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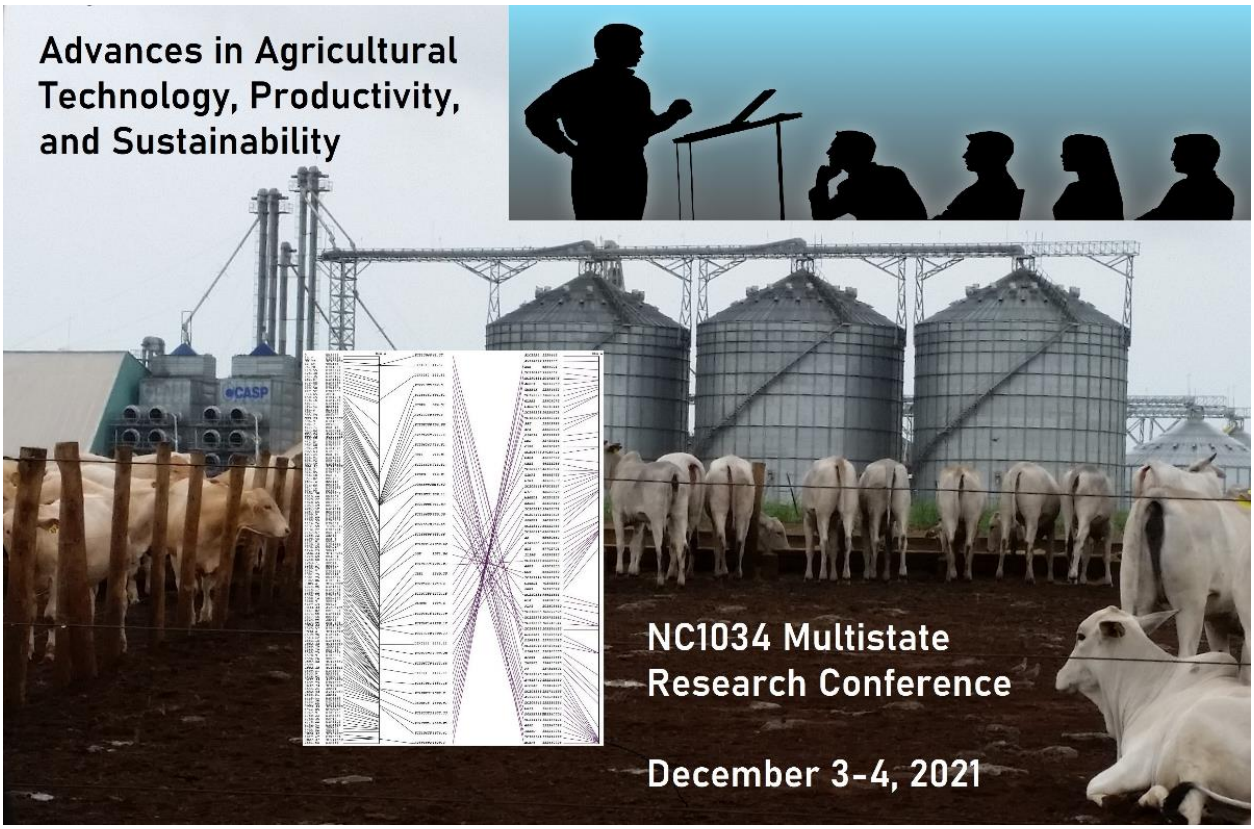

Contents

Schedule at a Glance:

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12:00-1:00 Eastern (9:00-10:00 Pacific)	**Session 1. Regulatory and Consumer Preferences** • Justus Wesseler, Wageningen University, Novel Food Regulation in the EU • Zachary Brown, North Carolina State University, Pest Control Gene Drives and Consumer Preferences
1:00-1:30 Eastern	*break*
1:30-2:30 Eastern (10:30-11:30 Pacific)	**Session 2. Producer Innovation** • GianCarlo Moschini, Iowa State University, Seed Density in US Maize • Juan Sesmero, Purdue University, WaterSmart Irrigation Scheduling
2:30-3:30 Eastern (11:30-12:30 Pacific)	**Session 3. The Value of Intangibles** • Jared Hutchins, University of Illinois, Cooperative Data Platforms • Brian Wright, University of California Berkeley, Patent Valuation
3:30-4:00 Eastern	*break*
4:00-5:00 Eastern (1:00-2:00 Pacific)	**Session 4. Opportunities and Challenges in the Bioeconomy** • George Frisvold, University of Arizona, The US Bioeconomy • Gal Hochman, Rutgers University, The Economics of Aquatic Plants
5:00-6:00 Eastern (2:00-3:00 Pacific)	*Happy hour and social networking*

Time	Saturday December 4
11:00-12:00 Eastern (8:00-9:00 Pacific)	**Session 5. Productivity Metrics and Measurement** • Justus Wesseler, Wageningen University, Does biotech make a difference? • Alejandro Plastina, Iowa State University, Quality of Lowe TFP indexes
12:00-1:30 Eastern (9:00-10:30 Pacific)	**Keynote panel: Climate Change, Productivity, and Innovation** • Ariel Ortiz-Bobea, Cornell University • Bruce McCarl, Texas A&M University • David Zilberman, University of California Berkeley
1:30-2:00 Eastern (10:30-11:00 Pacific)	*NC1034 business meeting*

Friday December 3, 2021 (All times are U.S. Eastern Standard Time/UTC -5, unless otherwise noted)

Friday December 3

11:00 Welcome (10:00 Central, 9:00 Mountain, 8:00 Pacific)

Gregory Graff, Professor, Colorado State University, and Chair, NC1034

11:10-12:00 Keynote address: ***Innovation in Symbiotic Value Chains***

Thomas Reardon, University Distinguished Professor, Michigan State University, Fellow of the AAEA and Honorary Lifetime Member of the IAAE

12:00-1:00 Session 1. Regulatory and consumer influences on agricultural and food innovation

The Development of the Novel Food Regulation and Its Impact on The European Union

Maximilian Kardung, **Beatrice Cortesi**, **Claudio Soregaroli**, **Alessandro Varacca**, and **Justus Wesseler** (Wageningen University and Catholic University, Piacenza-Cremona, Italy)

Within the food system, consumer demand is shifting towards new health, functional and ethnic food, and different dietary alternatives and environmentally sustainable choices due to demographic changes, globalization, and income and its distribution. The evolving consumers' demand and development of new technologies led to more innovation in the food sector over the past decades, and companies are applying to bring their new food products to the market. Such new food products are considered novel food by the European Union (EU) and fall under the EU novel food regulation. We assessed the length of the authorization procedure of novel food and analyzed regional differences across countries in submitting novel food applications. Moreover, we analyzed the determinants of a successful novel food application. The changes between the current Regulation (EU) No 2015/2283 and the former Regulation (EC) No 258/97 have implications for the authorization procedure. We applied an empirical strategy using Bayesian modelling to deal with the lack of information regarding the approval status of the NFs still under evaluation. We found that more novel foods are submitted and authorized per year under the new regulation. The procedure length declined under the old regulation, while it is too early to conclude on the impact of the new regulation. Applications from private companies and repeated applications were likely to have a higher chance to get authorized.

Landscape-level pest control externalities when consumer preferences are non-neutral

Michael S. Jones (University of Alaska) & **Zachary S. Brown** (North Carolina State University)

Area-wide production inputs provide a potential route to increase efficiency of pest control. Genetically engineered insects are arising as one such regionally deployed pest control technology, with substantial applications in agriculture. One design is a ‘gene drive’, using CRISPR-based gene editing. In gene drive, preferentially inherited, engineered traits are spread to reduce pest populations or inhibit their ability to spread disease, while also potentially reducing pesticide spraying and crop prices. However, this landscape-level strategy could also limit consumer choice to only host crops grown in the presence of gene drive insects. Consumer welfare impacts will depend upon the heterogeneous valuation of trade-offs between pesticides, prices, and drive insect presence. In this study, we administer a survey to a

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representative sample of U.S. adults, gathering willingness-to-pay (WTP) data for two host crops for insect species under current drive research. Through a hierarchical Bayesian framework, we find lower or statistically equivalent marginal discounts for drive insect presence versus increased conventional pesticide use or genetically modified crops. However, mean and median non-marginal consumer welfare impacts of unlimited drive releases are negative for fresh blueberries. For orange juice, the mean surplus estimate is small, negative and statistically insignificant, while the median estimate is positive and statistically significant. We estimate substantial consumer welfare gains from limiting drive systems to retain alternatives not grown in the presence of drive insects. Results provide insight into differential consumer valuations of biotechnology strategies and inform optimal design and deployment considerations for gene drive systems.

1:00-1:30 break

1:30-2:30 Session 2. Field level innovation by agricultural producers

Uncertainty and learning in a technologically dynamic industry: Seed density in U.S. maize

Edward D. Perry (Kansas State University), **David A. Hennessy** (Iowa State University), and **GianCarlo Moschini** (Iowa State University)

The large and sustained yield gains achieved since the introduction of maize hybrids in the 1930s (about 1.8 bushels per acre per year) have been accompanied by a remarkably parallel and steady increase in seeding density. This increase occurred in an environment characterized by rapid technological innovation, including genetic engineering, and commercial hybrid varieties with short life cycles. An important question, then, is whether and how breeders and farmers have learned about the optimal planting density. In this paper, we use unique and detailed U.S. farm-level data, consisting of more than 400,000 planting choices from 1995-2016, to assess the nature of learning about seeding density. Importantly, we control for unobserved confounders through both hybrid and farm-level fixed effects. We find that the variance in planting rates for a given hybrid has decreased over time, and that farmers tend to plant a given variety at higher rates over time. This is consistent with Bayesian learning in which risk-neutral farmers possess priors that are consistently below the true optimal rate. We cast doubt on risk aversion as a credible explanation for this finding by analyzing the contrasting evolution of soybean planting rates (a crop with exogenously different agronomic determinants of seed density). We interpret our results as evidence of inertia: the initial bias in maize farmers' priors is tilted towards the optimal planting rates of varieties planted in the past. One implication of the finding that farmers have historically underinvested in maize seeding rates is that eliminating this tendency could result in significant productivity gains.

Using Technology to Improve Intra-Seasonal Irrigation Scheduling: the Case of the WaterSmart Technology

Juan Sesmero (Purdue University)

Irrigation management during the growing season should carefully balance the intertemporal benefits and costs of increased water use. Yet, a heuristic that can help agricultural irrigators make decisions regarding the optimal timing of water application during the growing season and in response to evolving weather patterns remains largely elusive. This reflects two key difficulties of developing such a heuristic: the challenges associated with collecting information on weather and soil water in real time; and the difficulty of using that information to develop a forward-looking algorithm characterizing a profit-maximizing intra-seasonal irrigation schedule. In this paper, I develop such algorithm by solving a

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Markov dynamic program with partial observability of the State variable (soil water). I quantify the value of the algorithm by comparing (simulated) profits under the irrigation schedule suggested by the algorithm against a baseline schedule designed to minimize yield penalty. I compare these schedules under two technological scenarios: one in which the farmer uses a soil water balance equation to estimate soil water throughout the growing season; and an information technology (IT) scenario in which the farmer refines this estimate using data from soil sensors. Calibrating the model to growing conditions in Central Nebraska, I find that the algorithm can increase profitability and reduce water consumption. The algorithm performs best in combination with IT – their joint adoption can raise profits by 5% and reduce water use by 7%, on average. Perhaps more importantly, adoption of this technological package dominates the baseline schedule from a first order stochastic dominance perspective.

2:30-3:30 Session 3: The value of intangibles and innovation

Innovation Through Cooperative Data Governance: The Case of the US Dairy Sector

Jared Hutchins (University of Illinois) and **Brent Hueth** (USDA Economic Research Service)

With the emergence of precision agriculture, technology firms have become repositories for a diverse range of field and farm-level data. Who owns these data, what policies are needed to promote robust competition across platforms, and who gains from data-driven knowledge discovery and innovation? We examine these questions with a case study of a century-old data and innovation platform called the National Cooperative Dairy Herd Improvement Program (NCDHIP). This program developed as a decentralized, cooperatively governed, public-private program for collecting dairy farm data to produce annual estimates of dairy-bull genetic merit. We describe how NCDHIP produced substantial innovations in breeding research while ensuring full data sovereignty to farms who supplied primary data to the program. Nearly all the institutions in the NCDHIP are farmer-owned, making NCDHIP an example of cooperative data governance where data producers have input at each stage. We conclude by discussing how the NCDHIP story can inform data governance in agriculture today in three important ways: creating coordinated data standards, emphasizing cooperative data governance, and creating decentralized data platforms.

Estimating Patent Values Using Stock Market Responses

Wenjun Wang and **Brian Wright** (University of California, Berkeley)

This study estimates value of patents for U.S. public firms using stock market responses over short event windows around patent publication and grant, building on the work of Kogan et al. (2017) and Sun and Wright (2021). The methodology incorporates dynamic modeling and empirical regression strategies. The study applies this methodology to corporate patents published between 2001 to 2018 and provides individual monetary value estimates for 646,610 patents. This method advances the time when an invention can be valued, compared to classic citation-based methodologies, and enables comparisons across fields and years. The study then employs the patent values estimated to identify key factors that can be used to predict patent values at early stages (i.e. before patent grant). Using a novel dataset, the study finds that the number of claims, number of backward and forward citations, and field of industry are among the most important factors in predicting patent value.

3:30-4:00 break

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Friday December 3, 2021 (All times are U.S. Eastern Standard Time/UTC -5, unless otherwise noted)

4:00-5:00 Session 4: Opportunities and Challenges in the Bioeconomy

The US Bioeconomy: Issues in Definition and Measurement

George Frisvold (University of Arizona)

This presentation summarizes main findings and recommendations of Safeguarding the Bioeconomy, a Consensus Report of the U.S. National Academies of Sciences, Engineering, and Medicine. The U.S. bioeconomy (as defined in the report) is economic activity driven by research and innovation in the life sciences and biotechnology, and that is enabled by technological advances in engineering and in computing and information sciences. Based on the report committee's calculations and available data, the U.S. bioeconomy accounted for about 5% of U.S. GDP in 2016, representing $959.2 billion. The report addresses definition and measurement of the U.S. bioeconomy (including measurement of intangible assets), evaluates economic and national security risks pertaining to the bioeconomy, considers strategies to safeguard the U.S. bioeconomy, and identifies opportunities for international engagement and cooperation. Security issues considered included adequacy of investment in R&D and workforce development, intellectual property protection, cybersecurity, data sharing, critical infrastructure vulnerabilities, and climate change risks. Earlier North American approaches to measuring the bioeconomy tended to work from a more restrictive categorization of the bioeconomy, while others, particularly in the EU, have a adopted a broader characterization, at least in some dimensions. Each approach – restrictive and broad – has certain advantages and disadvantages, to be discussed. The NASEM Safeguarding report and recent activities in the EU (e.g., the BioMonitor Project and the work of the European Commission's Joint Economic Centre) suggest movement toward convergence of approaches, which will hopefully facilitate future research collaboration and policy cooperation.

The Economics of Aquatic Plants

Gal Hochman (Rutgers University)

This review examines global microalgae, seaweeds, and duckweed (MSD) production status and trends. It focuses on cultivation, recognizing the sector's existing and potential contributions and benefits, highlighting a variety of constraints and barriers over the sector's sustainable development, and discussing lessons learned and ways forward to unlock the sector's full potential. In contrast to conventional agriculture crops, MSD can rapidly generate large amounts of biomass and carbon sequestration yet does not compete for arable land and potable water, ensuring minimal environmental impacts. Moreover, MSD's applications are ubiquitous and reach almost every industrial sector, including ones essential to meeting the increasing needs of human society, such as food, pharmaceutical, and chemicals. To this end, the growing public awareness regarding climate change, sustainable food, and animal welfare yield a significant shift in consumer preference and propels the demand for MSD. In addition, once governments usher carbon prices, the markets are likely to increase severalfold.

5:00-6:00 Virtual happy hour and social networking (4:00-5:00 Central, 3-4 Mountain, 2-3 Pacific)

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Saturday December 4

11:00-12:00 Session 1. Metrics and Measurements of Productivity

(10:00-11:00 Central, 9-10 Mountain, 8-9 Pacific)

Does Modern Biotechnology Makes a Difference?

Yan Jin (Wageningen University), **Justus Wesseler** (Wageningen University), **David Zilberman** (University of California Berkeley)

The contribution of biotechnology to the productivity of crops has been heavily debated among scientists as well as other societal groups. Several studies point out the advantages of adopting biotechnology include the increase in crop productivity, the environmental benefits generated, and the contribution to reducing poverty and improving nutrition. Others emphasize the unknown risk related to the use of modern biotechnology, and negative impacts on the environment through e.g. increase in monoculture and reliance on glyphosate based chemical). Some argue that other strategies based on agro-ecological concepts can also reach what biotechnology targets, but are more environmental friendly and do not expose society to the potential risks. Both views have in common claiming that the agricultural sector would do better and is heavily debated in the literature. The differences in strategies and policies chosen by the US and the EU provide a natural experiment for testing whether or not the use of modern biotechnology made a difference. The paper provides an important contribution to the debate on technological change in agriculture and economic growth.

Quality Metrics for Lowe Indexes of Total Factor Productivity

Alejandro Plastina and **Sergio H. Lence** (Iowa State University)

A myriad of agricultural policy recommendations in the international and domestic arenas are based on Total Factor Productivity (TFP) analyses. Significant efforts have been devoted to properly measure the underlying components of TFP indexes, as well as to evaluate the relative merits of alternative aggregation methods. However, the literature has paid little attention to the practical implications of basket drift bias and the interpretation of TFP changes through time stemming from the inclusion of new categories, and the exclusion of discontinued categories of inputs and outputs in the index calculation. Similarly, in multilateral comparisons, the choice of a reference state with little overlap of input and output mixes with other states can render numerically correct but conceptually meaningless TFP comparisons. We develop a set of metrics to evaluate the quality of multiperiod and multilateral input and output Lowe quantity indexes, and the associated Lowe TFP indexes. Our methodology allows practitioners to intentionally choose the reference state-year combination that maximizes the quality of TFP comparisons. We illustrate the proposed metrics using disaggregated FAO output data and USDA input data for the United States, Bolivia, and Kuwait over the period 1961-2019. Conventional productivity comparisons can be highly misleading when the quality of the TFP series is low. Since quality measures depend on the actual states and periods under analysis, the entire set of input and output indexes for all countries in the FAO and USDA databases, along with relevant codes will be made available online.

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12:00-1:30 Keynote Panel: Climate Change, Productivity, and Innovation

Historical and future impacts of anthropogenic climate change on US agricultural productivity

Ariel Ortiz-Bobea (Cornell University)

Recent evidence suggests anthropogenic climate change has already slowed global agricultural productivity growth. However, regional and country-level estimates remain imprecise. This presentation will focus on ongoing work seeking to quantify both the historical and the potential future impacts of anthropogenic climate change on US agricultural productivity. This research effort ultimately seeks to quantify the research and development (R&D) investments necessary to compensate or modulate the impacts of climate change on the sector.

Is Climate Change Reducing Crop Yield Growth and R&D Effectiveness: An Investigation Using US Agricultural Data

Chengcheng J. Fei and **Bruce A. McCarl** (Texas A&M University)

Increasing agricultural technical productivity is an important means to meet growing future food demands and overcome some of the effects of climate change. In the US total production has increased for more than 100 years due to intensification through increased land productivity and extensification through cultivated land expansion. However, there is limited land for additional extensification and thus future growth will depend more on intensification as has recent growth. In the recent past rates of productivity expansion in the form of crop yield growth have fallen and in many cases so has investment in productivity enhancing research. Here we investigate possible reasons for the falling rates using US data mainly focusing on investment levels and changes in climate. Our investigation shows that while Agricultural R&D (AGRD) directly improves productivity, climate change has had a negative impact and also interacts to reduce the AGRD contribution. This raises a need for an increase in AGRD to overcome climate change effects both maintaining and increasing growth in crop yields.

Climate, Food Security, and the Three Visions of Agriculture

David Zilberman (University of California, Berkeley)

There has been an ongoing debate about the direction and role of agriculture. This debate was apparent during the recent UN World Food System summit. The evolution of agriculture in terms of technology structure and role will affect how humanity can address two of the most significant challenges it faces: climate change and food security. We present three visions of agriculture- the “natural paradigm”, the “status quo”, and the “bioeconomy”. The natural paradigm has multiple versions, including organic agriculture and ecological agriculture. A significant feature is an objection to genetic engineering and a precision automated system to a lesser extent. The status quo aims to avoid perceived conflicts- such as food vs. fuel or debates about biotechnology, between the EU and the US or environmentalist vs. "technologists." It emphasizes the role of agriculture in producing food and accepts the use of biotechnology in making feed and fiber but not food. The bioeconomy vision utilizes biological processes and living systems to have multiple products, including food, energy, and chemicals. The development of the bioeconomy relies heavily on the modern use of genetic engineering and data science technologies. With these tools, agriculture will play a crucial role in sequestering carbon and replacing nonrenewable resources with renewable resources. Each vision has its implications for resource allocation and human well-being, policies, and political economy considerations.

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Saturday December 4, 2021 (All times are U.S. Eastern Standard Time/UTC -5, unless otherwise noted)

1:30-3:00 Annual business meeting of NC1034 Multistate Research Project

Agenda:

1. Welcome to **Anne Dorrance**, Associate Dean, College of Food, Agricultural, and Environmental Sciences and Director Wooster Campus, The Ohio State University, and new Advisor for NC1034

2. Thanks and Tributes:
    - Marshall Martin
    - George Frisvold
    - Wally Huffman, in memoriam

3. NC1034 Annual Meetings: past, present, and future
    - Selection of location, date, and a planning committee for 2022

4. Discussion of opportunities for multistate collaboration

5. Nomination and selection of officers

6. Other business

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Registered Participants

Muhammad Tahir Ali, Graduate Student, University of Nebraska Lincoln
Julian Alston, Distinguished Professor, University of California Davis
Chris Barrett, Professor, Cornell University
Zachary Brown, Associate Professor, North Carolina State University
Amy Carruthers, Student, University of Saskatchewan
Ons Dhaoui, Student, University of Saskatchewan
Anne Dorrance, CFAES Associate Dean and Director Wooster Campus, The Ohio State University
Christopher Eze, Academic/Lecturer, Federal University of Technology Owerri
Chengcheng Fei, Postdoc, Texas A&M University
Wojciech Florkowski, Professor, The University of Georgia
George Frisvold, Professor, University of Arizona
Keith Fuglie, Econoist, ERS-USDA
Lilyan Fulginiti, Professor, University of Nebraska Lincoln
Eyassu Gachira, Lecturer, Mizan-Tepi University
Savannah Gleim, Research Officer, University of Saskatchewan
Gregory Graff, Professor, Colorado State University
Gelareh Heidariharatmeh, Master student, University of Saskatchewan
Gal Hochman, Professor, Rutgers University
Jared Hutchins, Assistant Professor, University of Illinois at Urbana-Champaign
Michael Jacobson, Professor, Penn State
Yan Jin, PhD, Teagasc
Michael Jones, Term Assistant Professor of Economics, University of Alaska Anchorage
Yoko Kusunose, Associate Professor, University of Kentucky
Rim Lassoued, Researcher, University of Saskatchewan
Bruce McCarl, Distinguished Professor, Texas A & M University
Kate McDonald Polakiewicz, Program Specialist, USAID
GianCarlo Moschini, Distinguished Professor, Iowa State University
Latha Nagarajan, Economist, IFDC
Anwar Naseem, Associate Professor, Rutgers University
Yvonne Ndelle, PhD Candidate, University of Saskatchewan
Kelly Nelson, research agricultural economist, ERS-USDA
Ryan Olver, Agricultural Research Economist, ERS-USDA
Ariel Ortiz-Bobea, Associate Professor, Cornell University
Richard Perrin, Prof, University of Nebraska Lincoln
Peter Phillips, Distinguished Professor, University of Saskatchewan
Alejandro Plastina, Associate Professor, Iowa State University
Carl Pray, Professor, Rutgers University
Xudong Rao, Assistant Professor, North Dakota State University
Thomas Reardon, Distinguished Professor, Michigan State University
Rod Rejesus, Professor, North Carolina State University
Bryan Sarauer, Program Head/Instructor, Saskatchewan Polytech
David Schimmelpfennig, Director, Phytosanitary Analytics, BES/PPQ/APHIS USDA
Juan Sesmero, Associate Professor, Purdue University
Guanming Shi, Professor, University of Wisconsin Madison
Robbin Shoemaker, National Program Leader for Economics, NIFA-USDA

Peter Slade, Associate professor, University of Saskatchewan
Ran Sun, Phd student, University of Saskatchewan
Bill Thomas, BEO, USAID/RFS
Federico Trindade, Postdoctoral researcher, University of Washington
Albert Ugochukwu, Senior Policy Fellow, University of Saskatchewan
Sun Ling Wang, Senior economist, ERS-USDA
Wenjun Wang, PhD Candidate, University of California Berkeley
Justus Wesseler, Professor, Wageningen University
Brian Wright, Professor, University of California Berkeley
David Zilberman, professor, University of California Berkeley