

1890 Foundation Center of Excellence for Emerging Technologies (CEET)

The rapidly growing world population presents the land-grant community a monumental responsibility of addressing global food security through rigorous research, extension, and educational programs. Technological advances applicable in agriculture, natural resource utilization and conservation, and food production, will likely enable us to meet this daunting challenge, provided there is appropriate allocation of resources to enhance infrastructure at agricultural universities. Topics such as precision agriculture, artificial intelligence, big data, and gene editing have become a part of day-to-day conversation within the agricultural research community. In order to enhance the strengths of the 1890 land-grant universities and maximize the 1890 system's ability to fulfill its unique mission set forth in the Second Morrill Act, a Center of Excellence for Emerging Technologies (CEET) is being conceived.

The list of emerging technologies pertinent to agriculture is endless, including biosensors, livestock biometrics, satellite imaging, neural networks, pervasive automation, genetically designed and in vitro foods, closed ecological systems, synthetic biology, and vertical farming, each at a different point along the path of progression from conception to commercialization. However, these emerging technologies also warrant institutions to establish suitable research infrastructure and make adjustments to their outreach and educational programming to enable them to effectively train the present and future generation of agriculture workforce and the farming community. This is particularly critical for smaller land-grant institutions charged with a unique mission of addressing the needs of underrepresented communities, as well as of producers and landowners with limited access to technology and resources. Therefore, the CEET's scope will encompass all emerging technologies within the confines of 1890 priorities and strengths; a couple of examples are discussed below.

There is an imperative and urgent need for institutions to build the capability to handle humongous volumes of data and at the speed and frequency with which they are being collected. During the previous administration, the White House Office of Science and Policy has mandated that federal agencies make data generated from federally-funded research and educational programs "open" and available to allow informed public policy decisions, to develop solutions to problems, and to encourage entrepreneurial ventures by the public. The recipients of federal funding are required to make adjustments in data management at many levels to meet these requirements. The challenges institutions may encounter in handling "big data" and in implementing "open data" processes and procedures, in addition to establishing the needed human and technology infrastructures are readily apparent. Building/strengthening the infrastructure at 1890 institutions through the proposed CEET is crucial to allow research investigators and practitioners of agricultural, food, and environmental sciences to take full advantage of new and more robust ways of doing research. More importantly, CEET will assist the 1890 system in training the students effectively and empowering limited resource farmers with the technological knowledge and skills needed to run successful environment-friendly agricultural enterprises.

Another example is the gene editing technique, which allows researchers to eliminate an undesirable trait by precisely knocking out a gene or to add a desirable trait by accurately

inserting a gene in a specific place in a genome, is viewed as a transformational tool in agricultural research. The CRISPR technique is so precise that it is considered the least biologically disruptive technique available to date. It is important, however, to exercise prudence and caution in adopting these emerging technologies such that the focus is not just on incremental agriculture (quantity of food produced), but also on promoting economic, social, cultural, and environmental values.

Other examples involve the use of AI and drone technology to determine soil characteristics and soil maps, plant disease and pest surveillance and management, soil and surface water management which are critical in good decision making process for the farm operations.

Education of future scientists in using these technologies is very critical. It is important to develop curricula that infuse these cutting edge technologies in the courses for student training in agriculture.

An aggressive education and outreach program about the emerging technologies in agriculture is also essential. Poor communication and public outreach can potentially jeopardize the wide application of these revolutionary technologies to address the challenge of meeting the world's food demands. For instance, public should not confuse gene edited foods with transgenic foods, although it is very likely to happen in the absence of outreach and education programs. Therefore, the CEET will have a three-prong mission of research, education, and outreach. **As no one 1890 institution has all the capabilities and expertise in these emerging technologies, it is important that development of partnerships and collaborations among the institutions in the establishment of such a center is very essential**