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Featured Researcher | Faisal Hossain

(http://www.tntech.edu/files/research/Featured_Researchers/Faisal.jpg)**TTU civil engineering professor works to discover impact of dams, water infrastucture on local climate**

Research Summary:

TTU civil and environmental engineering professor Faisal Hossain is working with a team of other researchers to investigate how the presence of large dams and reservoirs change local climates. His hypothesis is that in drier climates, the presence of a large body of water means more water evaporates into the air and then creates large and more severe rainstorms.

Co-investigators

Purdue University

University of Colorado

University of Georgia

Pacific Northwest National Laboratory

Graduate assistants

Abel Woldemichael, civil and environmental engineering at TTU

Ahmed Degu, civil and environmental engineering at TTU

Wondmagegn Yigzaw, civil and environmental engineering at TTU

Abebe Gebregiorgis, civil and environmental engineering at TTU

Fang Zhao, geography at University of Georgia

Center of Excellence or Research group affiliation

Center for the Management, Utilization and Protection of Water Resources

Research procedure, findings:

"We decided to look at this problem in two ways. The first was observational,
based on past records. The team compared regions with many dams and those with few to see if there was a significant difference in rainfall. They also did blind tests to see if they could tell, based on a dam's impact on its climate, if they could distinguish its location. They then went back to see if regions where climate change was apparent had a dam nearby. With the computer model tests, they played with data to see how a region's climate would change under the presence of a larger dam, or without one at all. The team's ultimate goal was to combine the data to generalize their findings about the community."

Research application:

Hossain and his team are collecting data about climate, including rainfall and wind direction, for thousands of dams across the country and world that were collected before and after a dam's construction. That data are then collated into mathematical models to see if there is a correlation between the dam's construction and an increase in rainfall.

What motivates you to do this research?

"The primary motivation for me to do this research is the state of our nation's infrastructure. The American Society of Civil Engineers currently rates our water infrastructure at a grade of D and D- so that tells you a lot about the poor health and the state that it is in which therefore needs really urgent studies and understanding so we can come up with better

ways to manage our dams and our precious water resources so that the dams are both safe and they serve the function that they were built for."

What are your future plans in this research area?

"We would really like to understand all these very large dams, water infrastructures that we have in the United States which are really literally tens of thousands and they're all quite old the average age is more than 50 years and we need to understand what kind of risk they might pose and what kinds of changes they might have brought to the climates around them. Through that understanding, our hope is that we can come up with better ways in which civil engineers can manage these large water infrastructures that are spread across the entire nation. Consequently, this would allow us to manage our water resources, which are very precious, and in the era of climate change I think that is daily more and more important." "It's time for us to connect the dots to see how we can change things and change our designs. That's a tall order, but it's going to keep us busy for the next couple decades."
"Eventually, our big goal is to tie all this together and make it a nationally visible and recommended program on water resources because as far as we know, there is no engineering program that is taking this approach."

Is this research integrated into classroom instruction?

"This research has found a way into both undergraduate and graduate curricula. For the undergraduate part, we have managed to use parts of this research into a senior-level elective course that students take when they want to specialize in water resources and try to understand what the state of our water infrastructure is. For the graduate curriculum, we have done a lot of directed studies and research. In some of the graduate courses that I teach, we use this as a prime example, as an application of new methods to understand how our water infrastructure is functioning."

What have been the biggest challenges in this area?

"Usually we treat whatever we build as a static thing that doesn't impact its environment. So to say that the infrastructures we built are actually 'talking' to the environment and climate seems very confounding for engineers to grasp even though there is a lot of research showing otherwise. This generally has been my biggest challenge when trying to start a dialogue with engineers." "The aspects of dam design and operations that have improved during the last century are those that are directly visible or have almost instantaneous impact on the land surface. This is not surprising as the very essence of engineering is "hands-on" in nature."
"On the other hand, climate impacts have received very little consideration by the engineering profession for dam building and operations. Climate, by virtue of its definition represents anything but a "hands-on" phenomenon. Unlike weather, climate impacts are not measured instantaneously, and conventionally trained engineers can have a difficult time conceiving that a large artificial late can have an observable effect on local climate."

What is your dream research project?

"The dream project would ideally be to have a plan where we would, on a case-by-case basis, study some of the major and large dams that are in the U.S. and also in other parts of the world. Most large cities have a dam nearby and by 2050, 60 percent of the world's population will live in cities."

"This means that a lot of the water, food and irrigation, and energy in the form of hydropower, will have to come from dams and other sources. This is what we call a 'nexus.' I am interested in studying dam-city infrastructure on the climate-sustainability nexus. So, it is important to measure urban centers and cities where water resources are already very scarce or are gong to be scarcer with climate change."

"Thereby, we can try to understand what impact these dams have had on the local climate and what it means in the global context so that we can come up with, again on a case-by-case basis, the best way to manage our precious water resources for each of these big urban centers."

Publications (* marks student):

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Woldemichael, A.T.*, F. Hossain, R. A. Pielke Sr., A Beltran-Przekurat. (2011). Understanding the role of land use on probably maximum precipitation, *Water Resources Research*.

Degu, A.M., F. Hossain, D. Niyogi, R. Pielke Sr., J.M. Shepherd, N. Voisin and T. Chronis. (2011). The Influence of Large Dams on Surrounding Climate and Precipitation Patterns, *Geophysical Research Letters*, vol. 38, L04405 (doi:10.1029/2010GL046482).

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Hossain, F. (2010) On the Empirical Relationship between the presence of large Damsn and the Alteration in Extreme Precipitation, *Natural Hazards Review*, vol. 11(3): 97-101 (doi:10.1061/(ACDE)NH.1527-6996.0000013).

Hossain, F., I Jeyachandran and R. Pielke Sr. (2009). Have Large Dams altered extreme Precipitation Patters?, *EOS-AGU*, vol. 90(48):453-454.

Gebregiorgis, A.S.* and F. Hossain. (2010). Hydrological risk assessment of old dams: A case study on Wilson Dam of Tennessee River Basin, *Journal of Hydrological Engineering*, (doi: 10.1061/(ASCE)HE.1943.5584.0000410).

Hossain, F., I. Jeyachandran* and R. Pielke Sr. (2010). Dam Safety Effects due to Human Alteration of Extreme Precipitation, *Water Resources Research*, 46, W03301, (doi:10.1029/2009WR007704).

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