ENGINEERING FOR AGRICULTURE: PROVIDING GLOBAL FOOD SECURITY
Session Organizers: Yoshisada Nagasaka, National Agriculture Research Organization, and Luis Rodríguez, University of Illinois at Urbana-Champaign

The standard of living seen in the developed world has been, in part, enabled by investment in agriculture. This investment generated great improvements in agricultural yield and efficiency, which reduced the cost to the consumer, and enabled investment to occur in areas far beyond agriculture. Nations currently seeking similar growth and opportunities will find significant challenges, particularly while world populations grow at unprecedented rates and while spending patterns rapidly change in populous countries with new found economic wealth. In the developing world, the challenges are most dire; it is precisely in these regions where people are the hungriest and the effects of climate change are expected to be the most severe. The developed world, however, will not be totally insulated from these effects. Recently we have seen wild fluctuations in food prices, reportedly leading to riots, attributed to the fluctuating demands around the world, unusual weather patterns, and insecurity in fossil fuels. There is a critical need to identify new approaches for providing food security for the world of the future.

Engineering solutions will undoubtedly play an integral role in ensuring a secure food supply. At minimum, there is a need to further improve our efficiency. Worldwide it is estimated that one third of food is lost on average, although estimates have been reported to be as high as 50%. In the developed world, losses primarily occur at the retail outlet and with the consumer due to exceedingly high quality requirements, whereas in the developing world significant losses occur at the producer, storage, and transit stages. New engineering solutions in supply chain logistics will target key opportunities for reducing these losses, delivering these foods to consumers, and keeping costs low. During production, precision use of external inputs, like irrigation, fertilizer, and pesticides, can be managed more efficiently to minimize applications in areas where they are not necessary, while reducing cost, managing risk, and improving yield. Engineers will need to provide technology and practices to improve yields by growing crops in new environments, including indoor and underutilized outdoor environments, with affordable cost and minimal environmental impact. The crops themselves can be reengineered to be tolerant to temperature and water stress or for reduced nutrient or pesticide requirements, improving yields, even in adverse conditions. The pressure to feed hungry groups, or to turn a profit, can lead to pressure to take risks with the distribution and consumption of unsafe foods. New sensing and tracking technology will provide the capability to ensure that our food supply is not only sufficient in quantity, but also safe to consume.

We have invited speakers who can speak about many of the challenges and opportunities for engineers addressing food security in the context of not only the developed and developing world, but also in rural and urban settings, using physical and biological technologies, and many others. We hope to have a discussion addressing the challenges of population growth and fluctuating demands, water shortages and temperature changes, increasing productivity while reducing environmental impacts, and maintaining food safety and quality assurance. Amy Kaleita (Iowa State University) will talk about applications of precision agriculture in rural communities. Keigo Noda (University of Tokyo) will talk about a building environmentally aware watershed models, considering the balance of food, water, and energy usage in developing countries seeking to adapt to climate change. Murat Kacira (University of Arizona) will talk about engineering controlled environments for agriculture for a sustainable future. Yoko Obayashi (Ajinomoto) will talk about quality assurance and food safety, particularly biological assessment of the pathogenicity or allergenicity of the source bacteria.