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Subcommittee on Agriculture, Energy and Trade

Hearing on "Restoring Rural America: How Agritech is Revitalizing the Heartland"

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I would first like to thank Chairman Blum, Ranking Member Schneider and the members of the Committee for giving me the opportunity to testify on an important and timely topic: how technology can help revitalize rural America. My name is Michael Fernandez and I am a Senior Fellow with the Food Institute at George Washington University.

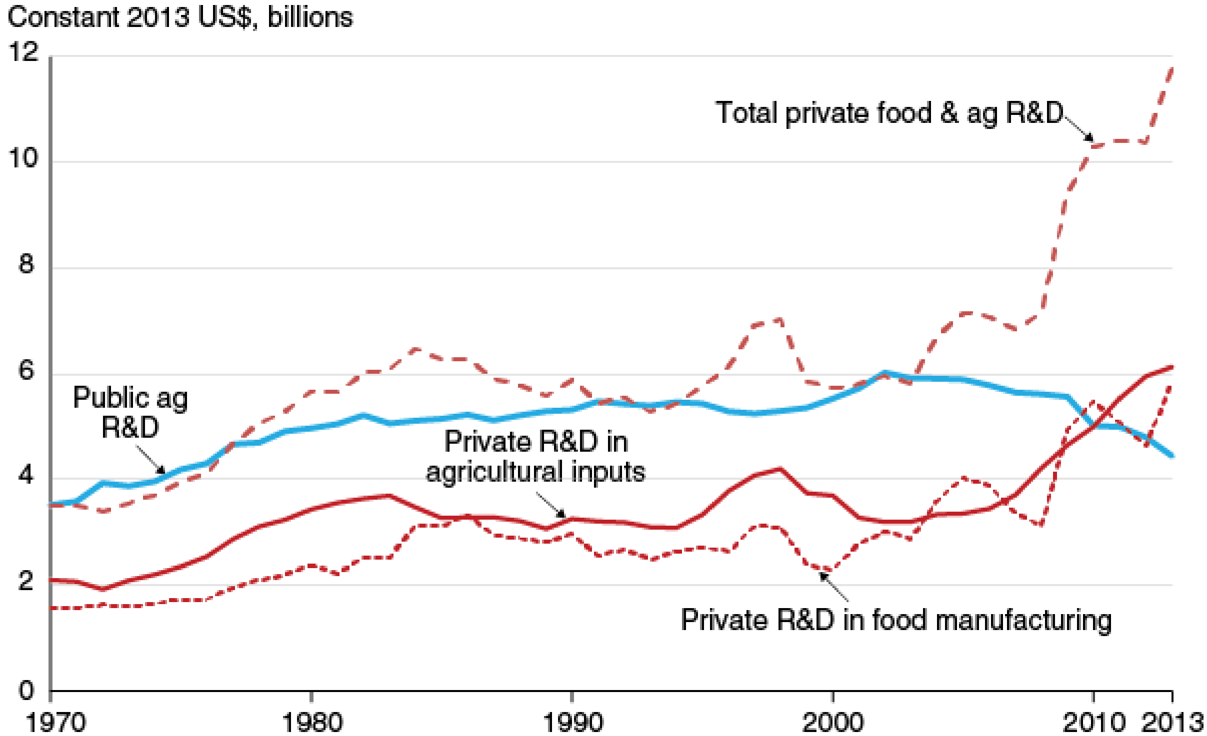
We live in an age of unprecedented technological advancement. I grew up at a time when the idea of a personal computer seemed like something out of science fiction. Today we all carry around devices that let us watch live as Chloe Kim flies through the air in Korea, or connect instantly with almost anyone on the planet, or buy almost any product with the touch of a finger and have it delivered to our door in 2 hours.

Agricultural technology is critical for the future of rural America, revolutionizing how our farmers, ranchers and foresters go about their business. Whether it's high tech, internet connected tractors used in precision farming or robotic milking machines or genetically engineered crops or "big data," technology now touches every aspect of farming and ranching. But even while technology has flourished, many rural communities have been left behind. Members of this committee know very well, for example, that 40% of rural Americans do not have high speed internet access. As we begin a national discussion about infrastructure, we need to be asking whether we are doing enough to support our agricultural science and technology infrastructure and whether that new technology is helping to build vibrant rural communities.

One thing that isn't up for debate is that supporting agriculture R&D is a great investment – the Economic Research Service says the rate of return on food and ag research can be as high as 60%. And we have seen private sector money flow into ag R&D and new agrifood technology startups like never before. According to the ERS, between 2008 and 2013, private ag R&D funding jumped 64% in real, inflation adjusted dollars.

Unfortunately, during that same time period public investment, including federal and state spending, dropped by about 20%. Public funding now accounts for less than 25% of all food and ag R&D funding in the US, and is at a level below where it was in the 1980's.

Private sector and public sector funding of R&D begins to diverge significantly in the early 2000s

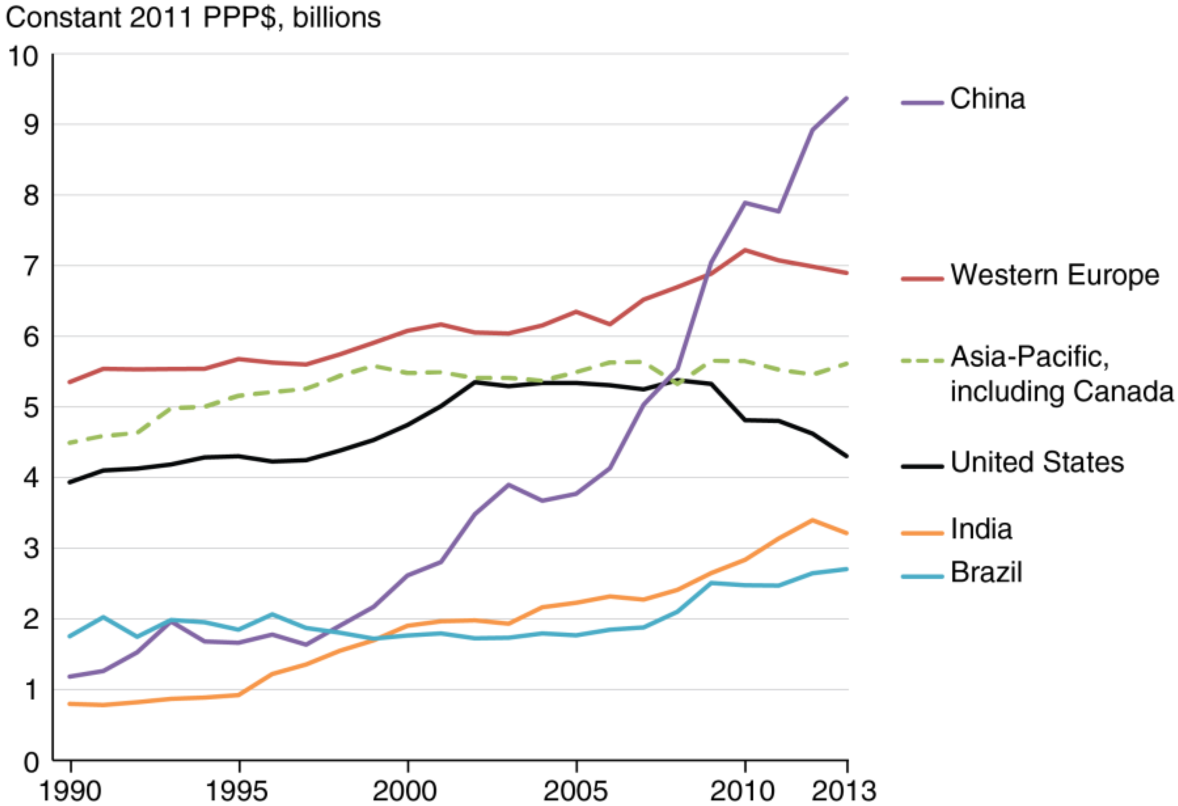


Annual spending on research is adjusted for inflation by a research price index constructed by ERS. R&D = research and development.
Source: USDA, Economic Research Service.

Private funding plays an important role, particularly in translating scientific breakthroughs into commercial products, but it is publicly funded research that has been the engine driving innovation. Public investment supports basic research that isn't driven by short short-term economic reward, and helps maintain the scientific talent pipeline that is critical for our future. The steady dwindling of this important part of the public infrastructure necessary to support vital, growing rural communities threatens our long term competitiveness.

The U.S. is, in fact, already falling behind our international competitors in terms of public support for ag research. China became the world's largest public supporter of ag research in 2008, and the Chinese government now invests about twice as much public funding in ag R&D as we do.

U.S. public sector funding for agricultural R&D falls as spending by China and India rises



PPP = purchasing power parity.
Source: USDA, Economic Research Service and Agricultural Science and Technology Indicators (ASTI), Organisation for Economic Cooperation and Development.

Today we are on the cusp of a new revolution in agricultural technology: gene editing. Gene editing is a suite of tools, the most well-known of which is CRISPR Cas-9 (and usually just referred to as CRISPR), that allows scientists to make precise changes at specific locations within the target plant or animal genome.

And it is this precision that gives gene editing its power and what differentiates it from earlier forms of genetic engineering. In the first generation of genetic engineering technology, which has yielded the GMOs that are so ubiquitous in American farming, large sequences of DNA, usually from another organism, are inserted into the target genome to confer the desired trait. That insertion happens at a random location within the host genome, which give rise to one of the biggest concerns about first generation GMOs: that the random insertion can lead to unpredicted and unintentional consequences. This is also one of the reasons why current GMOs require such extensive risk assessments and safety testing, to ensure that the end product doesn’t differ in any meaningful way from its conventional counterpart other than the desired new trait.

Gene editing works in an entirely different way. Derived from a kind of bacterial “immune system,” gene editing technology like CRISPR, allows scientists to target specific sequences within the host genome for changes. Those changes can include adding new genes, as we do with current GMOs, but also making targeted changes within the host genome itself. Scientists can make small changes at a specific location within the DNA sequence to knock out or alter the function of a given gene. Some have likened it to the “search and replace” function of a word processing program, where you can find the word you are looking for and change a few letters. There are questions about the level of specificity, including scientific reports that gene editing can result in “off-target” DNA changes outside the desired location, but it is this combination of relative specificity and the ability to make small changes within the target genome that gives gene editing the potential to be truly transformative.

Since the ability to use CRISPR in plants in was first demonstrated 2013, there has been a flood of gene editing research, with more than 50 scientific papers appearing in peer-reviewed journals and a number of companies seeking to develop new products using the technology.

DuPont Pioneer has used CRISPR technology to develop improved varieties of waxy corn, a type of corn hat already on the marketplace and that yields starch with unique properties for food and industrial purposes. As referenced earlier, U.S. researchers aren’t the only ones in the game: Chinese scientists have reported using gene editing to confer resistance to powdery mildew, a destructive fungal disease, in wheat. Scientists at Penn State have produced mushrooms that don’t brown when cut. Minnesota-based Calyxt has used a different form of gene editing to generate soybeans that create healthier oils, with levels of monounsaturated fats comparable to olive and canola oils. And new developments haven’t been limited to plants. Researchers at the biotech firm Recombinetics have used gene editing to create hornless cattle, potentially eliminating the need for the painful de-horning process.

Looking further into the future, exciting practical applications of CRISPR tools for sustainable agriculture can now be envisioned. Caribou Biosciences, the company set up by one of the original developers of the technology, has partnered with Pioneer-DuPont to work on drought resistant corn and wheat.

These are amazing technical achievements, but how will they contribute to revitalizing rural America? I’d like to offer four ways to think about this question:

Farmer bottom line First of all, and perhaps most obviously, these new technologies should contribute positively to farm income. One feature of gene editing technology is that it promises to be relatively easier and cheaper than earlier genetic engineering methods. That should, in theory, lead to lower cost products for famers. The relatively low cost and ease of use of CRISPR tools are also spurring research in academia and in companies of all sizes, essentially democratizing crop-trait development. If up-front costs are indeed lower that could create more incentive for companies to develop applications for lower volume crops like fruits and vegetables, and therefore bring benefits to a wider array of farmers.

Ownership Second, we must pay attention to how ownership of this new technology plays out. We are already seeing conflicts over who owns the underlying intellectual property rights to CRISPR, and the biggest ag companies are inking licensing deals with competing developers. A promising cross-licensing deal on ag applications of CRISPR that was struck late last year may ease those concerns. But as we see even greater concentration in the agritech industry, driven by economies of scale, there is a risk that the technology will be locked up in the hands of only a few large players. There are companies, like Benson

Hill Biosystems that are looking to bring the power of gene editing to smaller companies, including work on a so-called "CRISPR 2.0" that could bypass intellectual property fights, but it is important that we keep an eye on how this progresses.

Scale neutral As our farming population ages and a new generation of farmers and ranchers takes over, we must think about incentives for technology that will meet their needs. These younger farmers are likely to be even more technologically savvy than their predecessors, and open to new approaches, but they are also likely to be operating at a smaller scale. Most studies suggest that adopters of first generation biotech products have seen economic benefits, but it is less clear that those benefits have accrued equally across farm sizes. What policy incentives do we need to be thinking about to make sure that new technology will meet the needs of small and medium scale operations?

Consumer acceptance Finally, the products of this new gene editing technology must be acceptable to consumers. The first generation of biotech products was geared more towards farmers, not end consumers. As American consumers are ever more focused on food – what's in it, where it comes from, and how it is produced – we need to make sure that new products offer tangible benefits that consumers can embrace. We also need to be sure that consumers can have confidence in the underlying regulatory system that reviews these new products. A sound, credible regulation approach alone won't guarantee acceptance, but it is a necessary foundation.

The products of gene editing will be different than the earlier GMOs, and we will need to tailor our regulatory approach accordingly. A robust, scientifically justifiable, and transparent system is absolutely critical to ensuring success at home and to accessing markets abroad. Scientists are rapidly developing new products and are starting to knock on regulators' doors, but there is no clear answer for them. The Department of Agriculture has already told developers of some new gene edited products that they fall outside USDA's regulatory authority. To be clear, USDA regulators have not made a determination of safety, but rather have said that existing regulations tailored for the first generation GMOs simply don't apply. The Food and Drug Administration, on the other hand, has signaled its intention to use its rigorous, and often protracted, new animal drug approval process to evaluate animal products of gene editing.

The window to craft a clear, credible pathway to market is narrowing rapidly. Although it may be counter to our current trend towards deregulation, the history of biotech development shows us the importance of regulations. I would argue that the US biotechnology industry has been a success *because* of our regulatory system, not in spite of it. A system that allows products onto the marketplace without a clear and transparent evaluation of risks and benefits will not fly with today's consumers, and risks killing this technology before it even starts to deliver on its real promises.