Searching for global water and food solutions

November 5 2014, by Steve Calechman

As world population continues to grow, so does the need for water and food. It would be easy if the fix were laying down more pipes and cultivating more crops. But it's not that simple. The global climate is becoming unevenly warmer and more people are moving into cities. Both conditions put stress onto already-limited resources. These complex issues need complex solutions, and, for that, MIT has created the Abdul Latif Jameel World Water and Food Security Lab.

Started in the fall of 2014 under the direction of Professor John Lienhard, the lab will be able to support and coordinate research all over campus, helping at once industries trying to improve their productivity and localities trying to thrive. As Lienhard says, it's the interdisciplinary approach, coupled with MIT's unique capabilities, that will set the lab apart and bring innovative solutions to bear.

Taking on each region

The lab was established through a gift from Mohammed Abdul Latif Jameel '78, a civil engineering graduate, with the intent of tackling world food and water issues and the interplay of factors that affect them. As an example, in the Arabian Gulf States, conditions are arid with little agricultural capacity. Most of the water comes from desalinated seawater, and much of the food is imported. It's an area that will become warmer and drier and be subjected to extreme weather in the coming years, with a population that is rapidly growing, Lienhard says.

Along the equator, climate change will particularly affect agricultural

regions. Some of these areas are going to warm faster, but Lienhard says that the bigger issue is that food productivity will shift, making some crops less viable in equatorial areas and more productive closer to the poles, changing what can be grown, and turning strong producers into weaker ones and vice versa. Since food always requires water, one question is whether changing management practices can be the answer to increased production. Fertilizer is a known commodity and would be an easy solution, but, as Lienhard says, it brings with it runoff into waterways and resulting damage to ecosystems.

These specific considerations are reflective of the inherent nature of what the lab faces. "Each of these issues is a regional problem that needs to be looked at in its own context," says Lienhard, adding, "There is no single answer that's going to come from a neat invention and a new technology."

The lab will address this complexity by engaging faculty from across schools, including science, engineering, architecture and urban planning, humanities, arts and social sciences, and management, and by drawing upon work being done in various labs—for example, graphene membranes that can be used for desalination and wireless communication signals that can identify pipe leaks. "When we put people from different disciplines together, we get radically new ideas and approaches to the problems," he says.

The entry into food

One particular opportunity the lab will provide MIT is having a clear presence in solving global food needs. The impact of population growth is a central issue. In 1960, the world had 3 billion people. Today, it's 7 billion, and in 2050, the estimate is 9 billion. With that three-fold increase and ongoing development, 50, possibly 70, percent more food will be needed by 2050 than is produced today, Lienhard says. The

challenge is that more than one-third of the world's ice-free land is already being used for farming. Since converting more land to farms through practices such as cutting down rainforests isn't viable, the answer may lie in more efficient production techniques or different food choices. As he says, one-third of all crops are used for livestock, and producing beef takes 15 times more water than producing an equivalent amount of grain.

Another issue is the rise in urbanization. More than 50 percent of the population already lives in cities. By 2050, it's estimated that 86 percent of the developed world and 64 percent of the developing one will be there, Lienhard says. Most food, accordingly, is consumed in cities, and so another question is whether urban agriculture can be developed as a water and energy efficient approach to some portion of the food supply.

Many of these issues are known and studied, but a course of action hasn't been established, let alone enacted. While the lab will be able to identify already-existing food technology on campus to address a problem, one other benefit is it can help identify work that wasn't conceived for food-related uses but which nonetheless can be applied.

Take food spoilage: One MIT program in nanotechnology has developed sensors that can detect chemical weapons. But these sensors can also be used to detect ripening or rotting food. This could provide the chance to improve food distribution and reduce waste and spoilage along the supply chain. If that can be done, a significant obstacle can be cleared, since estimates suggest that wasted food is four times the amount needed to feed the world's hungry people, Lienhard says.

In search of partners

The next step, and the essential one, is collaboration, not only within the university but also with industry. Lienhard says that the lab is looking for

partners around the world who can develop and implement new water and food technologies and approaches. But more than that, the lab will help partners address their own business challenges. Some companies want to make their environmental footprints smaller. Others face product struggles in international markets, such as beverages and water. They have to contend with a different quality while also competing for it with locals. Lienhard says the lab can help find an equitable balance between commerce and sharing resources for domestic use.

Because the lab is new, Lienhard says there's an unknown element to what the work will look like. But for potential partners, there is also a certainty. "They get MIT," says Lienhard. They know, in other words, that they'll be working in a context where there are world-recognized faculty members, a large population of graduate and postdoctoral researchers, approximately 120 United States patents issued to Institute-related projects annually, and 20 spinoff companies per year, he says.

There is also the overall guiding philosophy of MIT's approach. It's a place that doesn't keep its work in the lab but instead focuses on translating research to real-world use. Supplying sufficient water and food as the population grows and the climate changes is a large task, but Lienhard says that's precisely the nature of what MIT does. "We take basic science. We apply it to human needs, and we solve problems."

This story is republished courtesy of MIT News (web.mit.edu/newsoffice/), a popular site that covers news about MIT research, innovation and teaching.

Provided by Massachusetts Institute of Technology