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National Academy of Sciences Releases Report on *Science Breakthroughs to Advance Food and Agricultural Research by 2030*

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On July 18, the National Academy of Sciences (NAS) released “Science Breakthroughs to Advance Food and Agricultural Research by 2030” a consensus report that identified five science breakthroughs and provided recommendations for agricultural research for the next decade. Sponsors included non-profit organizations, like the Foundation for Food and Agriculture Research (FFAR), and federal agencies including the US Department of Agriculture National Institute of Food and Agriculture (NIFA) and the National Science Foundation.

The impetus for the study, which launched in spring 2017, was to provide a short-term research strategy for the most challenges issues in food and agriculture. The committee included 13 experts from both land-grant and non-land grant institutions, as well as IBM Research and the Pacific Northwest National Laboratory (PNNL). The report is modeled off decadal surveys used by the space research community to generate consensus for strategic research priorities. Although human nutrition and obesity are acknowledged as major challenges, these topics were not included in the report because of the recent *National Nutrition Research Roadmap* (2016).

Breakthroughs identifies three major goals for food and agricultural research over the next decade: “improving the efficiency of food and agricultural systems; increasing the sustainability of agriculture; and increasing the resilience of agricultural systems to adapt to rapid changes and extreme conditions.” Efficiency, sustainability, and resiliency broadly respond to the myriad of key research challenges currently facing the American agricultural community ranging from “increasing nutrient use efficiency in crop production...” to “reducing food loss and waste throughout the supply chain.” The report indicates that the urgency and gravity of these agricultural challenges requires a convergent research approach. The report indicates that the urgency and gravity of these agricultural challenges requires a convergent research approach. This emphasis on convergent research reflects a burgeoning federal research trend: NSF Convergence is one of the 10 Big Ideas and NIFA launched a new Sustainable Agricultural Systems (SAS) program that focused on a convergent approach.

The following provides a brief synopsis of the five breakthroughs and corresponding recommendations:

- *“A systems approach to understand the nature of interactions among the different elements of the food and agricultural system can be leveraged to increase overall system efficiency, resilience, and sustainability.”* The report recommends that **“transdisciplinary science and systems approaches should be prioritized to solve agriculture’s most vexing problems”** and to achieve holistic solutions. Current federal programs Innovations at the Nexus of Food, Energy, and Water (INFEWS) and NIFA Sustainable Agricultural Systems (SAS) are cited as models.

However, the majority of current programs and standard grants funding levels could not provide adequate budgets or incentives to support a transdisciplinary approach.

- *“The development and validation of precise, accurate, field-deployable sensors and biosensors will enable rapid detection and monitoring capabilities across various food and agricultural disciplines.”* The application of transdisciplinary research and solutions to the food system will require next-generation sensors that will adapt to the purpose and environment. To facilitate this, the report recommends that the government **“create an initiative to more effectively employ existing sensing technologies and to develop new sensing technologies across all areas of food and agriculture.”**
- *“The application and integration of data sciences, software tools, and systems models will enable advanced analytics for managing the food and agricultural system.”* Innovations in data science and machine learning could make the entire agricultural supply chain more responsive and efficient. The report recommends **“establish[ing] initiatives to nurture the emerging area of agri-food informatics and to facilitate the adoption and development of information technology, data science, and artificial intelligence in food and agricultural research.”**
- *“The ability to carry out routine gene editing of agriculturally important organisms will allow for precise and rapid improvement of traits important for productivity and quality.”* The report stresses the incredible impact of gene editing to address the three major goals of increasing crop yields and ensuring sustainability and resilience in agriculture. The recommendation is to establish **“an initiative to exploit the use of genomics and precision breeding to genetically improve traits of agriculturally important organisms.”**
- *“Understanding the relevance of the microbiome to agriculture and harnessing this knowledge to improve crop production, transform feed efficiency, and increase resilience to stress and disease.”* Increased understanding of the plant, soil, and animal microbiomes could impact various elements of the agricultural supply chain, from disease resistance at the production level to making nutrient content more responsive to population needs on the delivery side. To access these future outcomes, the committee recommends that the government **“establish an initiative to increase the understanding of the animal, soil, and plant microbiomes and their broader applications across the food system.”**

In addition to the five research breakthroughs, the report details further considerations necessary to successfully address agricultural challenges. These conclusions acknowledge a lack of major federal investments in agricultural infrastructure, including tools and human capital, as well as inadequate investments in public and private research. Continued and robust support for existing assets, such as the Agricultural Experiment Station Network and Cooperative extension service, is emphasized. The report laments major shortcomings in both the education and scientific workforce and stresses the need to encourage the next generation of students and professionals to seek out careers in agricultural research. Further collaboration between the biophysical and socioeconomic sciences is also cited as necessary for effective policy design and producer and consumer acceptance of innovation in agricultural research and industry.

Sources and more information:

- The NAS report can be found at <https://www.nap.edu/catalog/25059/science-breakthroughs-to-advance-food-and-agricultural-research-by-2030>.
- The NAS press release can be found at <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=25059>.
- The NAS highlights can be found at <https://www.nap.edu/resource/25059/ScienceBreakthroughs2030ReportBrief.pdf>.
- Additional materials, including meeting minutes and webinars, can be found at <http://nas-sites.org/dels/studies/agricultural-science-breakthroughs/>.