Feeding the Planet **Sustainably**

A UIDP Bioeconomy Workshop
July 28-29, 2021

Executive Summary

UIDP
Strengthening University-Industry Partnerships

UIDP conducted this workshop on behalf of the NSF Biology Directorate to leverage top scientific minds to identify biotechnology research areas for strategic investments and acceleration.

Executive Summary

In the coming decades, agriculture will need major advances to meet the food, feed, fiber, and fuel demands of the growing population while reducing its environmental footprint. Within this context, there is an urgent and critical need to establish an agricultural bioeconomy that is sustainable, productive, and resilient to change. Accordingly, the National Science Foundation (NSF) is making investments to identify needed technological advances and develop partnerships to advance a new agriculture that can sustainably feed the changing planet. This workshop was convened to identify partnership strategies for how use-inspired research can be rapidly translated to innovations that support a new agricultural bioeconomy.

More than 100 participants from academic, industry – (large and small), government, and nonprofit sectors convened virtually for two days to offer a definition of the new agriculture and discuss challenges toward feeding the planet sustainably. The invited scientists and researchers were strategically selected to ensure that diverse perspectives and expertise were represented in the workshop deliberations. Participants envisioned what the new agriculture will look like, using terms such as predictive, sustainable, connected, innovative, collaborative, efficient, and united.

Purpose of the Workshop

Feeding a growing population that inhabits a warming planet is a significant undertaking that will require new strategies powered by technological innovations to improve food production and other agricultural products. The new agriculture should aim to reduce the drivers of climate change while still serving the planet's needs. To achieve this goal, a deep understanding of fundamental biological processes linked to practical innovations will be essential. Conventional approaches must be expanded to include advances in biotechnology, engineering, computation, artificial intelligence (AI), and mathematical modeling, while considering social, economic, and regulatory aspects. Additionally, it is pertinent to identify use-inspired research areas that are most amenable to collaboration and partnerships and where appropriate levels of investment will translate into near-term products, services, and techniques that generate societal benefit.

The workshop's goals were to define the needs for a new agriculture, identify gaps to progress, and articulate near- and long-term goals to achieve successful outcomes. Basic research should be directly connected with and lead to innovations that translate knowledge into practical outcomes. Inherent to success is the essential need for partnerships among all sectors—academic, corporate, government, and non-profit—for achieving these common goals. Industry-academic research consortia are one example of the kind of partnership that will contribute to developing the bioeconomy – both those participating in the research and those investing in it will benefit from collaborative R&D efforts.

Key Findings: The importance of integrating diverse perspectives from different fields remained a consistent theme throughout the workshop. Interdependencies between the bioeconomy, new agriculture, climate change, and social acceptance issues must be recognized and leveraged. Essential elements within such an approach include:

» **Incorporating the needs and wants of consumers and farmers** to deliver appropriate technology and solutions to different regions.

» **Interdisciplinary collaborations** between basic science and high tech and among social sciences, economics, policy, the industrial sector, and other stakeholders.

» **Effective and efficient communication among diverse groups** to foster collaboration and translate the problems, processes, and solutions.

Challenges and Opportunities

While there was overarching agreement about the need to develop approaches incorporating these elements, the participants acknowledged both challenges and opportunities to their development.

Challenges:

- **Contracting and intellectual property management barriers** must be removed to facilitate cross-sector collaborations.
- **Current partnership models do not work well** for developing countries, thus a new, adaptable model for public-private partnerships must be created.
- **Lack of adequate universal data standards**, such as FAIR (Findability, Accessibility, Interoperability, Reusability) standards,[1] capable of accommodating a rapidly developing new agriculture, must be addressed.

Opportunities:

- **The fundamental biology required to solve agricultural problems** is not well understood.
- **There is a knowledge gap between expanding and improving plant transformation technologies**, especially for orphan crops and lesser-studied species.

Recommendations and Next Steps

New agriculture's goal is to accelerate scientific and technological advances to the consumer market. However, the scientific community itself must do its part by instilling a greater sense of urgency, consistently engaging the public, and establishing international standards to catalyze research and commercialization efforts. Toward this goal, public understanding of, and

support for, new scientific and technological developments should be improved. Participants recommended the following specific steps for moving forward:

- **Identify actionable steps to enhance capacity** by convening small focus groups of plant transformation specialists from public and private sectors.
- **Invest in a long-term, sustainable solution for computing power** that continually updates and expands as data collection rapidly increases.
- **Establish additional funding programs from federal agencies that are accessible to multiple sectors and that will support research innovation and technology improvement**, thereby advancing existing research tools, such as algorithms and data, from pilot to production so they are more applicable to predictive agriculture.
- **Give special consideration to small-holder farmers** who need key infrastructures, such as seed production and distribution systems, roads, plots, equipment, and other resources.

This report summarizes the key insights and is not intended to be a detailed record of the entire proceedings. We encourage you to share this document with interested parties.

Workshop Findings in Brief

Steps to Address Areas of Concern

- Consider current use of terms that are not socially acceptable, such as "synthetic biology."
- Increase communication highlighting the value proposition for science and tech needed for the new agriculture.
- Expand and consistently apply FAIR data standards and management.
- Define goals for feeding the planet sustainably.

Solutions to Improve Collaboration

- Remove contracting and IP management barriers.
- Increase funding for collaborative efforts that break down boundaries and silos.
- Facilitate opportunities for public-private collaborations.
- Reimagine integrative training and education.
- Build, engage, and retain a diverse and inclusive workforce.
- Communicate effectively and efficiently among diverse groups to foster collaboration and translate processes and solutions.
- Incorporate the needs and wants of consumers and farmers to deliver appropriate technology and solutions.
- Develop a new, adaptable model for public-private partnerships for a new agriculture.

Necessary Technical Advances

- Improve understanding of basic biological and ecological processes.
- Integrate AI, machine-driven, and robotic advances in agriculture.
- Establish foundational infrastructure for advancing synthetic biology.
- Improve plant transformation capability and efficiency.
- Discover and leverage the networks underlying complex biological traits.
- Identify actionable steps to enhance capacity by convening small focus groups of plant transformation specialists from public and private sectors.
- Establish small, cross-sector focus groups of plant transformation specialists to develop actionable recommendations and enhance plant transformation capacity.
- Encourage more multi-sector collaborations, not only between basic science and high tech, but also the industrial sector and other stakeholders.
- Instill a greater sense of urgency, engage the public, and establish international standards to catalyze research and commercialization efforts.
- Translate technological innovation into practical solutions at speed and scale.
- Translate outcomes to diverse and global stakeholders such as end-users, consumers, and those in industry and commodities.

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