New study outlines economic and environmental benefits to reducing nitrogen pollution

July 29 2011

A new study co-authored by Columbia Engineering professor Kartik Chandran and recently published in the journal, *Environmental Science & Technology*, shows that reducing nitrogen pollution generated by wastewater treatment plants can come with "sizable" economic benefits, as well as the expected benefits for the environment.

Chandran was one of five scientists from around the U.S. who worked on the study, along with James Wang of NOAA's Air Resources Laboratory and formerly of Environmental Defense Fund (EDF); Steve Hamburg, Chief Scientist for EDF; Donald Pryor of Brown University; and Glen Daigger of CH2M Hill, a global environmental engineering firm based in Englewood, Colorado.

The study found that adding available technology to the existing infrastructure at a common type of wastewater treatment plant could create a trifecta of reductions in aquatic nitrogen pollution, greenhouse gas pollution, and energy usage. It also found that creating an emissions crediting system for the wastewater treatment sector could make the addition of new technologies much more affordable.

"As wastewater permits on wastewater treatment plants become more and more restrictive, the resultant increased capital and operating costs can pose quite a burden to utilities and municipalities," said Chandran, associate professor of earth and environmental engineering. "Our study

shows that, if the reduced emissions associated with well-designed and operated biological nitrogen removal operations can be used to earn CO2 credits, then this could be a big benefit both for the utilities from a cost perspective and for the environment from water quality and air quality perspectives."

The majority of wastewater treatment plants already have systems to reduce ammonia levels in effluent, but pay relatively little attention to overall nitrogen pollution reduction, especially in the form of nitrous oxide (N2O), a potent greenhouse gas. Using emissions credits to address the problem could create an economic incentive of up to $600 million per year for U.S. plants to reduce nitrogen pollution, with the added benefit of up to $100 million per year in electricity savings if they do so.

"Recent N2O monitoring studies conducted by Columbia Engineering and research groups across the globe have found that meeting wastewater treatment objectives actually decreases biogenic N2O emissions," added Chandran. "So designing and adopting better process technologies for improving water quality could actually have a significant impact on reduced N2O emissions."

"Our study shows that there's a win-win-win situation out there waiting to be realized," said James Wang, the chief author of the paper. "The creation of an emissions trading market could provide the needed incentive for wastewater treatment plants to adopt technologies that would reduce climate pollution, help clean up our waterways, and even save energy and money."

Chandran's research focuses primarily on biological nitrogen removal from wastewater, sustainable water sanitation and hygiene (WASH), and developing new technologies for resource recovery and reuse from waste. His team recently created the first protocol to measure nitrous

oxide (a greenhouse gas 300 times more potent than CO2). Using the protocol, his Columbia Engineering group developed the first nationwide database of N2O emissions from wastewater treatment plants. The database has now been adopted by the U.S. Environmental Protection Agency as the standard to estimate N2O emissions from wastewater treatment plants. Chandran is also working towards developing and implementing "energy-positive" wastewater treatment technologies that will produce energy rather than consume it at some of the largest wastewater utilities in the U.S.

Chandran was recently awarded a $1.5 million project grant from the Bill & Melinda Gates Foundation to develop a revolutionary new model in water, sanitation, and energy. Working with his partners Dr. Ashley Murray, founder and director of Waste Enterprisers, and Dr. Moses Mensah, a chemical engineering professor at Kwame Nkrumah University of Science and Technology, Chandran is developing an innovative technology to transform fecal sludge into biodiesel and create the "Next-Generation Urban Sanitation Facility" in Accra, Ghana.

Provided by Columbia University