

Abdul Latif Jameel World Water and Food Security Lab

Population growth, climate change, urbanization, and development pose unprecedented challenges to the world's diverse needs for water and food. The [Abdul Latif Jameel World Water and Food Security Lab \(J-WAFS\)](#), was established in the fall of 2014 as an Institute-wide effort to bring MIT's unique strengths to bear on these problems.

J-WAFS is an interdepartmental laboratory reporting to the vice president for research, and is committed to working broadly with the schools and departments of MIT. In typical MIT parlance, the word "lab" refers to a vehicle for cross-Institute research activities as opposed to a physical laboratory space.

Goals, Objectives, and Priorities

J-WAFS was created to coordinate and promote water and food research at MIT, emphasizing the deployment of effective technologies, programs, and policies that will have a measurable and international impact as humankind adapts to a rapidly expanding and evolving population on a changing planet.

In support of this mission, JWAFS spearheads the efforts of MIT's faculty, labs, and centers to work toward solutions for water and food security that are energy efficient and environmentally benign. JWAFS provides grants and support to MIT researchers in order to address critical issues in food safety, urban water supply, agriculture and irrigation, watershed protection, and water purification and reuse, and also promotes the development and commercialization of the next generation of technologies that can be broadly applied to these challenges. JWAFS's goals also emphasize collaborating with domestic and international partners in order to address issues that arise in specific regional contexts. Finally, JWAFS supports graduate student-driven water and food research and business communities on campus through fellowships, business plan competitions, conference sponsorship, and other mentoring and assistance.

We will launch our second round of seed grants on September 1, 2016. Concurrently, we are coordinating with the Deshpande Center for Technological Innovation on the selection and launch of the 2016 JWAFS Solutions grants. This second cycle of J-WAFS Solution grants will also launch September 1, 2016. In total, the first two cycles of these J-WAFS funding programs will have brought more than \$3 million in new, overhead-free research funds, and over another million in Solutions commercialization funding to MIT's portfolio of water and food research. Our third cycle of seed funding and Solutions grants will be initiated by during AY2017, with fall 2017 starting dates.

As of the end of June 2016, JWAFS's priorities include furthering our research initiatives, fundraising and industry engagement, the development of regional partnerships, and continued student support. Fundraising for JWAFS continues in collaboration with MIT Resource Development as part of the newly launched [MIT Campaign for a Better World](#). Development of newly funded international and regional partnerships will continue throughout AY2017. Regional engagement will support the collaboration of MIT faculty

and students with local experts in order to address particular issues and problems in parts of the world facing serious water and food challenges.

We are working with MIT's [Industrial Liaison Program \(ILP\)](#) and [Office of Sponsored Projects](#) to develop a J-WAFS Research Affiliate program in order to support direct sponsored research on campus. Industry consortia targeting specific water and food sector challenges are also under development. JWAFS will also continue to support student engagement and campus activities around water and food, including the initiation and awarding of one or more graduate student fellowships.

Highlights and Accomplishments

Supporting MIT Research:

In September 2016, J-WAFS launched nine seed research projects funded through our first call for proposals, held in FY2016. Through a competitive process initiated by our second call for proposals, JWAFS announced in the spring of 2016 the award of another \$1.3 million in seed grants of up to \$100,000 per year, overhead free, to seven new projects. Once these projects get underway, JWAFS funded research will involve Principal Investigators (PIs) from 12 MIT departments, spanning all five schools.

In FY2016, J-WAFS awarded two commercialization grants under our J-WAFS Solutions program. We also issued a second call for proposals, and awards for one renewal and four new projects were announced in September 2016.

J-WAFS has hosted a number of major corporations for research visits on campus, and has engaged in discussions with foundation representatives.

Engagement, Visibility, and Fundraising:

In October 2015, J-WAFS curated a panel on securing water and food supplies for a growing population (estimated at 9.6 billion people worldwide by 2050) for the Fuel pillar of MIT Solve. Four invited experts addressed various aspects of providing a safe and secure food supply with a minimal environmental footprint.

J-WAFS secured a gift of approximately \$50,000 from Rabobank to support a new student innovation competition in food and agriculture. Rabobank Group is one of the largest banks in the world and the premier bank to the agricultural, beverage, and food industries. The Rabobank-MIT Food and Agribusiness Innovation Prize was managed by the student [MIT Food and Agriculture Club](#). A generator dinner in the fall attracted nearly 100 students, and the final event in April 2016 featured pitches by six finalist teams.

J-WAFS and ILP co-sponsored a major conference on food and water in April 2016. This was J-WAFS's first major event and it was attended by MIT faculty, staff, and students, along with many representatives of ILP member companies and other attendees from the corporate and nonprofit sectors. The conference included a start-up showcase and a poster session featuring JWAFS-sponsored research projects. Nearly 250 people registered and attended the conference.

J-WAFS director John Lienhard participated in the MIT Campaign for a Better World launch event, speaking on the “Health of the Planet” panel in May 2016. Lienhard acts as the lead for the water and food theme of the campaign, and has been involved in many other campaign related efforts. J-WAFS is working closely with MIT Resource Development on fundraising around the water and food initiative, including the Office of Global Initiatives, the Office of Individual Giving, the Campaign Office, and the Office of Foundation Relations.

John Lienhard also gave presentations at various high-profile conferences and presidential events, and engaged with numerous potential corporate and philanthropic sponsors. These audiences included the MIT Corporation; the MIT Corporation Development Committee; the MIT Sponsored Research Visiting Committee; the MIT William Barton Rogers Society meeting in Houston, Texas; the MIT Alumni Club of Bombay; the MIT Club of Kuwait; the “Agriculture, Innovation, and the Environment Short Course” at MIT; as well as various events at other universities and large corporations.

J-WAFS received a pledge for a \$100,000 endowment (\$25,000 received to date), and gifts of up to \$2,500 from more than 15 individual donors.

J-WAFS launched a new email newsletter, distributed monthly to a growing list of 700 interested friends and colleagues.

Other Water- and Food-Related Activities:

J-WAFS was the major sponsor of the MIT Water Summit (November 13–14, 2015), organized by the student MIT Water Club.

J-WAFS director John Lienhard served as a judge for the Water Innovation Prize (April 8, 2016) given by the student MIT Water Club and sponsored by PepsiCo and Veraqua, with innovation grants totaling \$30,000. Lienhard and JWAFS executive director Renee Robins served as judges for the Rabobank-MIT Food and Agribusiness Innovation Prize (April 28, 2016), with \$25,000 awarded in prize money.

Research Support

J-WAFS is dedicated to working Institute-wide to improve the productivity, accessibility, and sustainability of the world’s water and food systems. J-WAFS coordinates the efforts of MIT’s faculty, labs, centers, and departments to work toward solutions for water and food security that are environmentally benign and energy efficient. J-WAFS supports technology innovation and basic research activities by motivating, accelerating, and coordinating research in water and food being conducted at MIT by stimulating interdisciplinary research.

Research funded by J-WAFS draws on a number of disciplines that span the five schools of the Institute. We promote innovative and translational research projects that can effect meaningful changes on the world at large, as well as regionally appropriate solutions, whether for fast-growing megacities or for the rural, developing world. During AY2016,

J-WAFS undertook the second round of funding for its two current funding programs for MIT researchers.

J-WAFS Seed Grants

J-WAFS uses the bulk of its endowment return to fund research seed grants at MIT, supporting innovative new work that will improve water and food solutions across a broad range of contexts. J-WAFS's second round of seed funding was announced in November 2015 through a request for proposals (RFP) sent to faculty and senior and principal researchers at MIT.

J-WAFS is particularly interested in attracting researchers new to food and water issues, and in catalyzing new partnerships across MIT departments. As part of the call for proposals process, a research speed-dating event was held in December 2015. Approximately two dozen MIT PIs—all of whom were new participants since last year's speed-dating event—made short presentations on their research interests in water and food, introducing faculty to each other's research across numerous different disciplines.

Seven new projects, encompassing innovative research in food safety and science, water supply, purification and testing, environmental science and engineering, and development were selected for seed grants of up to \$100,000 per year, overhead free, most for two years. The successful proposals represent PIs from seven MIT departments across in the School of Engineering, the School of Science, and the Sloan School of Management. Grant recipients include both junior and senior MIT faculty members.

The newly funded projects, which will begin September 1, 2016, are:

Active Materials for Heavy Metal Extraction from Water

PI: Timothy Swager, John D. MacArthur Professor, Department of Chemistry

Air Pollution Impacts on Global Crop Yields

PI: Colette Heald, Associate Professor, Department of Civil and Environmental Engineering and Department of Earth, Atmospheric, and Planetary Sciences

Bacterial Viruses as Pathogen Control Agents in Aquaculture Systems

PI: Martin Polz, Professor, Department of Civil and Environmental Engineering

Estimating the Benefits to Strengthening Water Markets

PI: Christopher Knittel, George P. Shultz Professor, Sloan School of Management

Gravity Fingering during Water Infiltration in Soil: Impact on the Resilience of Crops and Vegetation in Water-Stressed Ecosystems

PI: Ruben Juanes, Associate Professor, Department of Civil and Environmental Engineering

Real-time On-site Detection of Foodborne Pathogens by Engineered Bacteriophage Integrated with Microfluidic Sample Preparation Platforms

PIs: Jongyoon Han, Professor, Department of Electrical Engineering and Computer Science and Department of Biological Engineering; and Timothy Lu, Associate Professor, Department of Electrical Engineering and Computer Science and Department of Biological Engineering

Waste to Food: Yarrowia Lipolytica as Protein and Lipid Production Platform

PI: Gregory Stephanopoulos, Willard Henry Dow Professor of Biotechnology and Chemical Engineering, Department of Chemical Engineering

The nine projects funded last year that began September 1, 2015 are:

Advancing Water and Food Sustainability through Improved Understanding of Uncertainties in Climate Change and Climate Variability

PIs: Susan Solomon, Lee & Geraldine Martin Professor of Environmental Studies, Department of Earth, Atmospheric, and Planetary Sciences and Department of Chemistry; and Kenneth Strzepek, Research Scientist, MIT Joint Program on the Science and Policy of Global Change

A Bioassay-Based Approach to Food Safety in China

PIs: Anthony Sinskey, Professor, Department of Biology; Stacy Springs, Director, Center for Biomedical Innovation; and Vishal Vaidya, Associate Professor, Harvard Medical School

A Data-Driven Approach to Managing Food Security in Global Supply Chains

PIs: Retsef Levi, Professor, Sloan School of Management; Tauhid Zaman, Assistant Professor, Sloan School of Management; and Yanchong Karen Zheng, Assistant Professor, Sloan School of Management

Electrochemically-Modulated Separation Processes for the Treatment of Contaminated Water Sources

PI: T. Alan Hatton, Professor, Department of Chemical Engineering

Enabling Distributed Water Quality Management by Dry Sample Preservation and Centralized Analysis

PIs: Rohit Karnik Associate Professor, Department of Mechanical Engineering; John Hart, Associate Professor, Department of Mechanical Engineering; and Chintan Vaishnav, Senior Lecturer, Sloan School of Management

Engineered Nitrogen Fixation: Expression in Plant Organelles

PI: Christopher Voigt, Associate Professor, Department of Biological Engineering

Leverage Points: Opportunities for Increasing Food Production in Developing Countries

PIs: Dennis McLaughlin, H. M. King Bhumibol Professor, Department of Civil and Environmental Engineering; and Erica James, Associate Professor, Anthropology Program

Quantifying Mercury Contamination of Rice and its Impact on Food Security in China

PIs: Noelle Selin, Associate Professor, Institute for Data, Systems, and Society and Department of Earth, Atmospheric, and Planetary Sciences; and Valerie Karplus, Assistant Professor, Sloan School of Management

Strategies for Urban Stormwater Wetlands Los Angeles and Houston

PIs: Alan Berger, Professor, Department of Urban Studies and Planning; and Heidi Nepf, Professor, Department of Civil and Environmental Engineering

J-WAFS Solutions Grants

The J-WAFS Solutions program has the mission of moving water and food technologies from labs at MIT into the commercial world, where they will improve the productivity, accessibility, and sustainability of the world's water and food systems. J-WAFS Solutions aims to help MIT faculty and students commercialize breakthrough technologies and inventions by transforming promising ideas at MIT into innovative products and cutting-edge spin-off companies.

The J-WAFS Solutions program is funded through a research contract with Abdul Latif Jameel Community Initiatives and administered through a partnership with the MIT Deshpande Center for Technological Innovation. The program awards grants of up to \$150,000 per year. Approximately 15 projects in total are expected over five years, from September 2015 to August 2020. The program is structured to allow additional sponsors to join the program.

The first call for proposals was issued in spring 2015, and full proposal submission and review took place during the summer of 2015 for projects that launched in September of 2015. Two projects were funded during that first round. A second call for proposals was issued in February 2016. Nine proposals were received, four of which were invited to submit full proposals. Final funding decisions on these four projects for September 2016 launch are pending. In addition, one of the 2015 projects has received a renewal grant.

The two 2015 funded projects are:

A Multiplex, Nanosensor Platform for the Real Time Monitoring of Food and Water-Borne Contaminants

PIs: Michael S. Strano, Carbon P. Dubbs Professor of Chemical Engineering, Department of Chemical Engineering; Anthony J. Sinskey, Professor, Department of Biology (renewed for September 2016 through August 2017 funding)

Fouling-Resistant Nanoporous Membranes

PI: Jeffrey Grossman, Professor, Department of Materials Science and Engineering

Research Collaboration with Other MIT Programs

J-WAFS has engaged in discussion with several other MIT programs about opportunities to jointly fund MIT research, coordinate fundraising, and collaborate in other ways. Our AY2016 RFP for seed funding outlined a specific collaborative opportunity for joint funding with the Abdul Latif Jameel Poverty Action Lab (J-PAL). Other MIT funding programs with areas of overlapping interest that we have had some discussion with about potential joint funding include the MIT Environmental Solutions Initiative and the MIT Energy Initiative. Although no project was found for joint support during this cycle, J-WAFS will continue to explore collaborative research funding opportunities.

Joint funding was also discussed with the leadership of the MIT Tata Center for Technology and Design. The Tata Center already funds some water- and food-related research through graduate student support, covering a range of areas of potential mutual

interest. Some current synergistic funding of J-WAFS-related projects exists, including one early-stage project funded by the Tata Center that is expected to receive a J-WAFS Solutions grant, and another researcher with both Tata funding and a J-WAFS seed grant.

Other research collaboration opportunities are being pursued with the MIT Joint Program on the Science and Policy of Global Change and with various campus initiatives addressing food safety and plant bioengineering.

Conferences, Events, and Student Support

MIT Solve, 2015

Solve at MIT is a multifaceted program that brings thought leaders, researchers, students, and others together to identify and implement technology-centered solutions to the most difficult challenges of our times. A program of MIT's Office of the President and produced by MIT Technology Review, MIT Solve's mission is to inspire extraordinary people to work together to solve the world's toughest problems. With its inaugural four-day program in October of 2015, Solve convened technologists, philanthropists, business leaders, policy makers, and change agents to examine and address the problems where technology, business, innovation, and smart policy can be leveraged to bring about real and lasting change. Solve 2015 content was based around four pillars: Learn, Cure, Make, and Fuel. J-WAFS was charged with curating the session in the Fuel pillar addressing how we will provide a secure food supply for 9.6 billion people. J-WAFS director, John Lienhard, opened the session, which addressed the safety and security of an internationally connected food supply and the environmental footprint of food production.

Speakers included Barbara Burlingame (faculty, American University of Rome); Sandra Eskin (director, food safety, The Pew Charitable Trusts); Michael Ferrari (senior climate scientist and director, climate services for agriculture, aWhere); and Sonny Ramaswamy (director, National Institute of Food and Agriculture, US Department of Agriculture). Chandra Madramootoo (James McGill Professor and former dean of agricultural and environmental sciences, McGill University, who is a visiting scholar with J-WAFS), and Dennis McLaughlin (H. M. King Bhumibol Professor, MIT) moderated the sessions.

MIT Water Summit, 2015

The MIT Water Club is a student group and a leading network for water research and innovation at MIT. The Water Club is primarily sponsored by J-WAFS. In addition to a guest lecture series, the Water Club organizes a major annual summit as well as the MIT Water Innovation Prize and MIT Water Night, a graduate student research poster session.

The MIT Water Summit gathers students and faculty from MIT and the greater Boston area along with leaders from the water industry, other industries that rely on water, the venture capital community, and government in order to explore current problems and potential solutions to challenges in water. The annual Water Summit was held November 13–14, 2015 with the theme of Thriving with Change. The event was organized into three conversation panels—Interpret, Innovate, and Implement—and brought together speakers from MIT as well as diverse outside companies and the

government. Speakers included CEOs of both small (OptiRTC) and large (Gradiant) water companies, government agencies such as the US Department of the Interior, the US Army Corps of Engineers, and the US Department of Energy, and nonprofit organizations. J-WAFS was the major sponsor of the student-led event. Nearly 250 participants attended the event, including students and faculty, business leaders, technologists, and investors.

J-WAFS-ILP Food and Water Conference, 2016

Co-sponsored by ILP and organized around a theme of innovation and collaboration, J-WAFS's first major conference highlighted the growing need for creative, cross-sector problem solving to address significant food and water security issues around the world. J-WAFS organized the day-and-a-half-long program, which highlighted innovative water, food, and agriculture technologies under development at MIT, including current research by MIT faculty as well as numerous start-ups with MIT affiliations. Nearly 250 people registered for and attended the conference. Keynote speakers from industry and agricultural development organizations highlighted the need for innovation as well as the need to connect appropriate technologies to markets. In addition to innovation and technology development in areas such as water purification, sensors for water quality and food safety, and advanced technologies for food and agriculture, the conference also featured a panel titled "Risk and Resilience in an Era of Globalization and Climate Change." Moderated by Steve Polski, senior director and general manager for Cargill's Responsible Supply Chains Joint Advisory Business, the panel featured professors and researchers from MIT whose research addresses various threats to the world's agriculture and food supply chains. Nearly two dozen start-up companies participated in the conference's start-up showcase. A poster session featured the nine current J-WAFS seed research projects, two student groups, and agricultural research by J-PAL.

Rabobank-MIT Food and Agribusiness Innovation Prize, 2016

Sponsored by Rabobank, the new Rabobank-MIT Food and Agribusiness Innovation Prize—with awards totaling \$25,000—is intended to be the premier food and agribusiness business plan competition for university and graduate students in the Boston area and, by invitation, outside Boston. The prize is distinct from other competitions due to its specific focus on food and agribusiness, and because of the access it will provide successful entrants to the broader business community. J-WAFS received a gift of nearly \$50,000 from Rabobank—one of the largest banks in the world and a global leader in food and agribusiness financing and sustainability-oriented banking—to launch the competition and fund the prize. With oversight from J-WAFS, the student MIT Food and Agriculture Club (MITFAC) organized the contest.

Interest was strong, starting with a kick off generator dinner in the fall to help teams form. Twenty-three first-round proposals were submitted, nine of which were invited to develop full business plan submissions with the assistance of mentors recruited by MITFAC and matched to the teams. Six of these teams advanced to the final pitch event, attended by a capacity crowd in the MIT Samberg Conference Center. J-WAFS director John Lienhard and executive director Renee Robins served on the seven-judge panel. Gomango, a team developing smart, modular, refrigerated shipping boxes that can be rented out individually to cut costs and dramatically expand markets for perishable

goods in India won the first-place prize of \$12,000 at the competition. This solution will dramatically reduce food spoilage and expand food choices, driving growth for the start-up and for India alike.

Finances and Funding

Primary funding for J-WAFS comes from its core endowment, which supports J-WAFS personnel, the J-WAFS seed grants, and some activities by student groups at MIT, such as the MIT Water Club.

In addition, J-WAFS has a \$4.85 million sponsored research agreement with Abdul Latif Jameel Community Initiatives, which funds the J-WAFS Solutions program previously described.

J-WAFS has also been receiving payments toward \$1 million pledged in the spring of 2015 to endow a graduate fellowship. Once sufficient income from the endowment is in place, it will support an MIT graduate student pursuing research in the broad area of water supply.

An additional undesignated endowment gift to J-WAFS of \$100,000 was pledged, with \$25,000 received to date.

J-WAFS has also received gifts from over a dozen new individual donors. Fundraising for international partnerships, for corporate direct sponsored research, for graduate fellowships, and for other programs is ongoing.

Personnel Information

Professor John Lienhard, from the Department of Mechanical Engineering, was appointed as the founding director of J-WAFS and as the Abdul Latif Jameel Professor of Water and Food, effective July 1, 2014. In this role, his appointment moved to the Office of the Vice President for Research. Lienhard's research is on thermodynamics and transport phenomena, with a focus on energy-efficient desalination and water purification.

Renee J. Robins '83 was appointed executive director for J-WAFS in December 2014. She returned to MIT from a position at Harvard University, having previously worked for several programs at MIT from 1998 to 2011.

Brian Pierson is the administrative and fiscal officer for J-WAFS. Previously, Pierson worked within MIT for four years, serving as a staff accountant in MIT's central accounting department and as a fiscal officer within the Department of Mechanical Engineering.

Professor Chandra Madramootoo is a visiting scholar with J-WAFS for the duration of 2016 while he is on sabbatical. In 2015 Professor Madramootoo stepped down as dean of the School of Agricultural and Environmental Sciences at McGill University in Montreal. His areas of expertise include water management, irrigation, drainage, agricultural research, and international agriculture development. He is pursuing

research collaborations with MIT faculty, has offered a few noncredit seminars, and is also exploring ways to interact with and mentor students, particularly through the Department of Civil and Environmental Engineering.

John H. Lienhard

Director, Abdul Latif Jameel World Water and Food Security Lab

Director, Center for Clean Water and Clean Energy at MIT and KFUPM

Director, Rohsenow Kendall Heat Transfer Lab

Abdul Latif Jameel Professor of Water and Food

Renee J. Robins

Executive Director, Abdul Latif Jameel World Water and Food Security Lab