AGree
Transforming
Food & Ag Policy

Research & Innovation: Strengthening Agricultural Research

2015

Challenges

Meet future demand for food

Conserve and enhance water, soil, and habitat

Improve nutrition and public health

Strengthen farms and communities to improve livelihoods

Initiatives

Food & Nutrition

Immigration Reform

International Development

Local Food

Next Generation

Research & Innovation

Risk Management

Working Landscapes

Today, the world faces a unique set of societal and environmental challenges at the nexus of food, nutrition, health, and agriculture. Significant population growth – an additional two billion or more people by 2050 – is projected against a fast-evolving backdrop of changing food and agricultural systems, shifting global trade patterns, urbanization, and rural economic decline. Many experts estimate that global agriculture production will need to increase by 50 to 100 percent by 2050 to meet demand for food and feed,[1] while environmental challenges to productive capacity will increase: water scarcity, agricultural disease and pest outbreaks, emerging zoonotic and infectious diseases, climate change, extreme weather events, and finite limitations on the availability of cultivable land. At the same time, in the U.S. and globally, food insecurity and chronic under-nutrition are expected to coexist with rising rates of obesity, diabetes, and other diet-related diseases usually associated with adequate food supplies.

These major food and agricultural challenges are highly complex and multi-dimensional – biophysical, technological, socio-cultural, economic, institutional, and political. To meet these challenges, research and innovation must recognize and respond to the interplay among scientific, social, and economic factors and engage a multiplicity of stakeholders, many of whom embrace fundamentally different views and priorities. Food and agricultural innovation is key to surmounting multi-faceted challenges and transforming the food and agriculture system into one that sustains and improves the health of families, rural and urban communities, the economy, and the environment far into the future. In this way, research and innovation informs all aspects of the food and agriculture system and is fundamental to each of AGree's Initiatives – from *Immigration Reform to Food & Nutrition, Working Landscapes, International Development*, and efforts to improve agricultural *Risk Management* tools, strengthen *Local Food* systems, and prepare the *Next Generation* of food and agriculture actors.

The track record of innovation associated with food and agricultural research conducted both by the U.S. Department of Agriculture (USDA) and researchers outside of USDA is robust, evidenced by the fivefold increase in production[2] in the U.S. alone between 1910 and 2007.[3] Going forward, researchers in both the public and private sectors can draw upon a wealth of knowledge and experience to spark the next generation of innovation in food and agriculture. To keep pace with demands for system transformation, however, additional public research, education, and extension resources must be mobilized in the U.S. and around the world; human capital must be developed to provide leadership, conduct research, and generate innovations; and research and innovation must evolve to address the complexity of agricultural challenges, including differences in views among key stakeholders and changing societal values regarding the ways in which food is produced. Importantly, research and innovation must not only introduce new technologies, but also develop the new knowledge systems and social relationships needed to maximize their value to society and the economy.

In order to achieve the vision of an increasingly productive and healthy food and agricultural system driven by knowledge and innovation, AGree believes that:

- U.S. research priorities must be reviewed and reset to align effectively with emerging food and agricultural challenges and opportunities. Transdisciplinary, long-term, global, and systems-based perspectives should ground the process.
- The public food and agricultural research and innovation system in the U.S. and internationally must be better funded at the same time as efforts are made to increase the efficiency and effectiveness of the system, in part by shifting where and how funds are allocated.[4] AGree applauds the globally-focused Feed the Future initiative that engages multiple U.S. government entities in support of a widely agreed upon international agenda for food security. Also noteworthy are the U.S. Agency for International Development (USAID)-led efforts to promote innovative and collaborative research efforts among U.S. universities, as well as with the international agricultural research system. In addition, AGree recognizes meaningful reforms included in the 2008 and 2014 Farm Bills: establishing the role of the Chief Scientist and authorizing an office to support the Chief Scientist in carrying out his/her leadership and priority-setting responsibilities; calling for a roadmap for agricultural science; establishing the National Institute of Food and Agriculture (NIFA) as a new extramural agency headed by a Presidentially-appointed director having a six-year tenure; and authorizing a new Foundation for Food and Agricultural Research (FFAR), among others. However, AGree believes that additional reforms are needed.

The State of U.S. Agricultural Research

For over a century, the U.S. has been a prominent global leader in agricultural research and innovation. This excellence has contributed significantly to economic growth and increased agricultural productivity. Research and innovation have delivered a valuable return on investment: estimates of the annual social rate of return to producers, consumers, and the environment range from 20 percent to 60 percent,[5] with an average $10 economic benefit for every $1 invested in research.[6]

Nonetheless, support for public investments in food and agricultural research has waned in recent decades, even as rates of agricultural productivity growth have slowed, new food and agriculture problems have emerged, and global markets have continued to grow in volume and value. The President's Council of Advisors on Science and Technology (PCAST) concluded in its 2012 *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise* that *"our nation's agricultural research enterprise is not prepared to meet the challenges that U.S. agriculture faces in the 21st century for two major reasons. First,... the proportion of Federal funding for agricultural research allocated through competitive mechanisms is far below the current proportion in other agencies, which fails to adequately encourage innovation. Second,… the current agricultural research portfolio is not optimally balanced; it overlaps with private sector activities in several significant areas, while underfunding other important areas that are not addressed through private efforts."* Despite these noted concerns, Congress failed to hold any hearings to comprehensively examine publicly-funded food and agricultural research during the development of the 2014 Farm Bill.

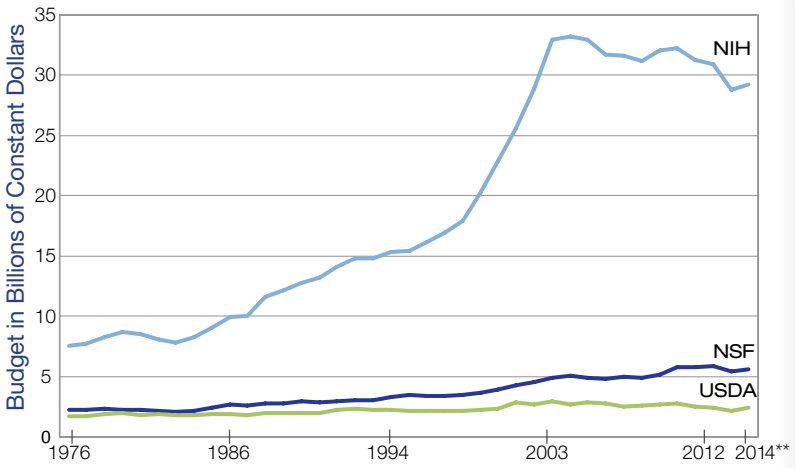
Addressing Funding for U.S. Agricultural Research and Innovation

In addition to making the case for additional federal resources through direct and discretionary funding, AGree sees the following complementary ways to increase and improve the effectiveness of public funding for food and agricultural research:

1. Increase funding for food and agricultural research from federal agencies beyond the U.S. Department of Agriculture (USDA), such as the Department of Energy (DOE), Department of Health and Human Services (HHS), National Science Foundation (NSF), and others. These agencies must recognize food and agricultural research as important priorities and allocate a greater percentage of their funding toward them.
2. Consolidate USDA programs and infrastructure that no longer serve to address current challenges and target funding toward facilities and programs with the greatest potential impact.
3. Redirect funding to high-priority research areas identified with stakeholder input and away from areas addressed by the private sector or with less potential to impact the public good.

Over the past several decades, funds appropriated to the U.S. Department of Agriculture's (USDA) Research, Education, and Economics (REE) mission area have lagged behind those allocated to general scientific and medical research, as illustrated by *Figure 1*. Between the years 1976 and 2014, USDA's research funding increased by 40 percent in inflation-adjusted dollars, while that of the National Science Foundation (NSF) increased by 149 percent and that of the National Institutes of Health (NIH), the research agency of the U.S. Department of Health and Human Services (HHS), increased by 288 percent.[7] From 1983 to 2003, USDA's research spending rose at merely one-eighth the rate of that of NIH.[8] More recently, frequent across-the-board budgetary cuts and fiscal pressures have resulted in USDA's 2014 research spending amounting to only 43.6 percent that of NSF and only a meager 8.3 percent that of NIH.[9] As a result of this limited federal support, private investments comprise the majority of U.S. food and agricultural research funding; in 2009,[10] private spending accounted for 61 percent of total funding for domestic food and agricultural research.[11]

Figure 1 | U.S. Federal Government R&D Budget by Agency, 1976-2014



Source: AAAS R&D Budget and Policy Program[12]
*** Latest estimates as of May 2014*

While additional funding for national food and agricultural research could help address challenges related to aging U.S. research infrastructure and outdated data and information systems, AGree believes it would be shortsighted to advocate for increased funding without aggressively pursuing both short- and long-term changes in the U.S. research and innovation system. Reforms in public research approaches, education, and systems that work to introduce new ideas and practices into the food and agricultural system would help build confidence that funding is being used efficiently and effectively while also enabling the U.S. to successfully address 21st century issues and respond to unforeseen challenges.

For example, recent reports about USDA's grant-making for research have identified issues related to both the effectiveness of funding mechanisms used and the balance between intramural (e.g., data collection by the National Agricultural Statistics Service, and research and analysis conducted by the Agricultural Research Service and Economic Research Service) and extramural research. In a *Point of View* (POV) paper solicited by AGree,[13] the author reviews current capacity funding mechanisms long used to support research in land-grant colleges and universities and suggests an alternative aimed at fostering more innovative, high-impact research. While the approaches in the POV paper do not represent a consensus of AGree Co-chairs and Advisors, this and other potential new funding mechanisms deserve deeper consideration and exploration. Without re-prioritizing as well as increasing public investments, the nation will be unable to advance the basic science research and transdisciplinary innovative thinking needed to meet 21st century challenges in food and agriculture.

As the U.S. has allowed public investments in national agricultural research systems to stagnate, other countries have bolstered theirs. China's public agricultural research spending, for example, surpassed that of the U.S. in 2009 and continues to remain ahead.[14] Analysts have found that U.S. public research capacities remain robust and competitive; however, there is some question as to whether this leadership will be sustained.[15]

Additional Efforts Advocating for U.S. Food and Agricultural Research System Reform

AGree's efforts within our Research & Innovation Initiative represent one among many attempts to strengthen the U.S. food and agricultural research enterprise. In recent years, a range of organizations and others have consistently called for increased and improved allocation of public food and agricultural research funding. Several prominent reports include:

- The Charles Valentine Riley Memorial Foundation's and Iowa State University's 2014 report *Pursuing a Unifying Message: Elevating Food, Agricultural and Natural Resources Research as a National Priority.*
- The National Research Council of The National Academies, Committee on a Review of the USDA Agriculture and Food Research Initiative's 2014 report *Spurring Innovation in Food and Agriculture: A Review of the USDA Agriculture and Food Research Initiative Program.*
- The Chicago Council of Global Affairs' 2013 report *Advancing Global Food Security: The Power of Science, Trade, and Business.*
- The President's Council of Advisors on Science and Technology's 2012 *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise.*
- The National Research Council of The National Academies, Committee on Twenty-First Century Systems Agriculture's 2010 report *Toward Sustainable Agricultural Systems in the 21st Century.*
- Creating Research, Extension, and Teaching Excellence for the 21st Century's (CREATE-21) 2006-2008 *A Bold Proposal.*
- The Research, Education and Economics Task Force of the United States Department of Agriculture's 2004 report *National Institute for Food and Agriculture: A Proposal.*
- The National Academy of Sciences' 2000 report *National Research Initiative: A Vital Competitive Grants Program in Food, Fiber, and Natural-Resources Research.*

Historic reports calling for similar changes include:

- The National Academy of Sciences' 1972 *Report of the Committee on Research Advisory to the U.S. Department of Agriculture.*
- The Rockefeller Foundation's 1982 report *Science for Agriculture.*

Several organizations and coalitions have also prominently advocated for REE system changes, including: the National Coalition for Food & Agricultural Research (NC-FAR); Supporters of Agricultural Research (SoAR); The AFRI Coalition; and the Association of Public and Land-Grant Universities (APLU).

Meanwhile, the U.S. contribution to international food and agricultural research has also languished, threatening U.S. international development goals and the success of countries in meeting their own food needs. Since the establishment of the Consultative Group on International Agricultural Research (CGIAR) in 1971, the U.S. has served as a major funder.[16] However, from 1992 to 2008, U.S. contributions to CGIAR remained fairly constant.[17] Since then, U.S. funding has increased, but funding from other sources has increased even further, reducing the U.S. share of total funding. Further, the U.S. and other funders of CGIAR have increasingly directed their funding to research very closely linked to near-term development objectives in specific countries and regions. While justified in terms of needed near-term impact, this may be seen as compromising the comparative advantage of the CGIAR system – that is, its ability to prioritize research efforts that have a longer-term horizon and an international scale. It should also be noted that a longer-term commitment is more likely to foster greater synergies between international research and the U.S. agricultural research enterprise.

Drawing on these observations, AGree has identified, with input from a diverse set of Advisors and partners, a set of recommendations for change that promise to strengthen the U.S. public food and agricultural research enterprise. By strategically targeting public resources toward food and agricultural research and innovation, the U.S. can maintain global economic and technological competitiveness and help ensure economic growth, national security, environmental quality, and the health and wellbeing of communities in the U.S. and abroad.

AGree's Recommendations to Strengthen U.S. Agricultural Research and Innovation

The recommendations described below focus on improving *how* the publicly-funded U.S. research and innovation system works – or should work – rather than specifying the research questions it should address. The recommendations suggest ways to improve its ability to engage multiple stakeholders and transdisciplinary research expertise, use competitive mechanisms to spark innovative thinking as well as to support long-term research focused on slow-emerging phenomena and systems-based issues, and apply sound performance criteria to assess whether results anticipated are achieved and used. Each of the recommendations, grouped under the categories of *overarching opportunities*, *priority setting*, and *funding*, provide a starting point from which additional dialogue, analysis, and experimentation can build.

Overarching Opportunities:

1. **Advocate for increased Congressional oversight of the U.S. agricultural research enterprise.** Congress has, in recent years, convened very few hearings to conduct comprehensive reviews of food and agricultural research priorities in the context of the critical food and agriculture challenges faced in the U.S. and globally. AGree believes that public hearings would help Congress legislate and appropriate according to need and programmatic effectiveness, as well as generate Congressional interest in and support for many of the potential reforms presented below. Issues in food and agricultural research and innovation are relevant to many committees in both houses – including those dealing with issues of agriculture, foreign relations, science and technology, energy, environment, health, and education – and deserve greater priority. Broader Congressional engagement in debates on the ways in which food and agriculture challenges interact with other political, social, and economic issues could suggest potential synergies and increase budget efficiencies through collaborative programming.

Food and Agricultural Research Priorities

While this report focuses more on the *how* of food and agricultural research rather than prescribing which research subjects should receive priority, a growing number of stakeholders across the research, NGO, and producer communities question whether federal food and agricultural research resources are being invested toward the most pressing challenges to society. Prominent reports have suggested that research priorities should move away from historically well-funded areas such as the productivity of individual commodities. AGree's *Working Landscapes: Achieving Productivity, Profitability, and Environmental Outcomes* consensus recommendations argue for investments in research, education, and the development of tools that enable producers to more efficiently manage soil, water, and nutrients so that long-term productivity, profitability, and ecosystem health are improved and sustained. Increased research and analysis is also needed to increase the understanding of the overall benefits, costs, and health and safety of agricultural inputs, practices, and systems in order to inform decision making by producers, supply chain actors, researchers, and government.

Several recent reports, including but not limited to the PCAST 2012 report, have also identified public research priorities. Priority areas identified encompass a wide range of interconnected challenges that include the food and health nexus, enhancing soil health, and reducing food waste at both the farm and consumer levels. AGree believes these areas provide a valuable starting point for continued discussions.

NIFA's Agriculture and Food Research Initiative (AFRI) currently awards grants according to six broad research priority areas:

1. Plant health and production of plant products;
2. Animal health and production of animal products;
3. Food safety, nutrition, and health;
4. Bioenergy, natural resources and environment;
5. Agriculture systems and technology; and
6. Agriculture economics and rural communities.

2. **Strengthen the role of the USDA Chief Scientist** to help ensure the U.S. continues to serve as a global leader on food and agricultural research and innovation. The Chief Scientist must oversee and direct all REE priority setting and advisory councils to ensure relevancy and continuity, and coordinate with other federal agencies that provide funding for research related to food and agriculture, including but not limited to the U.S. Department of Health and Human Services (HHS), Agency for International Development (USAID), Department of the Interior (DOI), NSF, Department of Defense (DOD), Department of Energy (DOE), and Environmental Protection Agency (EPA).

3. **Make data, information, and findings from publicly-funded research accessible.** Enhanced data sharing and collaborative analysis can improve communication, coordination, and collaboration among federal and state government agencies, researchers, NGOs, and other institutions across sectors. Data aggregation, management, and accessibility need to be modernized and streamlined to ensure that potential users can access and analyze the data, optimizing the impacts of research on the national and global landscape.[18] Of note, the USDA National Agricultural Library's PubAg resource is currently expanding at a rate of approximately 20,000 articles and citations per month. USDA has also served as a leader in establishing international data and research sharing through Global Open Data for Agriculture and Nutrition (GODAN). In addition, several USDA mission areas and other federal agencies are participating in the STAR METRICS program, which provides online access to detailed information about federally-funded research projects. AGree commends these efforts. However, further progress must be made to share data with the broad research community. Communication targeted to producers and other end users must also be expanded and strengthened. The Sustainable Agriculture Research and Extension (SARE) program's public database is a promising example of a more effective way to share research projects and outputs.

4. **Integrate research, education, and extension activities to promote coordination across each of these three interconnected elements at the university level.** Extension services must be strengthened to ensure that research results and new technologies are translated to producers and other users in a meaningful way. Connectivity among researchers, extension agents, producers, and others must be encouraged to frame research priorities and target investments toward critical challenges. For example, some NIFA competitive grant programs[19] state explicitly in requests for applications that "projects must involve work that is viewed by stakeholders as both necessary and important." Increased connectivity among these groups at the university level would also help educate and prepare students to address food and agriculture challenges in an effective and integrated fashion in their future careers. Non-land-grant academic institutions, such as community colleges, should also be engaged in and connected to extension activities, helping to educate professionals and ensure that research more quickly and effectively informs practice.

Partnerships among Community Colleges and Land-Grant Colleges and Universities

Land-grant colleges and universities and other public and private universities are pillars of public food and agricultural REE. While they successfully conduct many REE activities, dynamic partnerships among these institutions and others less traditionally involved in agricultural REE, such as community colleges, can yield impressive results. While universities are powerhouses of knowledge and research, community colleges possess complementary strengths: they are smaller and thus more structurally nimble; frequently partner with industry; receive funding from a diversity of sources; often have an entrepreneurial emphasis; are adept at public engagement; and have a unique understanding of and connection to community needs. In tandem, universities and community colleges can powerfully connect research, education, and extension efforts.

For example, Lewis & Clark Community College and the University of Illinois at Urbana-Champaign collaboratively launched The National Great Rivers Research & Education Center in 2002. This partnership has generated cutting-edge research and developed meaningful education opportunities for students and others in the surrounding community.

Priority Setting:

5. **Review and reset publicly-funded research priorities periodically, employing a transparent process with input from multiple stakeholders and end users** to ensure that funds are directed toward the most relevant and high-impact areas. Multiple experts have criticized the structure of USDA's current stakeholder engagement process. Of particular note, the advisory bodies lack clear roles and mechanisms to make them effective; processes are slow to respond to emerging issues; and advisors do not sufficiently represent a diversity of stakeholders. USDA must align public food and agricultural research priorities with broadly-supported public policy objectives, ensure that they address issues relevant to the public good, and adjust them to fit specific regional and geographic factors within the U.S. and global arena by drawing on creative ideas for more effective stakeholder engagement.[20] In particular, the USDA Chief Scientist's role in overseeing and coordinating the REE advisory bodies must be maintained and strengthened.

a. While resources should be prioritized toward in-person, high-quality stakeholder engagement, online outreach and engagement strategies, such as webinars and online feedback solicitations utilized by the National Institute of Food and Agriculture's (NIFA) Agriculture and Food Research Initiative (AFRI), must be further developed.

b. In addition, consolidation of the former Agricultural Science and Technology Review Board (ASTRB) into the National Agricultural Research, Extension, Education, and Economics Advisory Board (NAREEEAB) in 1996 left a gap in USDA's capacity to examine the costs and benefits of new technologies on social, economic, and environmental systems through stakeholder and expert input. Mechanisms to reintegrate the independent technology assessment expertise that existed within the ASTRB into current USDA stakeholder input processes must be further explored.

6. **Target public research funding to areas unlikely to be addressed by private industry.** Allocate public funding to those research questions and capabilities in which the public sector can add the greatest value. Publicly-funded research should not simply fill gaps left by private sector research, but should also create upstream capacity to drive a more productive research enterprise overall as well as contribute to downstream applications of high value to society.

a. Public research efforts must emphasize both basic, fundamental science and applied research, focusing on social, environmental, and economic challenges that are not easily monetized and have the potential to substantially impact the public good. Private industry, for example, has demonstrated its ability to effectively increase yields of major grains and livestock and is currently playing an increasingly important role in precision agriculture data collection and analysis.

b. Publicly-funded longitudinal data collection, stewardship, and analysis efforts must be strengthened, prioritized, and protected from federal budget cuts. These activities fall firmly in the public domain, as they generally lack commercial applications and generate findings in the public interest that are critical to the future of agriculture in the U.S. and globally.

Funding:

7. **Scrutinize and modernize federal funding mechanisms for public research, education, and extension to foster innovation and maximize public benefits.** Support more competitive grant-making and greater use of mechanisms that incentivize transdisciplinary and systems-based research, multi-stakeholder consultation and participation, and public-private partnerships that increase the value, relevance, and applicability of publicly-funded research. Specific areas of focus include the following:

a. *Capacity funding.* Multiple experts have scrutinized the way in which USDA's extramural capacity funds are allocated and have criticized it for inadequately promoting high-impact science and innovation.[21] AGree recognizes that these capacity funds provide certainty of funding to land-grant colleges and universities that often enables them to: build long-term and meaningful relationships with stakeholders; more easily make long-term investments in projects; and pursue higher-risk, innovative research with flexibility. However, alterations to the current balance of capacity and competitive program funds should be considered.

b. *Funding below authorized levels.* Competitive, peer-reviewed grant programs, such NIFA's Agriculture and Food Research Initiative (AFRI), Specialty Crop Research Initiative (SCRI), Sustainable Agriculture Research and Extension (SARE), Organic Agriculture Research, Education, and Extension Initiative (OREI), and Crop Protection and Pest Management Competitive Grants Program (CPPM), promote high-caliber fundamental and applied research, as well as education and extension activities. Despite its critical purpose, AFRI's estimated 2014 budget of $316 million is less than half of the $700 million authorized for AFRI in the 2014 Farm Bill. The same is true of SARE; the 2014 budget of $22.7 million is only slightly more than a third of the $60 million level called for by the National Research Council and authorized by Congress in every farm bill since 1990. These and other NIFA competitive grant programs, which emphasize multi-institutional and transdisciplinary projects that communicate results to end users, receive similarly weak levels of funding. The 2012 PCAST report recommended increasing AFRI's annual funding to $500 million.[22] AGree believes annual AFRI funding must be at least this level and that other competitive grant programs must similarly receive greater public investment.

c. *Expanding the universe of institutions* engaged in food and agricultural research and innovation. NIFA's competitive grant-making programs for research conducted by institutions external to USDA should be widely available to researchers unaffiliated with land-grant colleges and universities. These could include private colleges and universities, other publicly-funded institutions, and non-governmental organizations pursuing research and innovation goals in food and agriculture. As outlined in the 2014 Farm Bill, most non-land-grant institutions applying for NIFA competitive grant programs must secure matching non-USDA funds

for at least the amount of the grant.[23] While institutions can submit a request to waive this requirement, it is a cumbersome process that discourages non-land-grant institutions from applying for NIFA's competitive grants. The matching-funds requirement should be lifted in order to encourage a more diverse range of applications and ensure that grants are awarded to the most competitive, qualified research endeavors.

d. *Efficient grant application process.* In order to attract talent to food and agricultural research and ensure that needed research is conducted, NIFA must update and adjust competitive grant application processes. Due to the limited amount of funding available for competitive programs, many applicants are inevitably turned away, leading to frustration and concerns of wasted time among the research community. For example, AFRI's failure rate averaged roughly 87 percent from 2011 to 2014.[24] Some experts speculate that this may have contributed to the decline in the number of program applicants during 2014.[25] The application process must be adjusted to reduce unnecessary burden on applicants. For example, a preliminary review, following the letter of intent, could be established to reduce the number of candidates asked to submit a full application.

e. *Multidisciplinary approaches.* The complex challenges facing multiple facets of the food and agriculture system require new, transdisciplinary research and innovation processes: ones that cut across disciplines; involve multiple stakeholders, including producers and others throughout the supply chain; and leverage public-private partnerships. The public research enterprise should encourage these strategies in order to increase the efficiency, cost-effectiveness, and responsiveness of investments, as well as their ability to support systems research that addresses complex social and environmental dynamics. Such research projects, however, often require significant up-front funding to conduct outreach, engage stakeholders in dialogue, build trust, and identify priorities. Potential seed-funding mechanisms must be pursued and developed to address the current lack of support for the early stages of these collaborative projects.

8. Maintain U.S. leadership and engagement in international food and agricultural research.

Congress must maintain U.S. funding for the CGIAR system, appropriated to USAID through the Department of State, at least at the average level reached from fiscal year 2011-2014 ($120 million). In addition, U.S. assistance to national research entities in developing countries should support country-led efforts important for national and regional food security. Collaboration and exchange between U.S. land-grant colleges and universities and institutions in the developing world should also be expanded and strengthened. Governance of international food and agricultural research is a shared responsibility and one in which the U.S. should be prepared to participate fully.

9. Minimize duplicative efforts and unnecessary costs by assessing the value added from existing research infrastructure and improving grant monitoring and tracking systems to ensure that resources are well spent.

a. Systematic evaluation of the costs and benefits of operating numerous aging intramural laboratories and the many agricultural experiment stations across the U.S. would lay the basis for creating an efficient, modern research infrastructure that can meet 21st century needs. The assessment process could inform decisions to close, consolidate, revitalize, or build new, high-impact laboratories, as well as potentially expand the use of new data-gathering approaches that capture empirical experience on-farm, in a watershed, or in the value chain. The evaluation process must consider ways to reduce USDA's infrastructure costs while maximizing the capacity of high-performing, specialized, and region-specific labs to conduct

Strengthening Transdisciplinary Collaboration among Researchers, Producers, and Other Stakeholders

Transdisciplinary research processes that engage diverse stakeholders are more likely to result in high-impact discoveries and innovations that address the most pressing challenges and opportunities facing the food and agriculture system. They help ensure that findings and new technologies are applicable and available to producers by involving them in decision making, attracting multi-sectoral funding partners, and adapting and responding to local political, social, geographic, and economic circumstances. These collaborative research approaches also build human and institutional capital – magnifying and leveraging the long-term impact of research investments.

Successful multi-stakeholder engagement in research and innovation often requires:

- Funding to identify, convene, and engage an appropriate, broad, and equitable set of stakeholders;
- Trust and relationship-building to understand one another's objectives and leverage respective strengths;
- A well-articulated common goal;
- Sustained engagement of stakeholders with researchers to set priorities, provide feedback, and guide monitoring and evaluation that enables continuous improvement; and
- Incentive structures that encourage creativity and experimentation, permit risk-taking, and reward innovative discoveries, ideas, and developments.

cutting-edge and long-term research.[26] USDA has taken meaningful steps toward this goal, including the development of a Capital Investment Plan by ARS, per a request by Congress, and a similar plan created by APLU and member universities in consultation with the NIFA Director and USDA Chief Scientist; however, further efforts to assess and address infrastructure gaps and opportunities must be pursued.

b. Increasing transparency and accountability of grant allocation and monitoring techniques would enable USDA to better track research investments, intended outcomes, and actual outputs to effectively target investments. USDA's REE mission area must establish concrete metrics and objectives for both capacity and competitive research funding and assess progress toward objectives on a periodic basis.[27] AGree recognizes some recent USDA progress toward this goal: the Current Research Information System (CRIS) will soon be augmented with the Research, Extension, and Education Project Online Reporting Tool (REEport), enabling USDA to more easily track funding awards and project outcomes; and the STAR METRICS system currently used by several federal agencies and USDA mission areas will also improve USDA's ability to assess research strengths and gaps. Despite this progress, further improvements to grant monitoring and assessment are needed to ensure that federal resources are spent to maximum public benefit.

AGree's Implementation Plan

To mobilize efforts toward reforms outlined in the recommendations above, AGree will support three key actions:

1. **Convene a diverse coalition of leaders, including those not traditionally involved in agricultural policy dialogues, to identify and advocate for fundamental, long-term changes to the public food and agricultural research enterprise.** Issues that should be addressed include but are not limited to: revitalizing USDA intramural research infrastructure; increasing collaboration with other researchers across institutions, industry, NGOs, and government agencies; adjusting the balance of capacity and competitive grants, including increasing funding for competitive research grants; strengthening coordination among federal agencies that fund food and agricultural-related research; advancing public-private research partnerships; and strengthening linkages among researchers, extension agents, producers, and other stakeholders to both improve the research priority-setting process and increase the utilization of research outputs.

Significant increases in funding for food and agricultural research are unlikely in the absence of support from a broad coalition and far-reaching recommendations for reform.

Land-grant universities, farm and commodity organizations, and the private sector have historically played major roles in advocating for research and innovation funding. To successfully address the challenges and opportunities of the 21st century and increase federal funding, a new coalition must be assembled that includes organizations that have not typically been engaged in advocating for food and agricultural research funding, such as diverse industry representatives; community colleges; national, state, and local governments; and groups focused on nutrition, public health, rural economic and community development, the next generation of producers, conservation and environmental quality, global security, and international development. Reform efforts should also engage other federal agencies that fund food and agriculture-related research, including but not limited to HHS, USAID, DOI, NSF, DOD, DOE, and EPA. As this effort is pursued, it will be important to align messaging among the many groups advocating for reform such that a consistent, compelling case can be built and can translate information and priorities across organizations.

2. **Mobilize specific constituencies and build partnerships to shape and advocate for near-term changes to the U.S. food and agricultural research enterprise and USDA's REE mandate and practices.** Making a compelling case to increase public funding for research and innovation activities over the long term necessitates re-evaluating and streamlining the allocation and deployment of existing resources. While engaging in a longer-term reform effort, AGree sees opportunities for diverse stakeholders to advocate for near-term reforms that can be pursued within the next 12 to 24 months. Several specific near-term reforms could be pursued:

   a. Fostering greater Congressional ownership of and support for the U.S. agricultural research enterprise by holding public hearings focused on food and agricultural research and innovation challenges;

   b. Strengthening publicly-supported longitudinal data collection, stewardship, and analysis efforts by prioritizing those most critical and protecting them from federal budget cuts; and

   c. Repealing the matching funds requirement for NIFA's competitive grant programs, outlined in the 2014 Farm Bill, in order to encourage a more diverse range of applications and ensure that grants are awarded to the most competitive, qualified research endeavors.

d. Expanding incentives to participate in competitive grant processes. NIFA must adjust its competitive grant application processes to encourage more candidates to apply for funding. Potential modifications include establishing a multi-step process that would require full applications only from candidates successful in preliminary competitions.

Other general opportunities for near-term reform must be further explored by diverse interests, including: greater transparency in research priority-setting; increased competitive funding for transdisciplinary research, research processes that involve multi-stakeholder participation, and public-private partnerships; establishing a strong leadership role for the USDA Chief Scientist; improved tracking, evaluation, and measurement systems for extramural research; and increased public accessibility to research data and findings.

3. **Strengthen the ability of the new Foundation for Food and Agricultural Research (FFAR), outlined in the 2014 Farm Bill, to effectively engage multiple stakeholders in identifying research priorities and support public-private partnerships.** FFAR presents a promising opportunity to achieve immediate reforms to publicly-funded agricultural research, modeling the types of funding most needed to address emerging challenges and achieve economic growth. To successfully fulfill its mission of supporting research, innovation, and partnerships, FFAR could explicitly fund research informed by input from diverse stakeholders and guided by emerging models for transdisciplinary research. Notably, FFAR could provide the critical up-front funding needed to engage a range of stakeholders in dialogues to identify challenges, set and adjust research priorities on an ongoing basis, and monitor and assess progress.

[1]Peer-reviewed estimates range from a 50 percent expansion needed in crop production and 85 percent in meat production. For example, see, e.g., the World Bank, 2007, *World Development Report 2008: Agriculture for Development*, Washington, DC: World Bank. Others estimate a 70 percent increase in cereals production to a 100 to 110 percent increase in crop output. See International Assessment of Agricultural Knowledge, Science and Technology for Development, 2009, *Agriculture at a Crossroads*, Washington, D.C.: Island Press; and Tilman, David et al., 2011, *Global food demand and the sustainable intensification of agriculture*. Proceedings of the National Academy of Sciences U.S.A. 108 (50): 20260-20264.

[2]Major productivity gains prior to 1910 resulted largely from putting more land into production and increasing inputs and resources that improve productivity. More recently, economists attribute increased agricultural productivity to Total Factor Productivity (TFP), a combination of innovation and know-how. More importantly, future productivity will depend on innovation given the finite land and water resources within the U.S. and the world.

[3]Pardey, Philip G., Alston, Julian M., and Chan-Kang, Connie. AGree. 2013. *Public Food and Agricultural Research in the United States: The Rise and Decline of Public Investments, and Policies for Renewal*. Available at: http://www.foodandagpolicy.org/content/public-food-and-agricultural-research-united-statesthe-rise-and-decline-public-investments-a

[4]To garner increased public investment in food and agricultural research, federal agencies beyond USDA should invest additional resources toward food and agriculture-related research efforts. For example, the National Science Foundation's (NSF) fiscal year 2016 budget proposal would allocate $75 million to research at the nexus of food, water, and energy.

[5]Charles Valentine Riley Memorial Foundation and Iowa State University. 2014. *Pursuing a Unifying Message: Elevating Food, Agricultural and Natural Resources Research as a National Priority*. Available at: http://192.254.250.185/~swcs/wp-content/uploads/2014/12/FINAL-Unifying-Report.pdf

[6]The President's Council of Advisors on Science and Technology. 2012. *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*. Available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf

[7]Ibid.

[8]Shields, Dennis A. Congressional Research Service. 2012. *Agricultural Research, Education, and Extension: Issues and Background*. Available at: http://fas.org/sgp/crs/misc/R40819.pdf

[9]The President's Council of Advisors on Science and Technology. 2012. *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*. Available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf

[10]The total amount of public and private funding for food and agricultural research are available through the year 2009, as provided in the PCAST 2012 *Report to the President*. The USDA Economic Research Service (ERS) provides data through the year 2007 for total private funding and 2009 for total public funding (http://catalog.data.gov/dataset/agricultural-research-funding-in-the-public-and-private-sectors).

[11]The President's Council of Advisors on Science and Technology. 2012. *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*. Available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf

[12]AAAS R&D Budget and Policy Program. 2014. *Total R&D by Agency, 1976-2015*. Available at: http://www.aaas.org/page/historical-trends-federal-rd

[13]Ventura, Steve. AGree. 2013. *Reforming "Formula Fund" Distribution for USDA Funding for Research, Extension, and Education*. Available at: http://foodandagpolicy.org/sites/default/files/AGree%20REE%20report%20June2013.pdf

[14]Charles Valentine Riley Memorial Foundation and Iowa State University. 2014. *Pursuing a Unifying Message: Elevating Food, Agricultural and Natural Resources Research as a National Priority*. Available at: http://192.254.250.185/~swcs/wp-content/uploads/2014/12/FINAL-Unifying-Report.pdf

[15]The President's Council of Advisors on Science and Technology. 2012. *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*. Available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf

[16]CGIAR receives funding through the U.S. Department of State's appropriations to the U.S. Agency for International Development (USAID).

[17]Pardey, Philip G. and Beddow, Jason M. The Chicago Council on Global Affairs. 2013. *Agricultural Innovation: The United States in a Changing Global Reality*. Available at: http://www.thechicagocouncil.org/publication/agricultural-innovation-united-states-changing-global-reality

[18]Two *Point of View* papers commissioned by AGree (Niles, Meredith et al., 2013. *Strengthening the U.S. Agricultural Research, Education, and Extension System: A Reorientation Model to Address 21st Century Challenges*; and Porter, Marjorie and Steve Ventura, 2013. *Improving Information Management at USDA to Support Research, Education, and Extension*) highlight the need for articles and data produced through publicly-funded research to be openly available and accessible. Available at: http://foodandagpolicy.org/sites/default/files/AGree%20REE%20report%20June2013.pdf

[19]E.g., NIFA's Organic Agriculture Research and Extension Initiative (OREI).

[20]An AGree *Point of View* paper (Ventura, Steve. 2013. *Stakeholder Engagement in USDA Research, Extension, and Education.* Available at: http://foodandagpolicy.org/sites/default/files/AGree%20REE%20report%20June2013.pdf) argues for improved USDA stakeholder engagement and proposes bold new ideas for the REE advisory process. The author outlines components of effective stakeholder engagement, including: the involvement of a broader range of stakeholders oriented toward the public interest; enabling individuals not involved in advisory boards to engage through surveys, focus groups, and online mechanisms; better defining the scope and influence of advisory boards; supporting committees with adequate staff; documenting and sharing deliberations online; and periodically assessing advisory committees' activities and impacts.

[21]The PCAST 2012 *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise* states that capacity funds have been "critiqued for not efficiently stimulating high-quality research," and the report applauds universities that distribute their capacity funds competitively to "promote excellence and innovation." In addition, a *Point of View* paper commissioned by AGree (Ventura, Steve, 2013, *Reforming "Formula Fund" Distribution of USDA Funding for Research, Extension, and Education*) argues that capacity funds can sometimes support low-impact and/or duplicative research, as they "are substantially based on population statistics … not on variables related to agricultural production or value, resources management, Extension or research needs, or other priorities from an REE perspective." This *Point of View* paper proposes ideas for a long-term grant program that could replace current capacity funding.

[22]The President's Council of Advisors on Science and Technology. 2012. *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*. Available at: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf

[23]See Section 7128 of the Agricultural Act of 2014 (known as the 2014 Farm Bill). Available at: http://www.gpo.gov/fdsys/pkg/BILLS-113hr2642enr/pdf/BILLS-113hr2642enr.pdf

[24]National Institute of Food and Agriculture. 2015. *National Institute of Food and Agriculture Response to National Research Council Report "Spurring Innovation in Food and Agriculture: A Review of the USDA Agriculture and Food Research Initiative Program."* Available at: http://nifa.usda.gov/sites/default/files/resource/nifa_response_to_nrc_report_fnl_jan_08_2015_0.pdf

[25]National Research Council of The National Academies, Committee on a Review of the USDA Agriculture and Food Research Initiative, Board on Agriculture and Natural Resources, Division on Earth and Life Studies. 2014. *Spurring Innovation in Food and Agriculture: A Review of the USDA Agriculture and Food Research Initiative Program*. Available at: http://www.nap.edu/catalog/18652/spurring-innovation-in-food-and-agriculture-a-review-of-the?utm_source=NAP+Newsletter&utm_campaign=962653f9b4-Final_Book_18652_12_29_2014&utm_medium=email&utm_term=0_96101de015-962653f9b4-102710549&mc_cid=962653f9b4&mc_eid=c8eb456efc

[26]The USDA Agricultural Research Service's (ARS) Long-Term Agro-Ecosystem Research (LTAR) Network is a promising example of research sites dedicated to publicly-funded longitudinal data collection and analysis. The work underway at these facilities aims to help the U.S. meet 21st century challenges by understanding the long-term dynamics, characteristics, and resilience of agricultural systems. More information on the LTAR Network is available here: http://www.ars.usda.gov/research/programs/programs.htm?np_code=211&docid=22480

[27]An AGree *Point of View* paper (Niles, Meredith et al., 2013. *Strengthening the U.S. Agricultural Research, Education, and Extension System: A Reorientation Model to Address 21st Century Challenges*) proposes that USDA establish measureable, concrete benchmarks and objectives to track progress toward goals and help ensure that funds are not wasted.

Although all the individuals formally affiliated with AGree may not agree completely with every statement noted, they are committed to working together to find solutions to the challenges facing food and agriculture. AGree Advisors participated as individuals, not as official representatives of their organization.

About AGree

AGree seeks to drive positive change in the food and agriculture system by connecting and challenging leaders from diverse communities to catalyze action and elevate food and agriculture policy as a national priority. AGree recognizes the interconnected nature of food and agriculture systems globally and seeks to break down barriers and work across issue areas.

Co-Chairs

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