American Farmland Trust

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Department of Research, Education, and Economics
United States Department of Agriculture

Re:

Docket No. USDA–2020–0003
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Solicitation of Input From Stakeholders on Agricultural Innovations

Dear Secretary Perdue,

The Agriculture Innovation Agenda sets forth an ambitious goal for American agriculture that couples increased productivity with decreased environmental impacts. American Farmland Trust (AFT) believes that this future is not only possible, but essential if we are to feed a growing population while protecting the environment. We thank you for the opportunity to contribute to this process.

Founded in 1980, AFT is the only national organization that takes a holistic approach to agriculture, focusing on the land itself, the agricultural practices used on that land, and the farmers and ranchers who do the work. Because of this diversity of perspectives, AFT is uniquely positioned to offer recommendations for research and innovation that will have cross-cutting impacts on agriculture and the environment.

AFT has a vision for agriculture in the year 2050: America's agricultural land base is secure and the most threatened land—especially the most productive, versatile, and resilient land—is permanently protected from development with agricultural conservation easements. American farmers can feed the increased population nutritious food without the need to convert additional land to agriculture. Farms are diversified, producing many crops and products over the course of the year, and conservation practices such as cover crops and no-till are the norm. Producers are considered valuable stewards of the environment, and they are compensated not just for the food, feed, fiber, fuel, and timber that they produce, but also the ecosystem services that they provide – the carbon they sequester, water they purify, habitats they maintain, and the soil they protect and build. A diverse new generation of farmers can acquire farmland and contribute to a productive and regenerative food system. Farmers have easy access to government programs and technical assistance, and employ precision technology to optimize the use of inputs. Finally, farms are engaged in mitigating climate change, and are resilient to its effects.

AFT believes that achieving this future will require changes in policies and programming as well as societal priorities. However, the first step towards many of these changes is to address research and technology gaps. Capitalizing on a new generation of scientific opportunities will allow greater adoption of practices proven to benefit farmers, the environment, and society as a whole. Many of the recommendations below are based on

the belief that the increased adoption of conservation practices will be necessary to achieve the Agenda's goals. Conservation practices, such as cover cropping and no-till, support more consistent agricultural yields, make farms more resilient to climate change, sequester carbon in the soil, and improve water quality. In short, conservation practices present a simple, cost-effective, and familiar technology for achieving the Agenda's goals.

As stakeholders shape and advance this research and technology Agenda, AFT underscores the importance of taking a farm-focused "bottom-up," rather than "top-down" approach. This means working directly with farmers to identify their needs and create tools that will ultimately be used in the field. It also means recognizing that no two farms are identical. The American agricultural landscape is incredibly diverse, with nearly infinite permutations of climate, production systems, topography, scale, producer demographics, etc. The Agenda must take into account this diversity that makes American agriculture what it is today, with research and technology that is applicable to as many of these permutations as possible.

The Agenda must also account for the fact that a farmer is constantly juggling their numerous roles as business owner, agronomist, veterinarian, mechanic, and more, meaning that many have limited time and opportunity to learn new techniques, or try out new technologies. In addition, farming is a risky business, and producers can be reluctant to steer away from tried and true methods, even if the science is sound. As such, any innovation will require specialized technical assistance and producer education in order to ensure consistent, long-term adoption.

AFT's recommendations are presented within the "Systems-Based Farm Management" innovation cluster. However, given that agriculture is a complex and integrated system, many of our recommendations also relate to the other three innovation clusters. In addition, our own subcategorization scheme has been added to improve readability. Please note that these recommendations are not intended to represent a comprehensive list of AFT's research and technology priorities.

Conservation Practice Research

Recommendation #1: Research the ability of conservation practices to sequester atmospheric carbon into agricultural soils

Although there has been a wealth of research on this subject in recent years, more is needed to determine the rate and magnitude of carbon sequestration from agricultural conservation practices (e.g., no-till, diversified crop rotations, and rotational grazing), including for how long carbon can be held in the soil. In addition, this research must be highly region-specific, and take into consideration factors such as weather, soil type, and cropping system if applicable. There must also be further efforts into the development of standardized research protocols for determining rates of soil carbon sequestration, such as preferred soil sampling depth, timing, and methods so different studies can be better compared and a comprehensive body of research can be built.

These data will be necessary to equip producers, technical service providers, and other third parties with clear science on the most effective practices for carbon sequestration. This research will also inform the development of government programs and policies, as well as private and public carbon markets. These

markets can serve as an additional source of revenue for producers and have the potential to be a driving force in on-farm carbon sequestration.

Recommendation #2: Study the effects of conservation practices on environmental, social, and economic outcomes

In addition to carbon sequestration, agricultural producers provide many other environmental services to society, such as wildlife habitat, water filtration, aquifer recharge, and flood prevention. However, additional research is needed to better understand the direct relationship between conservation practices and environmental benefits. This research should include the effects of stacked practices, such as the use of both no-till and cover crops, because these practices are often not used in isolation. Specifically, the various benefits and tradeoffs of each conservation practice should be quantified, as well as the marginal benefit of each additional acre engaged in a given practice.

Although there is a need for new research and technology, there is an equally pressing need for the continuous improvement of existing technologies. Outcome quantification and decision support tools, such as COMET-Planner or USDA's Nutrient Tracking Tool (NTT), or other models and tools that capture landscape management such as the Operation Tillage Information System (OpTIS), need more data to be fully calibrated to maximize their effectiveness nationally. This could be achieved through the development of scattered research sites that engage in simultaneous research on region-specific environmental impacts of conservation practices. Without regionally calibrated models, modeling outputs could be inaccurate, leading to less effective policy recommendations, imprecise ecosystem service quantification, or ill-informed on-farm decisions. These tools also need to be better integrated with other tools and data sources, and seamlessly incorporate spatially explicit data on soils, topography, local climate, and other variables that affect model outputs.

It is especially important for this calibration of models to be effective at the watershed level. Because water quality monitoring can be prohibitively expensive, watershed managers would be best served by well-calibrated models that provide accurate guidance on the anticipated benefits of practices to achieving specific watershed goals.

Additionally, there is a need for economic research to determine the benefit to society associated with conservation practices. For instance, how does society as a whole benefit from the additional flood prevention provided by an additional acre of no-till agriculture? This would consist of quantifying both the direct economic impacts of conservation practices (e.g., the marginal flood prevention benefit of an acre of cover-cropped farmland), the social value placed on these benefits (e.g., the willingness to pay for each acre of no-till cropland), as well as the direct impacts of conservation practice adoption on communities (e.g., additional jobs, income stability, higher incomes).

Better quantification of the environmental and social benefits of conservation practices will help inform ecosystem services markets, where producers are compensated for the services they provide, as well as government programs and policies. It will also help demonstrate to the public the potential benefits farming can provide to the broader environment and the return on the public's investment. It should be noted that USDA's Conservation Effects Assessment Project (CEAP) represents an important step toward many of these outcome quantification efforts.

Recommendation #3: Research the risk-reduction benefits of conservation practices

Because of its widespread use, crop and whole-farm insurance plays a significant role in shaping decision-making in American agriculture. However, crop insurance can serve as a potential impediment to some conservation practice adoption because only a set list of practices are allowed on insured cropland, and those practices are highly regulated. For instance, specific rules regarding planting and termination dates can impede cover crop adoption. While these rules are changing to provide greater flexibility for producers, additional work must be done.

Improved research on the risk-reduction benefits of conservation practices (such as the flood and drought mitigation potential of no-till and cover crops) could enable insurance companies to more accurately account for the benefits of conservation practices within rate structures, thereby offering an incentive to farmers who proactively reduce risk. While incentives are already in effect in Iowa and Illinois, additional research will enable practices to be fully integrated into insurance.

Incorporating the risk-reduction benefits of conservation practices into actuarial tables will encourage practice adoption, while saving producers money on insurance premiums. Additionally, farms will become more resilient to unexpected weather events, such as those predicted to accompany a changing climate.

Land Use Research

Recommendation #4: Examine the climate, environmental, and social benefits of permanent farm and ranchland protection

As the only agricultural land trust that operates nationally, and as the primary NGO advocating for farmland protection, AFT recognizes the unique importance of land protection to maintaining a stable, sustainable, and productive agricultural economy. Without a dramatic increase in permanently protected agricultural land – especially of our most productive, versatile, and resilient land – the Agenda's goal of increased production will be difficult to achieve.

In addition to researching the benefits of land protection on food production, AFT recommends research into the climate and environmental effects of land protection. This includes building upon the research begun by AFT's "Greener Fields" studies[1] which explore the connection between farmland protection, compact development, and avoided GHG emissions. Efforts should also be expanded to evaluating the effects of farmland protection on other environmental factors, and the associated social benefit. For instance, agricultural land captures and retains water, leading to significantly less runoff than from impervious surfaces like cement. Because of this, agricultural land can help to mitigate flooding in downstream communities, avoiding costly flood damages. Well-managed agricultural land can also provide surface water filtration, which can reduce the need for expensive downstream water filtration systems, and groundwater recharge. All of these benefits should be quantified to better inform land-use planning and agricultural land protection efforts.

[1] American Farmland Trust. "Greener Fields: Combatting Climate Change by Keeping Land in Farming in New York." https://s30428.pcdn.co/wp-content/uploads/sites/2/2019/09/AFT_NY-GrFields-RPT_FNL2lo.pdf.

Additionally, open farmland, especially in highly developed areas, provides cultural and educational opportunities, scenic beauty, wildlife habitat, and other benefits that communities value. There should be greater social accounting of these public goods. Such research will help highlight the importance of farmland protection as a tool for maintaining not only food production, but also environmental and social outcomes.

Recommendation #5: Study systems that beneficially integrate solar energy and agricultural land

As the economy moves toward renewable energy and farmers seek opportunities to diversify their operations, there will be increased pressure to site solar panels on agricultural land. AFT supports the siting of renewable energies on farmland, as long as agriculture is not displaced, especially on the nation's most productive, versatile, and resilient lands.

There are, however, uncertainties about how agriculture and energy can be best integrated. More research must be conducted to identify crops that are compatible with solar arrays, such as identifying shade-tolerant crop varieties by determining their Photosynthetic Active Radiation (PAR) requirements. Alternative production systems should be researched and identified that take advantage of the diversity of lighting conditions created by solar arrays. This could include intercropping shade-loving species with those that require full sun, or integrating livestock into solar fields.

Research is also needed regarding the hydrologic impacts of solar panels on the surrounding plants, namely the effects on plants in the "rain shadow," as well as the plants that receive higher levels of precipitation due to run-off. There should be additional research into ways to improve solar array design to increase the amount of solar radiation captured by the plants below or making it easier to share the land with crops or livestock. This could include raising panels further off the ground or increasing spacing. Finally, there should be research into opportunities to create solar installation systems that allow the land to be easily reclaimed for agriculture, such as panels that do not require deep footings.

Better research on various aspects of dual-use siting will allow farmers to take advantage of the financial benefits of solar arrays, while not jeopardizing their ability to produce agricultural products.

Agronomic and Soil Research

Recommendation #6: Support further research on improved crop varieties and best management practices to support conservation practices

Despite the conservation and climate benefits of cover crops, they are only planted on about 4% of US cropland.[2] To make cover crops easier and less risky to implement, there should be increased research into the development of varieties more compatible with cash crops. This could include developing and identifying cover crops that are easier to incorporate into typical cash crop rotations, while still providing adequate soil cover and reducing nutrient leaching and runoff. Additionally, there should be research on: novel cover crop species that self-terminate before the cash crop is planted; delayed germination cover crops that could be seeded with the cash crop, germinating just prior to harvest; and technology to protect cover crop seeds to ensure that

[2] American Farmland Trust. 2017 Census of Agriculture Fact Sheet. https://s30428.pcdn.co/wp-content/uploads/sites/2/2019/11/AFT_FIC_CensusOfAg2017_FINAL.pdf.

germination is not affected by residual herbicides applied earlier in the growing season. Any innovation to make cover cropping more convenient would help increase adoption.

Because of their deeper root systems, perennial crops like Kernza® intermediate wheatgrass, generally require fewer inputs such as fertilizer or water. These crops can provide consistent soil cover, thereby supporting soil health. Additionally, once established, perennial crops often take less labor. Developing and deploying additional perennial crops could improve environmental outcomes, but both germplasm and agronomic management practices must be improved to increase yields. Pest resistance should be prioritized, since perennial crops must persist for multiple years without the benefit of crop rotation. Similarly, the possibility of multi-perennial rotations and perennial polycultures should be explored.

New research is needed to expand opportunities for double cropping, which is when a field produces both a summer and fall cash crop. With double cropping, the soil would be covered nearly all year long, and the farmer would sell two crops instead of one, potentially improving both conservation and economic viability. There should be research and development of region-specific double cropping systems and cultivars with associated Best Management Practices. A particularly promising approach is the development of winter-annual "cash cover crops" such as camelina and pennycress, which provide the benefits of a winter cover crop and a cash crop, along with the possibility of double cropping, even in northern latitudes. Research should also include the development of systems best suited for livestock, such as which crops are best to graze or harvest for animal feed.

Finally, there should be greater research on the effects of climate change on all cash and cover crops, with the understanding that as the climate warms, the ideal production area for crops will gradually shift. In order to use resources efficiently, it will be critical that production systems adapt to new weather patterns and average temperatures, either by changing crop species or varietals, or by implementing new practices to make a crop more resilient to the effects of climate change.

Recommendation #7: Conduct research examining the complex relationships between plants and the soil microbiome

One of the frontiers in agricultural research is the complex interrelationship between plants, soils, and the microbiome that links the two. The microbiome drives many of the critical functions of soil, such as carbon sequestration and nutrient cycling, and thus exerts heavy influence on plant function and resilience or susceptibility to external stressors such as disease and drought. A greater understanding of the microbiome and the potential of "biofertilizers" could allow farmers to increase crop resilience and yield while reducing their reliance on traditional inputs such as water and nitrogen fertilizers.

There is a significant opportunity to research the ability of plants to influence the microbiome, and for the microbiome to influence plants. For instance, how do different cropping systems or cover crop varieties support different microbial communities, and how does the microbiome work to improve drought resilience or increase carbon sequestration? Additionally, research is needed to compare and contrast the various potential benefits of the development of the full soil microbiome with technologies such as the use of microbiotic seed coatings.

Social Science Research

Recommendation #8: Improve information-gathering for the Census of Agriculture, TOTAL Survey, and National Resources Inventory

Additional publicly-accessible data must be gathered in order to present an accurate snapshot of the current state of the nation's agricultural system, including information on cropping systems, conservation practices, farmer demographics, production metrics, and more. USDA already collects data through various programs and surveys, such as Farm Service Agency programs and the National Agricultural Statistics Service's Census of Agriculture. These efforts, however, are not always well integrated, leading to an incomplete picture of the American agricultural landscape. It also makes it difficult to stack multiple variables such as farmer demographics, their operations, and the practices they engage in (e.g., determining how many female row crop farmers in Nebraska plant cover crops). Such analysis could help inform how to allocate limited resources and increase understanding of the various factors that influence producer decision-making. One key step would be making the Census of Agriculture as convenient and simple as possible to complete in order to encourage broader producer participation.

USDA's Tenure, Ownership, and Transition of Agricultural Land (TOTAL) survey, a component of the Census of Agriculture program, is another important tool in providing a more complete picture of American agriculture. With the most recent study released in 2014, this survey should be conducted every five years. In addition, subsequent TOTAL surveys should be expanded to cover all 50 states. This would enable analysis of land ownership trends, which could inform and assist in targeting farmland protection and conservation programs, financial incentives, and conservation practice education and outreach. It would also provide additional insights on agricultural landlords, especially non-operating landowners, and their attitudes on conservation practice adoption and succession of their land.

These enhanced demographic data must be integrated with data on land use and the environment. In particular, the National Resources Inventory (NRI) should be expanded to include more sampling locations, and funding should be provided to harmonize NRI and Census estimates of the land used for different agricultural purposes. Deploying automated data collection tools, such as unmanned aerial systems (drones), could increase the efficiency and coverage of the NRI, though on-the-ground sampling must remain the core of the program.

Recommendation #9: Conduct research on the best ways to encourage conservation and regenerative practice adoption

The research remains inconclusive on how to best to encourage agricultural producers to adopt conservation practices, since their decision-making is influenced by numerous factors. A better understanding of what motivates producers will enable programs and policies to be even more effective.

Research should be focused on at least two different areas. First, research should examine which policy and financial incentives are the most effective at encouraging conservation practice adoption, such as insurance rebates or cost-share programs. In addition to examining single mechanisms, research should also explore how different incentive mechanisms can work in tandem with one another. Second, research should examine which ground-level interventions are the most effective, such as peer-to-peer networking, education, and NRCS

engagement. This research will need to be conducted at the regional and local level, because motivations are likely to differ depending on many variables, including location and production system.

The more insight we have into how to increase adoption, the more efficiently and effectively government resources can be employed, and the more likely it will be that producers will adopt said practices.

Product and Technology Development

Recommendation #10: Develop affordable, accessible, scale-neutral conservation equipment

Many conservation practices require highly specific machinery which can be difficult to access due to availability or affordability. Development of low-cost, easily accessible implements for reduced tillage (e.g., no-till drills, strip-tillage bars, no-till transplanters), cover crop implementation (e.g., cover crop seeders), non-chemical crop termination implements (e.g., roller crimpers), and more, will remove a key barrier to adoption for many important practices that will increase productivity while decreasing an operation's overall risk and environmental footprint.

Additionally, many crops require highly specific machinery for planting and harvesting, which means that crop diversification requires up-front investments in new equipment. Developing multi-purpose machinery that can be used to plant, cultivate, or harvest multiple crops with minimal alterations will remove a barrier to diversification. Finally, there should be greater investments in the development of highly efficient tractors and other machinery, including scaling up electric vehicles and ensuring that they are competitively priced with combustion-engine vehicles.

Recommendation #11: Improve sensing technology to allow for fast and accurate data collection

Further development is needed of easily accessible technology that provides rapid, onsite, accurate soil and water testing, to get real-time data on field conditions and the impacts of conservation practices. In-field sensors would provide continuous data on soil carbon levels, nutrient availability, soil moisture, and other applicable metrics, while in-stream sensors would measure nitrates, dissolved phosphorus, and dissolved oxygen. Improved satellite data could also be used to better model erosion, and to determine field residue and cover cropping rates and locations. Additionally, there should be increased research into developing sensors for use on planting and harvesting equipment, to gather full-field data on soil health, including soil carbon content, moisture, nutrient content, and other information.

This innovation will increase the amount of field-level data collected, which will inform scientific modeling to better understand the impacts of agriculture practices on the immediate environment. This will also help facilitate carbon and ecosystem markets and will help to inform precision agriculture decision making that can reduce input costs for producers.

Recommendation #12: Advance technology for sustainable livestock management

There are also many research breakthroughs that could help livestock become more sustainable and reduce its environmental impacts. First, there should be greater research on natural, non-antibiotic feed additives that

would reduce the methane production of livestock while improving overall performance. For example, there are indications that kelp can serve as an effective methane-reduction additive, which has even spurred research sponsored by the Foundation for Food and Agriculture Research.[3] Feed additives could have a large climate impact, while requiring minimal changes in management.

Second, additional research is needed into the development of virtual fences for grazing animals. Virtual fences control animal movements through the use of wireless technologies and electric collars rather than fixed fences. This technology would allow producers to more easily exclude livestock from waterways, thereby improving water quality. It would also help producers engage in rotational grazing, especially if it were integrated with sensing equipment to determine forage quality and quantity. Rotational grazing is a widely accepted conservation practice that supports the health of ecosystems and the livestock themselves, and also has the potential to sequester carbon. Virtual fencing technology would help producers overcome rotational grazing barriers, such as the additional cost and management of frequently installing and moving temporary fence.

Finally, life-cycle assessment studies are needed to determine the climate impacts of various livestock production systems. For instance, there is currently a debate as to whether grain-based ruminant production has a lower carbon footprint (due to faster growth and lower enteric methane emissions), or whether grass-based production has a lower footprint (due to its greater potential for soil carbon sequestration). Systems-level research is essential to identifying the management factors that contribute most to overall sustainability.

Conclusion:

American Farmland Trust appreciates the opportunity to contribute to the development of the Agriculture Innovation Agenda and is grateful for your consideration of our recommendations. As an organization, we look forward to continuing our participation in this process and welcome serving as a resource for any questions. We thank USDA for its work to make American agriculture more productive and sustainable.

Respectfully submitted,

American Farmland Trust

[3] Foundation for Food and Agriculture Research. "FFAR Awards Grant to Reduce Methane Emissions from Dairy Cattle." https://foundationfar.org/2018/10/09/ffar-awards-grant-to-reduce-methane-emissions-from-dairy-cattle/.