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Earth Institute Profiles

Upmanu Lall

Director, Columbia Water Center

"The goal of engineering is to develop solutions to societal problems," as Upmanu Lall stated in a recent issue of *Columbia Engineering*. Lall is focused on the societal problem of severe water shortages expected to occur in one-third of the developing world during this century and the relationship between global water systems and climate variability and change.

Lall grew up in India, seeing the impact of droughts and remembers how even middle class people had to stand in line at government ration shops for days on end because of the major famines. He was drawn to study water because the areas that appealed to him in engineering had to do with mathematics and physics, and water brings these two disciplines together in a way that also addresses real-world problems. It was Lall's intellectual interest in systems analysis, which is where he focused his graduate studies, that led him to approach water issues by investigating the complex linkages between climate, natural hazards, agriculture and energy.

As the director of the Columbia Water Center, a unit of the Earth Institute that Lall helped found in 2008, understanding the results of human interaction with water systems offers multifaceted challenges. The first challenge is related to scale. Water problems are usually seen as "a collection of local crises—whether they are related to access, pollution or scarcity. We rarely address the global elements of these individual problems." There is also a time dimension involved. There is the need to understand what Lall calls "the collective impact of people doing their thing," how prior human interference with water systems changes present conditions. This can be through irrigation for agriculture, which accounts for 70 to 90 percent of the world's water use; through dams, such as those that were built to make the American West habitable; or through the widespread use of chemicals like phosphorus which can continue to be reintroduced into water today from sediments, long after their use has been abandoned. A third challenge is protecting human society from the effects of water systems, and here the goal is to focus on predicting water and climate issues that could have disastrous effects for human populations. If a massive hurricane can be predicted even a few months in advance, it is possible to prepare by upgrading dykes

and putting other engineering solutions into place in time to minimize the degree of damage that occurred during Katrina. As an example, he mentions the 1997 El Niño forecast for California which lead the state to dredge rivers in time to avoid catastrophe there.

Lall's work with the Columbia Water Center emphasizes the importance of viewing water issues across several traditional academic disciplines in order to understand the dimensions of these global problems. "In earlier times, climatologists studied precipitation and convection, oceanographers studied the action of water oceans, and hydrologists took rainfall as an input that someone provided them, not concerned with where it came from." While studies were once regional, the Center enjoys funding that allows its scope to be global. The Center is working in India, Brazil, China and Mali through a three-year, $6 million grant from the PepsiCo Foundation as well as in regions of the United States including the Everglades, the Delaware Water Basin and the Colorado River. A grant from the Pulitzer Foundation has supported research on water development in Northern Ethiopia. Much of the work of the Center focuses on improving efficiency of agricultural water use, especially in the developing world, where water problems are most prevalent. The Water Center views farmers as a source of knowledge, and so incorporates interviews with farmers into the research process. The Center also considers farmers to be key catalysts for the adoption of sustainable practices. According to Lall, one way to influence the political process in a democracy like India is to educate the electorate. If the demand for improved practices comes from the farmers, the populist politicians are more likely to listen than they would if they are only advised by experts.

Over his 33 years of experience as a hydrologist, Lall has developed expertise in statistical and numerical modeling of hydrologic and climatic systems and water resource systems planning and management. He has pioneered statistical methods and their application to the prediction of hydrologic and climate conditions, and advanced tools for decision analysis and risk management. His research projects have covered water quantity and energy resource management, flood analysis, groundwater modeling and subsurface characterization, climate modeling, and the development of statistical and mathematical modeling methods. He has been involved as a consultant with specialization in groundwater flow and contaminant transport modeling covering mining operations, stream flow modeling and water balance, risk and environmental impact assessment, and site hydrologic evaluation. Lall has also served as a reviewer and expert on a number of other hydrologic problems. He has also taught over 20 distinct university courses.

Upmanu Lall received his B.S. in 1977 from the Indian Institute of Technology and both his M.S. (1980) and Ph.D. (1981) in civil engineering from the University of Texas. He is the Alan and Carol Silberstein Professor of Earth and Environmental Engineering, and he served as Earth and Environmental Engineering Department chair from 2003 to 2006.

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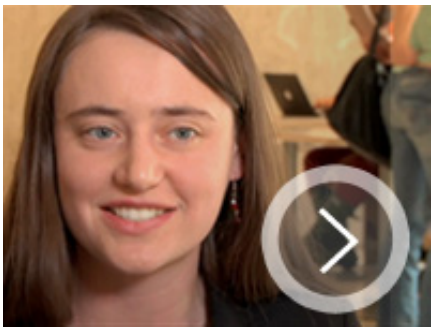

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