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A National Study of Capital Infrastructure at Colleges and Schools of Agriculture



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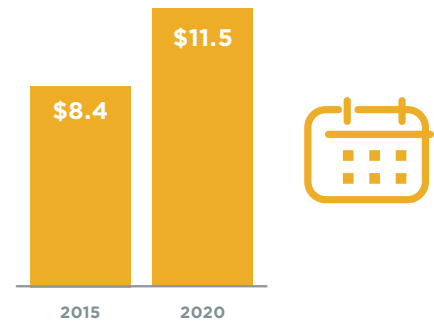
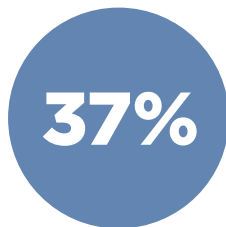
The Problem With Deferred Maintenance

ACROSS 97 INSTITUTIONS

2020
TOTAL DEFERRED
MAINTENANCE IS
ESTIMATED TO BE



BETWEEN
2015 AND **2020**
DEFERRED
MAINTENANCE
COSTS GREW BY



AS DEFERRED
MAINTENANCE EXCEEDS
\$100 PER GROSS
SQUARE FOOT (GSF)...



...building system
failures become
more likely



...day to day
operating costs
increase



...occupant
experiences are
impacted



...research
innovation &
impact are reduced



...building
reliability is
impaired



A Call to Support U.S. Agricultural Research Infrastructure

Douglas I. Steele, PhD, APLU Vice President of Food, Agriculture and Natural Resources



The land-grant university (LGU) system serves the nation by fostering excellence in research, delivering game-changing breakthroughs and training tomorrow's agricultural, food, nutrition and bioeconomy innovators. Our

enterprise accelerates technology adoption, growth of the agricultural and food marketplace, entrepreneurship and public-private partnerships. By doing so, we have supported American jobs, exports and economic growth – even as public sector funding for agricultural research lags behind that of our international competitors.

Still, the United States (U.S.) risks losing the ability to compete internationally if we ask our researchers and educators to conduct and deliver 21st century results in facilities from the 1950s and 1960s. Unfortunately, the challenges of aging infrastructure and deferred maintenance are now everyday conversations for many campus administrators. We have received reports from every type of institution that deteriorating facilities interrupt the pursuit of research and education excellence. These challenges on campuses are more than a nuisance: they are a national economic threat.

A 2015 study conducted by Gordian (formerly Sightlines) raised the alarm, identifying approximately \$8.4 billion in infrastructure and deferred maintenance needs across more than 90 institutions.¹ This need resulted from: 1) aging facilities constructed under lower quality standards and 2) under-investment in facility renewal and repair. In the 2021 update, Gordian assesses the state of facilities again, including additional institutions not in the original study, finding that 69% of the buildings

are at the end of their useful life. This update indicates that the cost of deferred maintenance upgrades is now \$11.5 billion, with a replacement value of \$38.1 billion. These pre-existing infrastructure shortfalls will only be exacerbated as we face new agricultural, weather, and supply chain challenges.

This report makes one thing clear: the problem will not go away unless we act and recommit to agricultural and food innovation. Modernizing agricultural research infrastructure will not only solve an existing problem; it will allow us to seize a new opportunity. According to Gordian, strategic federal investment in these facilities at 1862, 1890, 1994, and insular land-grant and non-land-grant schools of agriculture would create 200,000 new jobs nationwide. The jobs and growth created by bridging the infrastructure gap would provide a boost to communities suffering from economic downturn while simultaneously securing our strategic position as a global leader in agricultural science.

A nation that controls its food controls its destiny. The Association of Public and Land-grant Universities' Board on Agricultural Assembly calls upon Congress and the administration to provide resources to update the invaluable network of extramural research facilities via a grant program administered through the National Institute of Food and Agriculture.

Modern agricultural research and education facilities serve as the backbone of science solutions. Invest now to affirm U.S. leadership on climate change research and adaptation, agricultural profitability, food safety, zoonotic disease preparedness, personalized nutrition, biosecurity, new biobased packaging and energy innovations.

¹ Respondents included three types of land-grant university and colleges (1862, 1890, and 1994) and other non-land-grant universities.

Section 1: Introduction

Why study deferred maintenance at colleges and schools of agriculture?

The importance of agriculture to the prosperity and well-being of the United States cannot be overstated. Society faces immense challenges today, including climate change and economic disruption, which threaten access to safe, affordable food. Our agriculture research enterprise has risen to meet these challenges, consistently increasing productivity and access over the years.²

Colleges and schools of agriculture conduct cutting-edge basic and applied research while educating and training the next generation of agricultural scientists, business leaders, educators and producers. Every year, land-grant universities graduate more than 36,000 students in food, agricultural and natural resources disciplines. In 2019, agriculture and related industries contributed over \$1.09 trillion to the U.S. GDP, 5.2% of the total GDP.³ Our agricultural industry is responsible for 22.2 million jobs or 11% of U.S. employment.³ Food accounts for 13% of the average American households' expenditure in 2019, behind only housing and transportation.³

The success of U.S. food and agricultural industries can be attributed in large part to the advancements made in the research, education and Extension programs at colleges and schools of agriculture throughout the United States. The U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) provides \$1.57 billion annually in funding and grant programs for these extramural activities.⁴ This commitment is an acknowledgement of the grand challenges that colleges and schools of agriculture address through research, education and Extension. These challenges include food security and safety, climate variability and change, water availability and quality, the creation of a thriving bioeconomy (bioenergy and bio-based products) and combatting childhood obesity.

Colleges and schools of agriculture train the next generation of scientists, producers and educators to undertake both discovery-oriented and applied research to address these challenges. LGU faculty and staff conduct breakthrough research, training, and outreach in critical challenge areas related to biosecurity and pest/disease control, plant and animal genetics, climate soil resources, microbiomes, natural resource and forest management, bioeconomy development and food nutrition and access. Innovations, decision analytics and behavioral changes developed through research and education activities are then put in the hands of the people who need them most—farmers, communities, and our food and agricultural entrepreneurs—through effective rural and urban Extension programs. Yet the cost of the deferred maintenance in buildings and facilities at colleges and schools of agriculture threatens to undermine the success of our public institutions in meeting these public mission mandates.

Researchers and educators now perform 21st century science and education in facilities constructed in the 1950s and 1960s. These buildings and facilities—which are at the foundation of our nation's food, fuel, and fiber security and at the starting point of food and agricultural innovations—have not received capital infrastructure investment sufficient to avoid leaky roofs or to update air circulation and HVAC systems. The findings of this study reinforce an urgent call for federal investment in agricultural research infrastructure at our nation's colleges and schools of agriculture. As we describe in this study, federal investment would drive both short-term and long-term economic growth. We anticipate that 200,000 new local jobs will result from investment for capital infrastructure to address the deferred maintenance at colleges and schools agriculture.

2 <https://www.ers.usda.gov/data-products/agricultural-productivity-in-the-us/agricultural-productivity-in-the-us/#National%20Tables>

3 <https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/>

4 <https://nifa.usda.gov/sites/default/files/resource/NIFA-2018-Annual-Report.pdf>

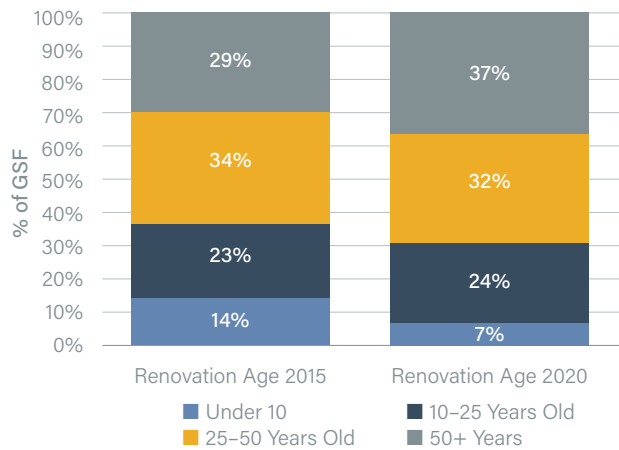
The rising demand for capital infrastructure investment

In its work with higher education institutions across the U.S., Gordian has identified several driving factors that project a substantial backlog of deferred maintenance and need for infrastructure investments above the already-elevated levels seen today. The following key drivers explain both the current backlog of deferred maintenance and capital infrastructure, and the risk that this backlog will markedly and rapidly increase.

- Age distribution of campus facilities.** Our research has identified specific points in time when a building's core mechanical, exterior and interior systems reach the end of their useful life and must be replaced. This generally begins as a building reaches 25 years of age and accelerates once that building's age exceeds 50 years. As more facility space falls in the 25 to 50-year and over 50-year categories, campuses are unlikely to have the funding to address all the systems that are coming due. As a result, maintenance on those systems are deferred to a later date. **69% of the infrastructure at colleges and schools of agriculture are >25 years (Figure 1).**

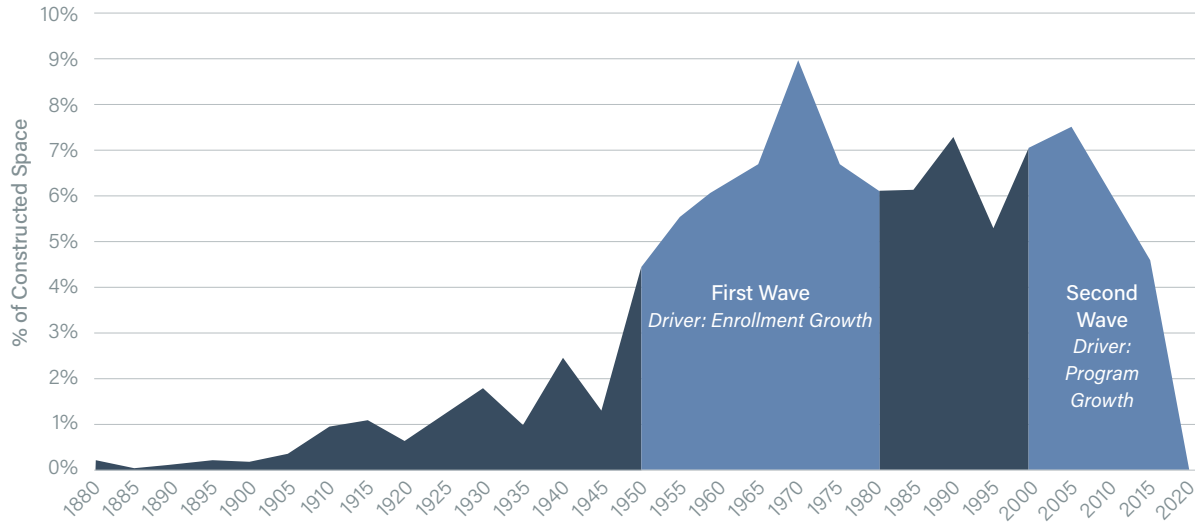
- Underfunding of capital infrastructure investments and major renovations.** When discerning investment needs for campus facilities, Gordian makes a distinction between “**keep-up**” and “**catch-up**” investments. “**Keep-up**” investments are the projects that ensure buildings will continue to perform properly, and that systems operate until the end of their useful life. “**Catch-up**” investments are the major infusions of capital, typically occurring into facilities that have not received sufficient “keep-up” funding over their lives, resulting in a major rehabilitations or renovations. We consistently see levels of “**keep-up**” funding that are inadequate and declining across higher education, leading to an increased number of projects being deferred. In addition, other funding is frequently focused on new construction projects, rather than on major renovations or “**catch-up**” needs, leaving older facilities to fall into ever-greater disrepair.

Figure 1. Schools of Agriculture Age Category Distribution Comparison



- Competition for funding between legacy buildings and modern buildings.** Two distinct waves of building construction that occurred in higher education over the last 150 years. *The first wave, legacy buildings, were built between 1950 and 1980.* These buildings represent a majority of the buildings that still exist on campuses today. These facilities were constructed at a time when campuses were expanding dramatically. Over the last 50 years, these buildings have played a crucial role in support of key programs in plant breeding; soil health; conventional and organic agriculture; human health and nutrition; and watershed, fishery and natural resource science at each institution. Yet many of these facilities are nearing the end of their useful lives. These buildings require substantial investments to meet their current and future needs. *The second wave, modern buildings, were constructed after 2000,* and represent high-quality, but also highly complex buildings. Many of these facilities were added to campuses to meet the increasing facilities demands of 21st century research. These facilities have complicated components that are expensive to replace. Within the next five years, this wave of buildings will also cross the 25-year age mark, driving costs up as a large portion of the complex components exceed their useful life. Facilities at colleges and schools of agriculture are made up of 40% and 18% in legacy and modern buildings, respectively (Figure 2). It is

Figure 2. Schools of Agriculture Waves of Construction



unlikely that either group will receive enough funding to stem the increase in deferred projects, since both groups of buildings require capital investment at the same time.

These three drivers are firmly in place across colleges and schools of agriculture in the U.S., making it likely that

deferred maintenance risks will become more acute over the next 10 years. The goal of this report is to understand the current size of the deferred maintenance problem, how it has changed, and its root causes, to raise awareness of the urgency of the problem and develop effective strategies to transform the risk of failure into an opportunity for growth.

Section 2: Methodology

This study includes only buildings and supporting facilities at colleges and schools of agriculture that are authorized to receive USDA NIFA funding. Throughout the course of the two studies, we have collected standardized data on over 16,000 buildings and 95 million gross square feet across 97 institutions. The information collected for each facility includes size, function, technical complexity, construction year and renovation year. We have compiled all this data into a database of deferred maintenance studies that Gordian (formerly Sightlines) has completed at more than 150 campuses. Compiling this information into a single database has allowed us to amass one of the largest

Figure 3. Total Deferred Maintenance Need (Billions of \$)

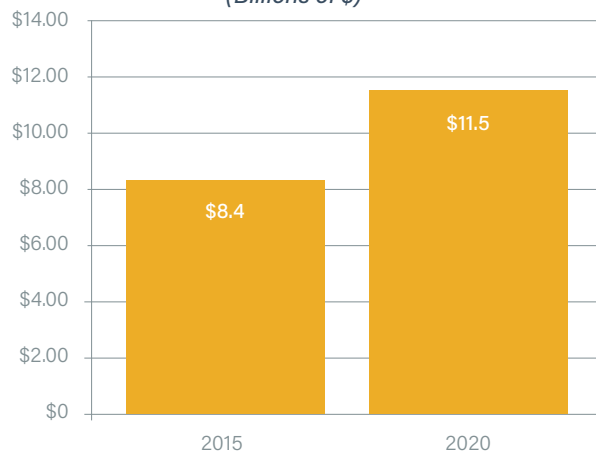
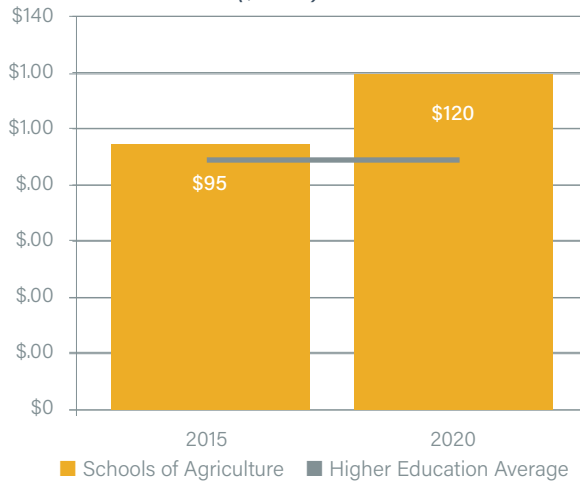


Figure 4. Total Deferred Maintenance Need (\$/GSF)



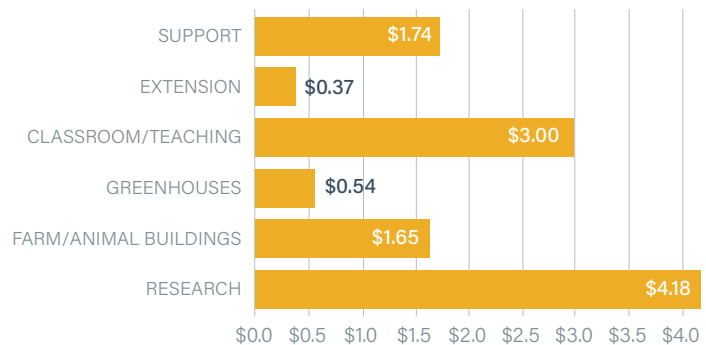
databases of building level details for U.S. colleges and schools of agriculture research, classroom/teaching and Extension facilities. We estimated the current level of deferred maintenance and capital infrastructure investment needs using this database.

Section 3: Summary of Findings

According to our analysis, the 2020 deferred maintenance estimate across the 97 institutions is \$11.5 billion. The total replacement value of the same facilities is \$38.1 billion. The \$11.5 billion figure represents a growth of approximately 37% since the previous study in 2015 (Figure 3). The growth over these five years can be attributed to both the increasing cost of capital infrastructure investments (inflation) and to additional projects being deferred due to the drivers discussed above. Ultimately, looking at this figure on a per gross square foot (GSF) basis makes it possible to compare it to industry benchmarks. At \$120 per GSF, colleges and schools of agriculture have exceeded our higher education national average (Figure 4). Gordian data indicates that as deferred maintenance exceeds \$100 per GSF, building system failures become more likely, day to day operating costs increase, occupant experiences are impacted and building reliability is impaired.

Our data differentiates spaces across colleges and schools of agriculture based on the functional classification of each building. The space surveyed

Figure 5. Deferred Maintenance Costs for Space Classifications (Billions of \$)

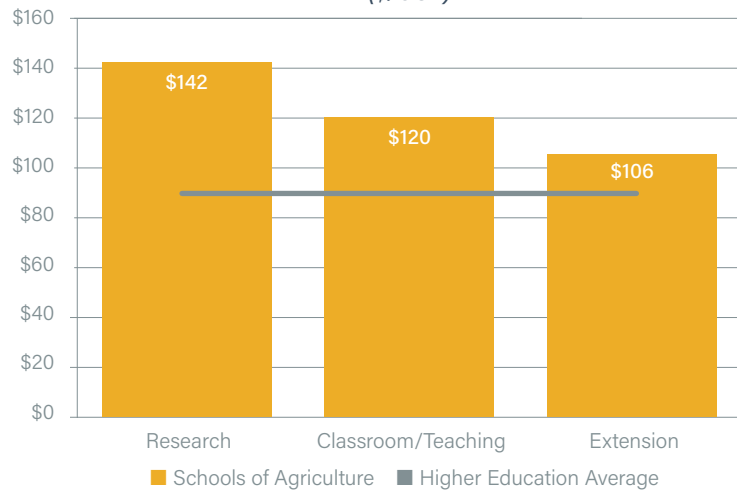


is made up of 31% research space, 26% classroom/teaching space, and four percent Extension space. The remaining 39% is distributed between farm, support, and greenhouses.

Research, education and Extension facilities are critical to the land-grant university (LGU) system mission mandate. At the colleges and schools of agriculture, these facilities exist on main campus and outlying stations. According to our analysis, \$7.5 billion (or 66%) of the deferred maintenance identified falls within the research, classroom/teaching, and Extension space

classifications (Figure 5). However, the expansive state networks of experimental farms, greenhouses and support facilities make agricultural innovations possible through the State Agricultural Experiment Stations, 1890s institutions and Tribal Colleges. These facilities are essential to all production innovations, breeding, animal husbandry and veterinary science, bioenergy, climate and nutrition research because they exist at locations that are geographically relevant to each state's producers and communities. Experimental farms and facilities house faculty and staff who also perform outreach to growers in the region. While the farm/ animal buildings and greenhouse spaces only represent about \$2.1 billion of the total amount of deferred maintenance, they are paramount to excellence in agricultural and food research. Opportunities exist to expand these facilities to reach more local producers and innovators.

Figure 6. Total Deferred Maintenance Need (\$/GSF)



Considering the data on a per GSF basis, research is at \$142 per GSF, classroom/teaching at \$120 per GSF, and Extension at \$106 per GSF—all well above the school of agriculture average and the national average (Figure 6). This further confirms the risk of research, classroom/teaching, and Extension interruption or impact due to deferrals of maintenance.

Section 4: Strategies for Change

This study indicates that the deferred maintenance problem at colleges and schools of agriculture will only continue to grow in magnitude and urgency. Despite efforts made by some institutions to implement strategies to stem this growth, the continued aging of facilities, lack of funding to address capital infrastructure and competing demands between different eras of construction have led to a 37% increase in deferred maintenance need in five years. The Gordian database analysis suggests that the severity of the deferred maintenance problem at colleges and schools of agriculture will become more acute absent significant action from policymakers and stakeholders.

To turn the tide on this deferred maintenance problem, efforts will have to address the need to **catch-up** on the deferred maintenance that exists today while

simultaneously establishing an approach to **keep-up** with future capital infrastructure renewal. This balancing act can be exceptionally difficult due to the need to coordinate funding and efforts between many different institutions, administrators, agencies and government bodies.

Investment in catch-up is needed. An immediate, targeted, and substantial investment of approximately \$11.5 billion is needed for the renewal and reinvestment of existing agricultural research and education facilities.

- The colleges and schools of agriculture support federal and state research and innovation. Due to the magnitude and urgency of the situation, any successful effort to address the current problem will require investment by the federal government.

- States also have a role to play in supporting their colleges and schools of agriculture. A matching program between states and the federal government presents a promising approach to marshal the amount of funding required to address this problem.
- A large infusion of federal government funding contingent on some ongoing state funding to support these facilities long into the future may also be an option.

A plan for upkeep is needed. An immediate investment of funding will have dramatic effects and create significant benefits to the institutions and communities receiving it. We advise campuses, government entities and stakeholders to develop a plan for routine maintenance and repair that will foster ongoing research and educational excellence.

- This plan will provide a framework for understanding how the campus is going to set funding priorities, target major renovations over time and determine conditions for demolition and/or divestment of existing buildings.
- Campuses can use that plan to steward new or newly renovated facilities via proactive maintenance programs. This planning will put a process in place to secure recurring funding for maintenance and repair. Gordian research suggests that \$1 dollar spent on preventive maintenance can equate to \$3-4 dollars in reactive maintenance, when deferral results in a failure.⁵
- **Our analysis suggests that colleges and schools of agriculture will require a sustaining annual investment of approximately \$550 million each year just to keep deferred maintenance from growing.** A successful long-term strategy will address the immediate \$11.5 billion while identifying

sources of funding that can grow over time to address the \$550 million that we anticipate is needed on an annual basis.

Capital Infrastructure investment benefits the local communities. The economic impact of a \$11.5 billion investment would extend far beyond just improving the facilities and student, faculty, and staff experiences of those at the colleges and schools of agriculture. We estimate that approximately 200,000 new local jobs would result from funding capital infrastructure investment to address the deferred maintenance identified in this study.

As Josh Bivens, Director of Research at the Economic Policy Institute, discusses in his report on employment multipliers for the U.S. economy, *"Each industry has backward linkages to economic sectors that provide the materials needed for the industry's output, and each industry has forward linkages to the economic sectors where the industry's workers spend their income. Therefore, in addition to the jobs directly supported by an industry, a large number of indirect jobs may also be supported by that industry. The subtraction (or addition) of jobs and output in industries with strong backward and forward linkages to other economic sectors can cause large ripple effects."*⁶ Our calculation of 200,000 new jobs is derived from Bivens research.

Due to the presence of colleges and schools of agriculture throughout the country, the distribution of their facilities across states, and the presence in both rural and urban communities, investments in capital infrastructure across colleges and schools of agriculture will have incredible impacts. Such investments will not just sustain the research, education, and Extension activities, but can be a driver of economic growth and development in many communities across the U.S. that rely heavily on local universities, research stations and/or Extension centers for information and innovations.

5 Sightlines, *State of Facilities in Higher Education-2015 Benchmarks, Best Practices & Trends*, Guilford, Connecticut.

6 <https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/>

Conclusion

Building maintenance expenses at colleges and schools of agriculture are the result of aging buildings, scarce funding and increasing building complexity. This report estimates that **catching up** and **keeping up** the U.S. food and agricultural research infrastructure at colleges and schools of agriculture around the country will require federal investment and planning.

The U.S. structure of national, state, and local research and outreach provides a significant return on investment (ROI). International research from the Organisation for Economic Co-operation and Development (OECD) indicates that agricultural research investments result in \$10-\$20 in benefits for every \$1 spent on research depending on the nature of the applied research (or a 20-60% internal rate of return).^{7,8,9} Investing in food and agricultural research can generate growth in the GDP and increase agricultural sustainability and productivity. In constant dollars, current public investment in

agricultural research and Extension is below 1980s levels. Meanwhile, investments by our competitors are growing rapidly.¹⁰ In 2016 alone, China outspent the United States in agricultural research investment by \$3 billion.¹¹

The U.S. can cultivate a new era for agricultural research and bio-based innovation. Strategic investment in agricultural research facilities aimed at catching up with deferred maintenance costs estimated at \$11.5 billion and keeping up with an annual investment of \$550 million will allow us to regrow our agricultural innovation enterprise to address the issues of today. These investments can benefit farms of all sizes, improve health outcomes for all communities and foster innovations that stimulate local and global economic growth. We estimate that such an investment will have long-term economic growth implications and provide an estimated 200,000 new jobs. There is no time to lose.

7 OECD Food and Agricultural Reviews Innovation (2016). *Agricultural Productivity and Sustainability in the United States*. OECD Publishing. ISBN: 9264264124, 9789264264120.

8 Heisey PW and Fuglie KO (2018, May). *Agricultural Research Investment and Policy Reform in High-Income Countries*, ERR-249, U.S. Department of Agriculture, Economic Research Service.

9 Baldos UL, Viens FG, Hertel TW, and Fuglie KO (2018, July) *R&D Spending, Knowledge Capital, and Agricultural Productivity Growth: A Bayesian Approach*. *Amer. J. Agr. Econ.* 101(1): 291–310; doi: 10.1093/ajae/aay039

10 Mohamedshah F, Havlik S, and Velissariou M. (2020, January.) *Food Research Call to Action on Funding and Priorities*. IFT.

11 Beintema N, Pratt AN, Stads GJ (2020, September) *Key Trends in Global Agricultural Research Investment*. IFPRI

About Gordian

Gordian (www.gordian.com) is the leader in facility and construction cost data, software and services for all phases of the building lifecycle. A pioneer of Job Order Contracting, Gordian's solutions also include proprietary RSMeans data and Sightlines Facility Intelligence Solutions. From planning to design, procurement, construction and operations, Gordian's solutions help clients maximize efficiency, optimize cost savings and increase building quality.



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