will provide an important foundation for replicating this approach in other challenging areas, and potentially serve as a model for communities across the United States and globally that face similar challenges.

The project brings together expertise in water management, engineering, public health, law, and policy, bringing together an interdisciplinary team from Columbia University, including faculty at the Fu Foundation School of Engineering and Applied Science, Columbia Law School and the School of International and Public Affairs, as well as the partnership with researchers from the University of Alabama, University of South Alabama, University of California Irvine, and the University of North Carolina.