Ag Innovation Agenda: Comments from the Northeast (July 14, 2020)

An effort hosted by the Association of Northeast Extension Directors[1] (NEED) and the Northeastern Association of State Agricultural Experiment Station Directors[2] (NERA)

Background:
The Association of Northeast Extension Directors (NEED) and the Northeastern Association of State Agricultural Experiment Station Directors (NERA), with technical support from eXtension, hosted a virtual Ag Innovation Agenda listening session on July 14, 2020 from 10:00am - 12:00pm. Invited to attend were college deans, Cooperative Extension and AES directors, or associate directors, and institutional scientists. Eighteen attendees joined the session.

The narrative that follows describes the output of the Northeast conversation on the challenges and opportunities associated with increasing agricultural productivity and decreasing the environmental footprint and their connections to the USDA's pre-defined innovation clusters:

- Genome Design
- Digital/Automation
- Prescriptive Intervention
- Systems Based Farm Management

Importantly, these reflections feature a Northeast perspective and incorporate the unique agricultural, environmental, natural resource, social and community attributes of the region.

Productivity
General Comments. Northeast participants voiced a concern about posing a goal of increasing agricultural productivity by 40% without defining the dimensions of productivity. Agricultural productivity could be increased through crop monoculture; heavy water, fertilizer and herbicide use; and diminution of biological diversity. We're confident that's not the strategy to meet the productivity goal. As the Northeast refers to increasing productivity, we do this in the context of developing, growing, and distributing plant and animal-based food that have healthy nutritional profiles, is accessible to and affordable for consumers, and is sustainable. How do we feed the world without wrecking the planet? We recommend that the USDA closely consider what it means by "productivity" and design opportunities in research, outreach, and engagement with private industry, producers, and universities in a way that does not encourage the elevation of monoculture production, the consolidation of land ownership, nor volume over quality, and socio-ecological factors. A tangible consideration is to evaluate whether "productivity" could (or should) be changed to "resilient productivity" or "sustainable productivity." We hope that the USDA will leverage the relationships and infrastructure

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already available through the agricultural experiment stations and cooperative extension services to this end.

We also reflect that there is great intersectionality across the grand agriculture challenge domains. We strongly urge the USDA to avoid creating research RFPs, outreach education endeavors or program incentives based exclusively on a single innovation cluster. Further, the human dimension of all future programs must be elevated and respected. Last, your colleagues at the Northeast Land-grant institutions look forward to employing our highly effective R&D strategy using a bench/field research – extension feedback loop.

Challenges

Natural disasters, pandemics, and climate variability. The Northeast climate is changing and because of its strategic location, phenomenal compression of biomes and ecotones, and the unique nature of climate change in the region, New England is one of the best places on Earth to observe and study adaptation processes of cultivated organisms. Wetter springs, cold snaps, drier summers, warmer winters, and more frequent severe storms is challenging regional agriculture. Then superimpose a pandemic that challenges our healthcare system and labor force. From a plant perspective, frost-, drought- and heat-protection constitute addressable challenges. Likewise, environmentally-friendly technological approaches to pest and weed control are needed to offset the impacts of climate change. Development and identification of regionally suitable plant ecotypes would assist in ensuring healthy and relevant regional food systems. Likewise, development of plants that could be left alone during periods of disaster and saltwater intrusion would assist in mitigating the detrimental effects of natural disasters.

The warming environment also affects animal production. In the Northeast, dairy and poultry production are the region's two largest animal agricultural enterprises. Developing farm-building strategies that provide protection from heat-stress and developing strains of animals that are heat tolerant is essential for animal welfare and productivity. Sea-level rise caused by global warming is affecting commercial fisheries, an important economic driver in the many coastal Northeastern states. For these challenges, the innovation clusters that could be deployed include genome design (genetically modifying plants and animals to provide traits that allow adaptability to the agricultural ecosystem) and prescriptive intervention. How might we use big data to model disruption and develop solutions?

Healthy soil, healthy food, healthy people. While this challenge in not uniquely Northeastern, it's a challenge that Northeastern food systems face and encompass the complexities of diverse sources of food and large urban hubs. For our regional producers, building and maintaining healthy soils (later we cite carbon sequestration as a decreasing environmental footprint opportunity) is essential. How might our healthy soils be monetized and marketed? How can farmers, ranchers, and foresters be incentivized to incorporate best practices to continually improve soils for productivity and carbon sequestration? The USDA should use its position to stand up, test, and support new markets for farmer collectives to support themselves and their communities and earn a profit from these "non-product" benefits they produce.

Likewise, the nutritional profiles of our food must match our needs. We can build healthy foods through precision nutrition. And we need to cultivate healthy people. Later, we cite the proximity of urban hubs with Northeastern agriculture as an opportunity. Here, we pose food access in urban areas as a challenge.

Building healthy soils and foods could be accomplished by utilizing genome design and systems-based management. Likewise, healthy people, are dependent on food systems-based management. How do we ensure access to healthy and affordable food to those in most need?

The economics of agriculture in the Northeast. The Northeast is the home to large urban centers and highly populated areas. Northeastern land prices are among the most expensive agricultural lands in the country. Access to capital and to profitable regional markets are two clear challenges that must be addressed. Hence, the region would benefit greatly from the development of science-based policies to address the complex of Northeastern food system issues including farm labor and labor management, capital access, market development, population demographics, access to farm subsidies spanning the breadth of small to large operations, social justice and equity. What strategies could be employed to provide access by producers to high-income consumers? Application of prescriptive interventions and systems-based management are essential strategies to address the complexity of the economics of Northeastern agriculture.

Opportunities

Production systems that are uniquely suited for the Northeast. The Northeast is uniquely situated to support wide ranges of agricultural enterprises including field agriculture and controlled environment agriculture, an enterprise cluster suited for urban settings. The Northeast today is also a barometer of a more densely populated United States of the future: areas that have large rural-suburban-urban interfaces. Importantly, the Northeast has had a tradition of direct farm sales, niche agricultural enterprises as well as traditional commodity agriculture. The high concentration of Land-grant universities make this region a unique test bed for innovation in food system research and outreach. Furthermore, most weather simulations forecast greater precipitation in the Northeast region during the growing season months, in contrast to drier growing seasons in the southern half of California and in the arid southwest. This may present an opportunity for a greater proportion of produce and animal products to be raised and sourced from the Northeast.

The access by agricultural producers to university-based, intellectual property and technologies should be widely exploited and employed. The other resource that is abundant in the Northeast is water. Hence, the access to an educated labor force, intellectual hubs, urban areas suitable for controlled agriculture (e.g., brownfields, industrial parks, rooftops, etc.), short distances between urban hubs and ag producing areas (minimize food miles, long storage needs, and related waste), and the natural resource base is encouraging for the development

and expansion of regional food systems. Employing big data and systems-based management will accelerate Northeast agriculture as an economic force and food dynamo.

Northeastern diversified farming. The Northeast is home to a diverse set of agricultural enterprises and food systems. These encompass coastal saltwater aquaculture, poultry production, dairy farming, fruits and berries, and a strong green industry (e.g., turfgrass and ornamentals.) Thus, consumers have access to a wide variety of agricultural products. Research and extension are needed to develop strategies to decrease energy use, increase water and nutrient use efficiency for production of high-value and high-demand niche crops selected with short growth period in small spaces to enhance economic profitability. Further, increasing profitability will improve farming community resilience by building prosperity. Ultimately, understanding how to build increased connections between farmers, urban consumers, and researches would provide Northeast farmers with valuable insight about the types of foods and production practices that enable economic, social, and environmental sustainability, expand nutritional choices for consumers, and reduce waste resulting from supply and demand imbalances.

The shifting consumer mindset on agriculture. Access to healthy food is a challenge throughout the U.S. and the Northeast is no exception. With a large human population and relatively small land mass, the Northeast is well-positioned to further develop local food systems. Direct sales through farmer's markets, CSAs, and farm stands and institutional sales (e.g., schools, hospital) are prime venues for improving access to healthy food. Direct markets are especially effective for developing producer-consumer relationships and promoting agricultural literacy by providing consumers with farm experiences and education. Extension is poised to develop and implement effective educational programs to assist the development of a mindset towards healthy, nutritionally and culturally relevant, regional, sustainable, foods. In viewing agriculture innovation, the Northeast strongly encourages the USDA to consider the breadth of the food system: producer to consumer.

Decrease Environmental Footprint

Challenges

Reduce physical distance between producers and consumers. The supply chain accounts for approximately 20% of the food system's greenhouse gas emissions. Identifying appropriate (environmentally suitable, culturally respectful, accessible, financially viable) spaces in an urban environment is challenging. In circumstances where the distance between the consumer and producer cannot be reduced, we suggest modifying supply chains and utilizing modern intermodal/multimodal transportation systems that incorporate cutting-edge, technological innovations including robotics, automation, and artificial intelligence. New strategies that increase: productivity in novel bio-intensive systems; value-added chain processing and packaging; and building bio-energy and healthy composted soil from food waste are necessary.

Northeastern milk production/dairy production. Across the globe, animal production contributes approximately 30% of the greenhouse gas emissions associated with food

production. How might the microbiome of agriculturally important ruminants be altered to decrease the carbon output while ensuring animal productivity and animal product quality? Using genome design to shift carbon output of ruminants and/or the utilization of carbon-capture farm system infrastructure should be employed to make progress in this area.

Eliminate waste; change views on what is "waste." In the United States, 40% of food produced ends up unconsumed and in a waste stream. This problem is magnified in the Northeast where large hubs of populations reside. What strategies could be used to reduce "nonconsumption"? Relevant consumer education programs that target changing consumer behavior are needed. Further, how could the unconsumed food products be repurposed for human or animal consumption or energy production? There are needs for technologically advanced storage capabilities of unconsumed food. (Can unconsumed food be stored for later use?) Transportation (using modern intermodal/multimodal strategies) of unconsumed food to repurposing sites (consumption or energy) and utilizing modern technology to turn the unconsumed food into usable products is needed. Likewise, reduction of microplastics in both wild and cultivated seafoods requires attention.

Several final observations: decreasing the environmental footprint must be done collaboratively with increasing productivity. This not an exclusive U.S. challenge, it's a global challenge. How do we reduce the barriers to work across international boundaries in global collaboration and cooperation?

Opportunities

Create animals and plants with smaller environmental impact. Earlier we cite the environmental impact of animals (specifically diary animals) as a challenge. We also believe that there are opportunities as well. Intentional design of plants and animals has the potential to improve environmental quality, agricultural productivity, nutrient utilization (by plants and animals) and economic opportunity. Modern farms are carbon sinks and have the potential to be market-makers. Development of markets that ensure farm prosperity are needed as are the policies that will serve to support the markets. For example, aquaponics is one of the most rapidly developing agricultural processes because it is a sustainable farming approach that saves water, improves environment, and promotes integrated food systems. Genome design, prescriptive intervention, and systems-based management will all be important innovation clusters to address these opportunities.

Promote soil health in the face of a changing climate. Land use intensity modifies soil services. Plant agriculture provides a means to reduce atmospheric carbon dioxide through sequestration. To ensure soil health, research is needed to identify approaches for building the soil environment. This includes identification of rotational grazing strategies for cool season grasses, sustainable means for enhancing soil organic matter through food waste to compost, and schemes to assess and monetize soil and plant ecosystem services. Erosion control at the urban-rural interface will require the development of novel approaches to ensuring environmental quality. All of this must be accomplished in an era of a changing environment.

Incentive compatible public policy - incentivize to decrease environmental footprint. We suggest focusing strategies on a regional/sub-regional basis to identify investment opportunities that incentivize decreasing the environmental footprint while ensuring farm viability. Identification of food production systems that reward environmental stewardship is essential. All members of the Northeast food systems chain must have access to science-based, data-driven information on innovations that preserve the quality and quantity of water, maintain soil quality and health, preserve air quality, sustain biodiversity and reduce agricultural pollution.