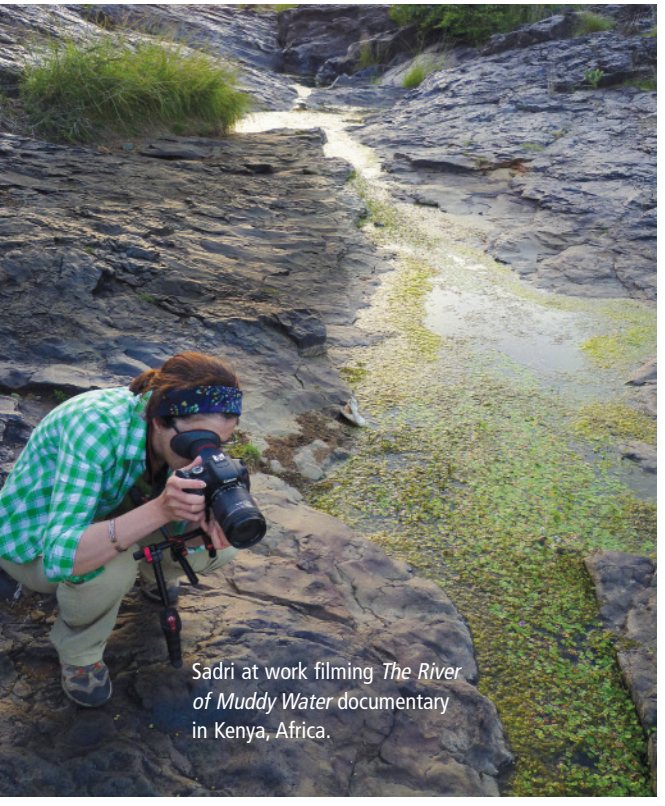
ENVIRONMENTAL ENGINEER'S PASSION FOR WATER RUNS DEEP

Sara Sadri, PhD, P.Eng., a newly licensed professional engineer, is a dedicated scientist and truth-seeker with a dizzying resumé.

By Marika Bigongiari

When Sara Sadri, PhD, P.Eng., isn't making films in Kenya, rubbing shoulders with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and braving crocodile-infested waters doing research or working with Princeton University and the University of California, Los Angeles (UCLA) on NASA-funded projects, she's winning at chess and going on blog tours to educate people about small-operation coffee roasters. Scientist, photographer, filmmaker: her wide-ranging interests epitomize the spirit of the modern engineer.



Sadri at work filming *The River of Muddy Water* documentary in Kenya, Africa.

AN ENGINEER IS BORN

Sadri's work ethic, passion for engineering and activist spirit were sparked at an early age. Born in Tehran, Iran, much of Sadri's childhood was spent on her grandfather's farm, escaping city life, chasing chickens and climbing fig trees. There, she built a treehouse with her brother and learned about farming, gardening and the challenges that come with not having enough water in the developing world. Her ensuing passion for the environment, which touches all aspects of her work, drove her to become a professional engineer. "Every time we study the environment, we find something new we didn't know before," she enthusiastically exclaims.

Sadri came to the engineering profession through a combination of family influence, environment and conviction. Because her mother was a pharmacist, her father a physician and her brother a mathematics Olympian, she felt getting a higher education was a no-brainer. She struggled at first to find a niche for herself but excelled at math—geometry in particular—and physics. "I chose engineering because of good grades in these subjects, but I was amazed by how understanding mathematics and physics—the foundations of engineering—opened doors to other possibilities, such as the arts," she says.

Sadri, whose ambition saw her determined to become a licensed P.Eng., strongly believes in the value of being an engineer: "Understanding facts, logic and algorithms helps us understand how the physical world around us works and how we can connect the dots and variables in the world and make realistic predictions. The more we understand the physical world, the more peaceful life can become—and engineering is the umbrella that makes it all possible."

SCIENCE DYNAMO

Her environmental focus was set early in her academic career. After moving to Canada in 2003 to earn a master's in biosystems engineering at the University of Manitoba, Sadri went on to earn a PhD in civil and environmental engineering from the University of Waterloo. She also holds a bachelor's degree in agricultural, irrigation and drainage engineering from the University of Tehran. Sadri loves travelling, enjoys working with different people and sees herself as a "world citizen," an identity, she says, makes her fit right in.

After earning her PhD, Sadri began postdoctoral work at Princeton University, where she conducted research for the African Drought Monitoring Programme. There, she also befriended the owners of a local coffee shop. Her curious mind soon led her to a behind-the-scenes tour, where she learned all about the coffee-roasting process. She made a short film about it and, soon after, the budding filmmaker was at it again while conducting research in Kenya, Africa, this time making a film about water gauges, drought and floods in collaboration with UNESCO's water division.

The film, *The River of Muddy Water*, was shown at several indie and small festivals in Europe, played at NewFilmmakers New York, was featured during the UNESCO Youth Workshop and appeared at Green Market Toronto, Ghent University, Princeton University and at the American Geophysical Union Cinema. Sadri sees filmmaking as another form of scientific enquiry. She recognizes its value as a tool for reaching a larger audience and as a medium that serves her goal to help people understand experimental design, algorithms and critical thinking. "Making films in my field brings scientists, stakeholders, policy-makers and NGOs together, breaks the ice and helps them communicate their ideas better," she explains. "I'm fascinated by the art of filmmaking and storytelling. As a scientist, I wonder if better films with scientific undertones could get the world more excited about science."

Sadri, who was also a consultant for the United Nations World Meteorological Organization, is presently engaged in postdoctoral research at UCLA. She's in the process of transferring to a senior research specialist position at the department of civil and environmental engineering at Princeton University and will also be a visiting scientist at NASA's Jet Propulsion Laboratory, a federally funded research and development center for robotic exploration of the solar system.

ENVIRONMENT WARRIOR

Sadri's focus on studying climate change and addressing its far-reaching effects has led her to undertake frequency and risk analysis of droughts and floods all over the world, including Canada, Denmark and the United States, in addition to her research in Africa. Sadri says water conservation continues to be an important part of her work: "Our freshwater resources are under pressure globally to meet our future demands, due to both population growth and climate change. Between 2000 and 2050, water demand is projected to increase by 55 per cent. Agriculture is the major consumer of 70 per cent of freshwater, and food production will need to grow by 69 per cent by 2035. This means we'll be facing one big freshwater drain after the next."

Although Sadri worked on several different projects at Princeton, her focus was on statistical hydrology using various methods to monitor low flows in the eastern US. "The analysis of low flow patterns provides scientists with a better understanding of climate change impact, which helps them in decision making regarding allowable withdrawals and other studies," Sadri says.

Her NASA-Princeton project is about understanding the risks associated with extreme hydrologic conditions, which are crucial for effective water management. She's also building a national and international soil moisture monitoring system to assess drought risk for NASA's Soil Moisture Active Passive mission and has developed an online drought index map that updates every 24 hours. "My goal is to develop this into the first global near-real-time soil moisture drought index system," she explains. "It's unique because it's based directly on remotely sensed data and not common land surface models forced mostly by precipitation. We need to monitor extreme events in near real-time and real-time before we can predict them."

Sadri points out that because population and temperatures are constantly rising, the limited freshwater we have is under severe strain. She describes an alarming global trend and cautions against the folly of thinking fresh water is an inexhaustible resource: "The water table is dropping all over the world—there's no such thing as an infinite supply of water."

Musing on the irony of looming water shortages on a planet that's 70 per cent water, she's quick to point out 97.5 per cent of it is sea water, requiring significant processing to be fit for human consumption. Technology, Sadri says, is making progress: Sea water can be desalinated, and drills might be able to go deep into the ground to access depth freshwater, "but we need to keep in mind that under such scenarios, water will not be free—it will cost a lot to provide water in that way," she cautions. "It's not unimaginable people might fight over water in the future. Since we don't want that to happen, we must conserve what we have."

Sadri thinks of climate change as an umbrella concept encompassing many different spatial and temporal aspects of environmental change, including temperature, rainfall, snowfall and seasonality. As such, and because it's an abstract term, "it opens doors to conspiracy theories or denial," Sadri says. "It's true that climate has always been changing but it's not true, when compared with different spatial and temporal scales, that it's been changing at the same pace. It's important to understand that when we talk about climate change, we mean changes in water, temperature, landscape, groundwater, land development, flood, drought and the numbers and statistics under population growth."

Sadri and other climatologists and hydrologists work to pursue answers on how these changes occurred, discern what role humans played and determine whether changes should be addressed through policy-making. "Essentially, under the terminology of climate change, we're raising awareness on whether we'll have enough resources—water, air, land—to leave for future generations and how our actions and decisions contribute to rising temperatures, sea level rises, increased flooding and droughts and consequently food and water security in the future. These are important questions," Sadri explains.

Sadri finds satisfaction in the study of the environment, and she's asking big questions she believes it can ultimately solve. Environmental study, she maintains, demonstrates how the world is more connected than disconnected. "We've barely scratched the surface of understanding what's going on with our environment, and that's a huge challenge for mankind," she says. "Understanding our environment requires an understanding of physics, statistics, geography and computers. It's also fun, involving fieldwork and travel to parts of the world one would never have imagined existed. We hear a lot about going to Mars, but we barely know anything about our own planet. Much has been done, but much has been left to explore. What resources do the deep sea and deep groundwater have for us? What alternative sources of energy and design can be used to maximize harvesting solar and wind powers? And what agricultural alternatives can be used to eradicate poverty in the world? We don't have those answers. They remain underexplored areas in environmental engineering we must keep exploring." **e**