Food Supply Chain Disruptions during the COVID-19 Pandemic: Implications for Future Research

Conference White Paper Provided by

FACTS
Food and Agriculture Collaboratory for Transforming Supply

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1.0 Introduction

From farm to table, global food supply systems have seen unprecedented disruptions due to COVID-19. Beginning in March 2020, food processing plants were forced to slow or shut down operations. Concurrently, local governments ordered the closure of foodservice businesses, reducing food availability and increasing pressure on grocery stores to satisfy consumer demand. These forces created supply and demand shocks reverberating up and down food supply chains. With guidance from government agencies - Center for Disease Control and Prevention (CDC), Occupational Safety and Health Administration (OSHA), and the United States Department of Agriculture (USDA) - food processors instituted testing and safety protocols to ensure the health of employees and regain plant capacity. Though this experience has proven to be a good teacher, much remains unknown about effective and efficient responses should any future pandemic occur.

The COVID-19 pandemic brought supply chain management to the attention of citizens who would otherwise have been uninterested and unaware of how food is produced, even less so of the systems of delivery that bring products to their desired points of purchase. The experiences of the food system have left the nation with an array of broad questions – How did COVID-19 impact labor, processing, logistics, and consumer behavior during COVID-19? What lessons did we learn? What are the pressing areas of research required to aid the food supply chain? – as well as many narrower ones.

To help provide answers to some of these questions, Mississippi State University's Food and Agriculture Collaboratory for Transforming Supply (FACTS) hosted a virtual conference. Industry leaders representing the Produce, Meat, Dairy, and Food Retail industries were invited to share firsthand experiences with the pandemic alongside an overview from the USDA regarding funding initiatives intended to support the food industry. The industry speakers addressed five main topics in their discussions: 1) the major challenges their respective industries faced during the pandemic, 2) the strategies adopted to maintain production and distribution, 3) the successes and shortcomings of the adopted strategies, 4) lingering and future challenges to the industry, and 5) the areas of research they recommend academia focus.

One goal of the conference was to attract participants from as wide a degree of backgrounds and experiences as possible to maximize reach. The second goal of the conference was to foster a common understanding of the implications of COVID-19. The third goal was to encourage interdisciplinary and interexperiential connectivity to build stronger teams that can address the food industry's current and future supply chain challenges.

This White Paper summarizes the lessons learned as well as what the speakers and the participant surveys identified as future implications for research. The results highlight the experiences of the food industry in the current crisis to identify potential research areas dedicated toward improving the resiliency and efficiency of the supply chain.

2.0 Conference Presentation Overview

The following overview attempts to provide an informational guide to the reader regarding points made by the industry representatives on major challenges, actions taken, lingering issues,

and suggested future research. As there are obvious overlapping issues across industries, the authors identify general and industry-specific food system issues and researchable topics.

This section provides additional information and organization relevant to academic researchers, with no intention of altering the presenter's intended meaning. For further details, we invite the reader to view the speaker presentations at https://www.dafvm.msstate.edu/facts-conference.

2.1 Meat and Poultry

The meat and poultry processing industries were arguably hardest hit by the COVID-19 virus. Dr. Ashley Peterson of the National Chicken Council presented information specific to the poultry, as well as the meat industry in general. The foremost and most immediate challenge identified was worker safety. Because processing laborers typically work closely with one another, there was a greater probability of transmission and an increase in illness rates. This decreased the availability of workers to maintain production, forcing some meat processing plants to close temporarily. Such plant closures resulted in isolated instances of euthanasia of market ready hogs and broilers because there existed no financially feasible means for either altering harvest or extending the growth of these animals. In response to the potential for more disruptions in the meat supply chain, President Trump issued an Executive Order mandating that meat and poultry processors continue operations under the guidance of the CDC, OSHA, and USDA. This order extended to the entire food production system under the designation of 'essential employees.'

To facilitate worker safety, the industry took several measures, including increasing plant sanitation, issuance of personal protective equipment, multilingual COVID-19 safety education and training, physical barriers between workers, and temperature screening. As a result of these measures, the average of monthly new cases declined from a high of nearly 500 in May 2020 to approximately 20 in February 2021.

Though processing facilities continued to operate at reduced capacity, a second-stage challenge presented itself in the form of state-mandated closures of foodservice outlets such as hotels, restaurants, and schools. This resulted in an estimated 46% loss of potential sales. Given food products are required to be designated for foodservice or retail, the Food Safety Inspection Service agency allowed processors to relabel existing stocks of foodservice products as retail. This resulted in an immediate funneling of nearly all meat products to the retail sector, a common shift by all food suppliers who rely on both market channels. In response to the closure in the foodservice outlets, consumer demand shifted to retail, and expectations of food shortages increased hoarding behaviors by consumers. These behaviors were especially observed in meat and poultry products. The combination of reduced capacity and increased demand resulted in the retail sector experiencing stockouts, which in turn exacerbated the perception of food shortages and increased hoarding behavior.

The lingering questions facing many food manufactures are suggestive of potential academic research areas. The first set of questions are more fundamental: predicting the duration of the pandemic, the emergence of new COVID-19 variants, the development of vaccines, and public acceptance of vaccination. These are frontline concerns that will continue to receive scientific

attention. The second is more specific to vaccine acceptance and whether to develop and institute voluntary or mandatory testing and vaccination policies to ensure a healthy workforce. The effectiveness of these policies will depend on legality, the ability of employer to monitor, and worker acceptance in relation to the gain in productivity. The third is related to the impacts of expected new governmental regulations aimed at reducing the spread of the virus, especially in congested workspaces such as meat and poultry processing plants. During the pandemic, it became more apparent than ever that it is extremely difficult and nearly impossible in some instances to simultaneously satisfy conflicting federal, state, and local government regulations. The fourth question, which is universal in the food supply system, is the persistence of the consumer demand shift from foodservice to retail, especially for individual food products.

To prepare for future pandemics, several specific areas of academic research were proposed for the meat and poultry processing industry. The first is the development of feasible automation throughout the plants. Currently, human visual acuity and physical dexterity outperform machines. The second is a speciation of the first in the development of enhanced imaging systems for flexible production and process monitoring. The third is to develop virtual animal welfare auditing systems to improve consumer confidence.

2.2 Dairy

Another hard-hit industry was the dairy processing sector, represented by a consulting firm president, Mr. Phil Plourd of Bliming and Associates. The first major challenge facing many dairy processors was that, due to product specificity, they are heavily dependent on either the foodservice or retail market channels. As a result of closures in the foodservice sector, the firms mostly dependent on this channel lost nearly their entire market. Fluid milk was almost instantly impacted by the closures of schools and foodservice due to a combination of high perishability and plant specificity. For instance, the redirecting and repackaging of fluid milk supplies from carton milk (foodservice: k-12) to gallon jugs (retail: grocery stores) could not be accomplished in the foreseeable future. This resulted in an estimated increase in the destruction of milk by 275 million pounds over the normal annual levels of 25 million pounds. Other dairy products such as cheeses, which are more storable than fluid milk, faced significant challenges of retrofitting equipment for the repackaging of product from 5-pound bags (foodservice) to 8-ounce bags (retail). The second major challenge is that the supply disruptions led to historically low and high prices within 100 days of the start of the pandemic, making it one of the most volatile commodities at the time. Finally, in the face of increasing supplies, grocery stores, which comprise the largest retail sector of food products, increased the volume but reduced the number of dairy product offerings (and others as well). This resulted in fewer market channels, especially for specialty items.

These challenges, primarily the issues of fluid milk perishability and plant specificity economics, persisted throughout the pandemic and continued to linger even as the foodservice sector began reopening. To prepare for future pandemics, several specific areas of academic research were proposed for the dairy processing industry. In a more general sense, an investigation into the costs and benefits of ‘just-in-time’ inventory management for various products should be conducted accounting for various storability. Not an entirely unrelated topic is the feasibility of

expanding fluid milk processing to elevate bottle necks. Also, due to product/market channel specificity, the feasibility of processor to balance their product portfolios, possibly through consolidation or expansion to better facilitate intra-firm supply chain management is of interest. Next is the improvement in shelf life and portability of most dairy products to meet the increased demand for home delivery and E-commerce. Finally, a comparative study between the impacts on demand from increased government spending via direct purchases as opposed to increased SNAP benefits.

2.3 Produce

Though somewhat overlooked in the media, the produce industry faced significant challenges as well. The industry was represented by the president of a large grower and packer company, Mr. Sammy Duda of Duda Farm Fresh Foods, Inc. Like industries just discussed, produce packers are dependent upon both the foodservice and retail sectors, have packaging specific to each market channel, and deal in products that are perishable. As such, many of the same general challenges faced by meat, poultry and dairy were experienced by the produce packing industry.

Pre-pandemic, produce was consumed roughly evenly between the foodservice and retail sectors and produce companies tended to either specialize in providing product and packaging for one sector or a mix between the two. As such, the impact of the closures in the foodservice sector were first and most deeply experienced by those who primarily relied on foodservice.

Like the meat and poultry processing sectors, produce-packing laborers are near one another and the spread of COVID-19 posed a serious first-stage challenge. Fortunately, the same type of safety measures enacted by the meat and poultry industry were more effective, resulting in a continued healthy work force throughout the pandemic. At the same time, another challenge for the produce sector was the pre-dedication of existing planted acres such that adjustments to higher-demanded products were slow. Packaging adjustments to retail were more feasibly implemented in the short run. For Duda's company, only the unwrapped products such as husked corn and celery were difficult to provide in packaging. Though produce is more versatile than fluid milk, Duda's company still experienced destruction losses of roughly 3 million dollars. As the pandemic continued, suppliers switched to retail and drove down prices to growers and packers. Additionally, speculation of increased demand by retail buyers overwhelmed logistics and delivery channels, resulting in price volatility and order cancelations.

Several enduring issues and challenges are facing the produce industry and are suggestive of potential academic research areas. To help improve the matching of planted acres by growers to meet changing consumer demand and market channels as the foodservice sector is re-opened, consumer demand and market channel logistics predictions are warranted. Currently, the industry has taken a 'wait-and-see' stance and will thus be slower to adapt. Because it is expected that consumers will continue to demand food products from online sources (e.g., Amazon, Hello Fresh, Uber Eats) post-pandemic, new products and packaging must be developed to feasibly handle the last mile of delivery.

These continuing issues culminated into specific proposed research topics. The first is last-mile logistics, product quality, and efficiency research for online purchases and 'dark-store' selection

and pickup locations (e.g., Kroger). Second, new packaging research is needed to satisfy current and demand that is cost-effective and environmentally friendly. Third, the development of improved information tools to provide grower/packer/shippers with more timely and accurate consumption trends.

2.4 Retail

With the closures of businesses in the foodservice sector, the retail sector faced an enormous challenge of increasing its throughput of products to meet increased consumer demand with a fixed capacity. To identify the major challenges facing the retail industry was Mr. Tom Madrecki from the Consumer Brands Association. Unlike the suppliers that experienced challenges in more clearly defined stages, the retail sector experienced several challenges almost simultaneously after foodservice closures because it is the point of purchase for consumers. Like the processing industries the most immediate challenge was worker health. Workers are not only in relative proximity to one another, but also to customers, thus compounding the risk of exposure. This led to increased absenteeism, thus reducing the available workforce and the ability of retail to meet demand. Together, product stockouts were a common occurrence. Observing stockouts, consumer confidence in the food supply chain waned, thus perpetuating hoarding behavior. Retailers observed consumers making fewer trips during the pandemic but making larger purchases especially in storable products (e.g., frozen, canned, and dry products). This forced retailers to alter their product mix offered (a.k.a., SKU). The change in consumer behavior in turn created new logistical and pricing challenges for purchasing agents, suppliers, and transportation. These challenges were not only experienced locally, but on a global scale as well.

Like suppliers, to cope with these challenges' retailers increased worker safety. To reduce stockouts, retail began hiring an around-the-clock work force and increased the frequency of replenishment deliveries even to the detriment of more efficient full truck loads. This led to a strain on the capacity of available trucks and together increased transportation costs. Retailers were also forced to increase cooperation and communication with suppliers and other business partners. Nonetheless, stockouts persist in many products due to reliance on pre-COVID informational systems and management directives.

Several lasting and future issues are facing the retail sector and are suggestive of potential academic research areas. Consumer purchasing patterns and food sourcing has shifted from foodservice to retail and E-commerce. A Consumer Brands survey found that 80% of the consumers will continue purchasing food via E-commerce. The question facing the food supply chain is to what degree these patterns will persist. Future purchasing patterns are expected to be impacted by the degree to which workers continue working at home and the costs of last-mile delivery, both testable hypotheses. To accommodate these changes, retailers, suppliers, and other business partners must continue to improve cooperation and communication. To do so will require an evolution in new corporate organizations and more dynamic nonlinear network designs. This system redesign is expected to aid satisfaction of increasing consumer demand for transparency and improving consumer trust, both of which may lead to less hoarding behavior during future disruptions. It is also expected that new government policies and involvement may

improve the function and resiliency of the supply chain. Finally, due to the shift in food sourcing, plastic packaging and waste are expected to incline. As such, the 'broken' recycling system needs to be fixed.

To prepare for future pandemics, several specific areas of academic research were proposed for the retail sector. The first is increasing the development, management, and effective use of big data systems. The second is a wholistic redesign to a more nonlinear dynamic supply chain, which will require better data management and cooperating systems along the supply chain.

2.5 United States Department of Agriculture

In response to the food supply chain disruptions, the USD instituted the COVID-19 AFRI Program: Rapid Response Foundation Program consisting of nearly 14 million dollars to Universities. The topics included i) health and security of livestock, ii) food and food processing, iii) well-being of farms, foodservice, and rural America, and iv) economic security. Projects were funded primarily based on their quick application to inform and aid consumers and food growers, processors, distributors, and retailers. Dr. Robbin Shoemaker, the National Institute of Food and Agriculture National Program Leader, suggested several areas of future research for academicians. The first is evaluating the short-term and long-term risks to agricultural supply chains from climate change. The second is describing the interaction between innovation in the agricultural sector and supply chain risk. Third, exploring the nature of supply chain risks in specific agri-food sectors, such as livestock, organic food, and wine. Finally, considering the impacts of public policies, including agricultural policies, trade policies, and environmental policies, on the nature of agricultural supply chains and their risk of disruption.

3.0 Summary of Conference Participation

The conference was supported by 363 registrants from 36 US states and 10 countries (Figures 1 and 2) representing industry, academia, and government alike. The virtual conference maintained between 100 to 150 active participants at a time, as some were more interested in only one or two of the speaker presentations.

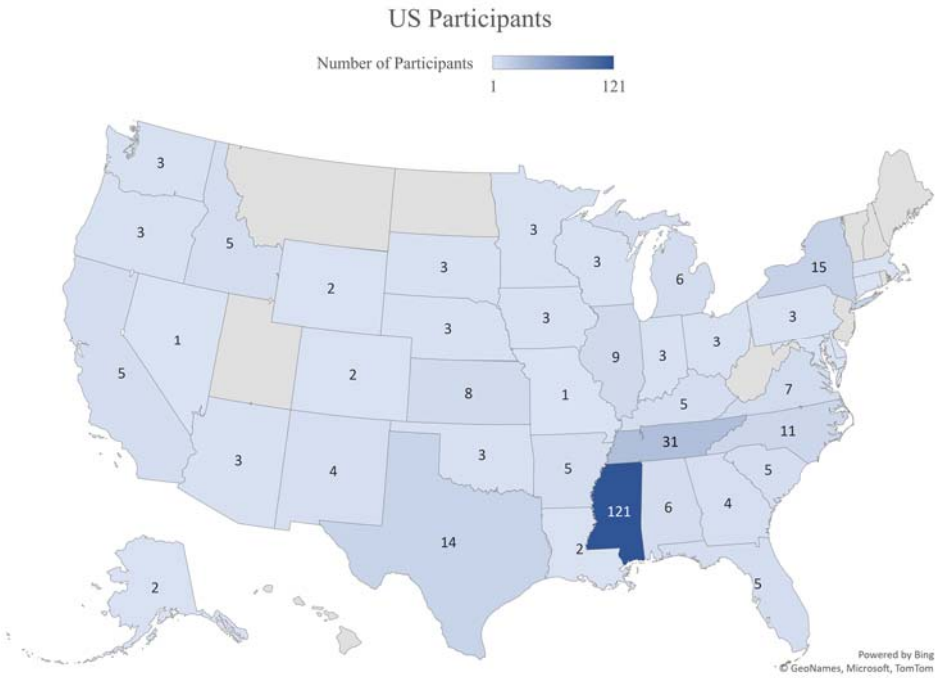


Figure 1

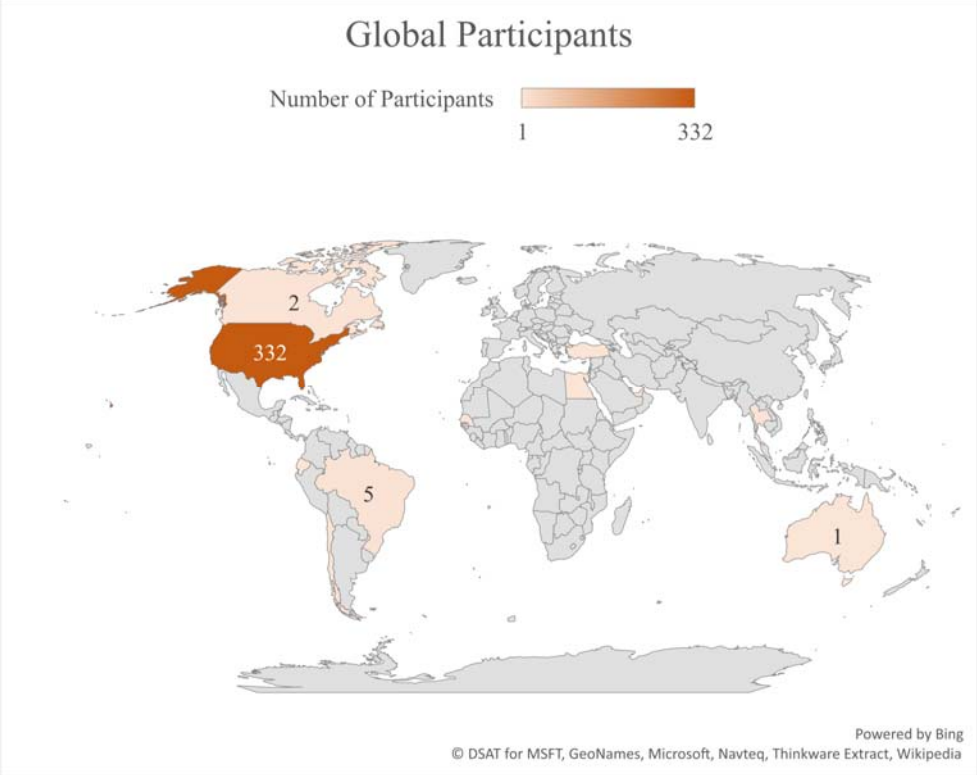


Figure 2

Appendix A provides the participant demographic descriptive statistics collected at registration. The following summary of results is only for those recording an answer to the following

questions. Regarding race and sex information, most were Caucasian (70%) and males (78%). The largest portion of the participants represented academia (75%), with a smaller proportion from industry (9%) and government (3%). Most of the participants were faculty and students (66%) with the remainder holding management, independent research, and post-doc positions (43%). Most participants had between 10 and 30 years of experience (81%) and some over 30 years (19%). Over half of the participants were directly involved in responding to the COVID-19 pandemic (57%). Nearly half of the participants were directly affiliated with the food and agricultural food supply chain (43%), while a slightly larger proportion reported they were involved in other areas (57%). Finally, most of the participants were willing to share their contact with the FACTS group (67%).

Though participation from industry was not as great as hoped, the participants displayed a wide variety of interests and expertise. Overall, the participants have a great deal of experience in their respective fields, and many were involved to some degree in responding to the COVID-19 pandemic. Finally, the participants were largely a collaborative group in favor of allowing the FACTS team to share their contact information to facilitate future research connections.

4.0 Summary of Participant Survey

An *ex-post* participant questionnaire was conducted with Mississippi State University IRB approval. The responses from 67 participants (18.46 % response rate) are provided in Appendix B. Most of the respondents were from academia (82.81%) followed by industry (9.38%) and government (7.81%).

The industry respondents were from the produce, catfish, and grains industries, as well as new product research and development. These respondents echoed the speakers regarding the responsiveness of their organization regarding labor, the impacts that COVID-19 had on their supply chains, as well as their proposed short- and long-run solutions. For more specific details, we invite the reader to their answers to questions I6 to I9.

Academician respondents were primarily from Colleges of Agriculture - many stating an economics background - with notable exceptions from industrial engineering, business, veterinary science, and law. Most of the respondents were very familiar with production/manufacturing and distribution. Roughly 28% have expertise in meat and poultry industries, 31% in produce, and 38% in a variety of other agricultural products and retail.

The academic responses to questions A5 to A7 in Appendix B provide a detailed list of supply chain disruption research interests, proposed short-run, and proposed long-run solutions. Respondent interests span the entire food supply chain including but not limited to human resource management, production practices, logistics, contracting, community development, and government regulation. Research that has been planned to be conducted to develop short- and long-run solutions for future pandemic disruptions are varied, and thus we invite the reader to peruse the list for comparison to their research interests. Essentially, the proposed researchable solutions are related to the respondent's research interests.

The government respondents indicated they were involved in produce, economic development, all commodities in general. Limited responses were given for supply chain disruptions on their stakeholders, and proposed research was general.

5.0 Conclusions and Suggested Areas of Research

Though only a few sectors of the food supply chain were represented, their industries are instructive to other food supply chains as well. Given the extremely complicated nature of business interconnectivity and the sheer scope of the COVID-19 impacts that reverberated up and down the food supply chain, there appears to be no area of research too small to be an important contribution to mitigating the impacts of another pandemic.

From what was learned during the conference, some major areas of current and future research were identified. It is suggested that food supply chain research should focus on feasible solutions for improved labor safety, labor-saving technologies, alternative logistics, inventory management less reliant on just-in-time, more flexible vertical contracting, expansions to and improvements of data and data management, increases to vertical information sharing, improved product shelf-life technologies, new eco-friendly packaging materials, multi-product processing plant designs, processing industry capacity, distribution storage, and consumer demand studies. Given the vast array of researchable topics, successful improvements to the resiliency and efficiency of the food supply chain will require an interdisciplinary research approach that fully recognizes these interconnections along the food supply chain.

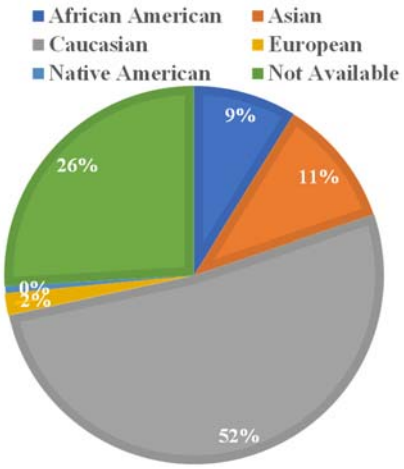
Appendix A: Participant Demographics

Participants Demographics

- Total registered attendees: **363**
- The participants attended from **41** different US states. The top *three* US participants were from Mississippi (**121**), Tennessee (**31**), and New York (**15**).
- The participants attended from **11** different countries. The top *three* global participants were from United States (**332**), Brazil (**5**), and Canada (**2**).

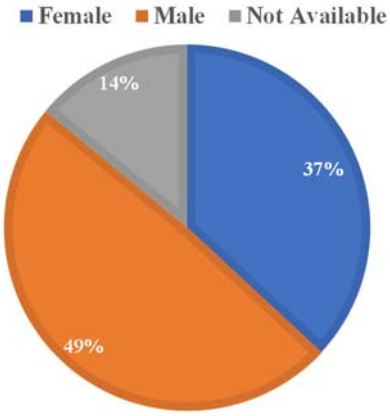
Race

- Total registered attendees: **363**
- Among the registered attendees, **9%** were African American, **52%** Caucasian, **11%** Asian, **2%** European, **0.6%** Native American, and **26%** didn't report their gender.



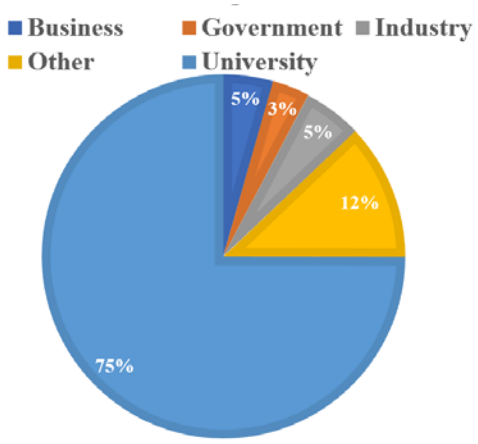
Gender

- Total registered attendees: **363**
- Among the registered attendees, **49%** were male, **14%** female, and **37%** didn't report their gender.



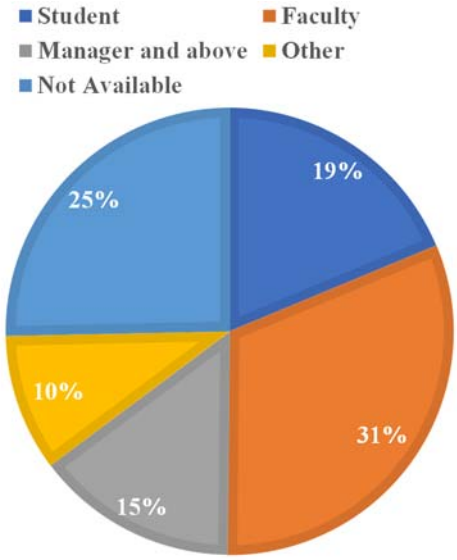
Organizational Affiliation

- Total registered attendees: **363**
- Among the registered attendees, **75%** were from University, **5%** from the industry, **3%** from Government, **4%** have their own business, and others **12%** (didn't specify).



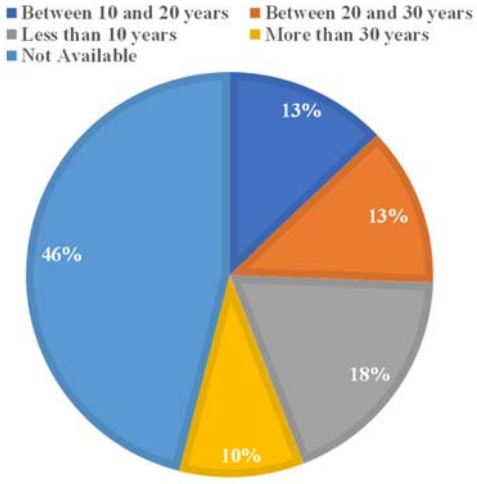
Position Within Organization

- Total registered attendees: **363**
- Among the registered attendees, **19%** were students, **31%** faculty, **15%** managers and above, **10%** others (e.g., independent researchers, postdocs), and **25%** didn't report their position.



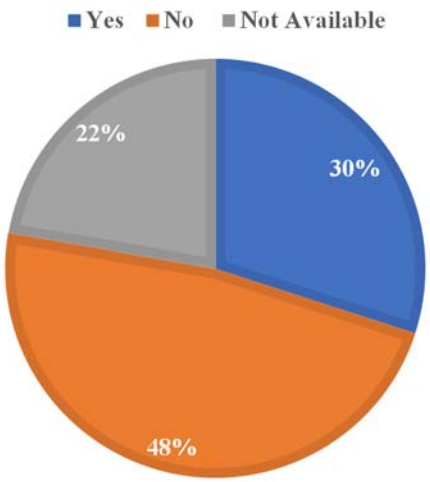
Professional Experience

- Total registered attendees: **363**
- Among the registered attendees, **18%** had less than 10 years of professional experience, **13%** between 10 to 20 years, **13%** between 20 to 30 years, **10%** more than 30 years, and **46%** didn't report their years of professional experiences.



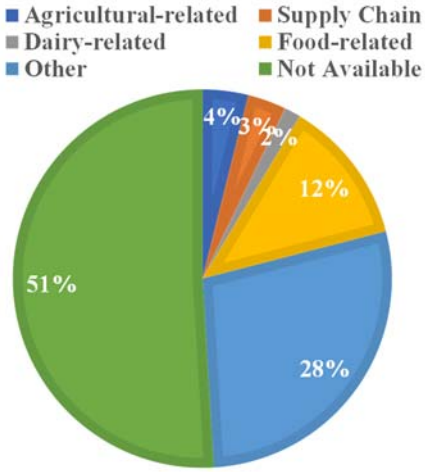
COVID 19 Response Involvement

- Total registered attendees: **363**
- Among the registered attendees, **30%** were involved with COVID 19-related responses, **22%** were not, and **48%** didn't report their involvement.



Area of Expertise

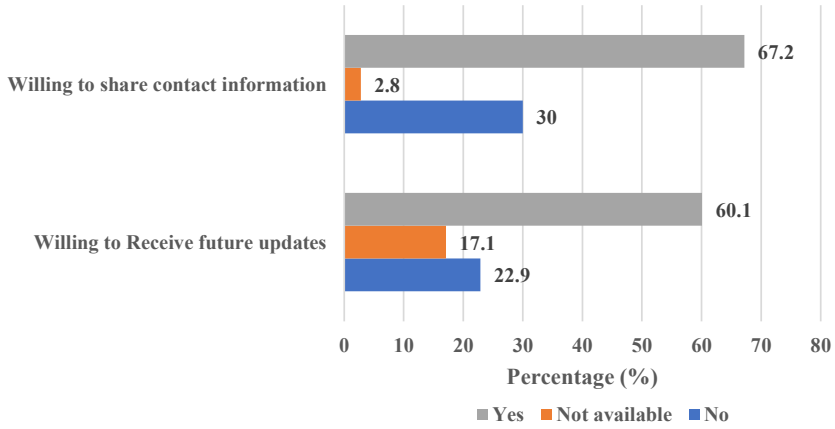
- **Total registered attendees: 363**
- **Among the registered attendees, 4% were involved with agricultural-related research, supply chain, 2% dairy-related, 12% food-related, 28% others, and 51% didn't report their expertise.**



3%

Willingness for Future Collaboration

- Total registered attendees: **363**
- Among the registered attendees, **67.2%** were willing to share contact information with FACTS, **30%** were not, and **2.8%** didn't respond.
- Among the registered attendees, **60.1%** were willing to receive future updates from FACTS, **22.9%** were not, and **17.1%** didn't respond.


Willing to share contact information
67.2
2.8
30
Willing to Receive future updates
60.1
17.1
22.9
0
10
20
30
40
50
60
70
80
Percentage (%)
Yes
Not available
No

Appendix B: Participant Survey

Qualtrics Report
Supply Chain Conference - Survey
June 3rd 2021, 10:24 pm MDT

Consent - Survey Consent IRB Approval Number: IRB-21-138 Title of Research Study: Supply Chain Conference Survey Researcher(s): Thu Dinh, Kalyn Coatney, Mohammad Marufuzzaman The following survey is associated with the virtual conference "Food Supply Chain Disruptions during the COVID-19 Pandemic: Lessons Learned and Future Implications". The information collected includes COVID-19 impacts on your organization and solutions developed to respond to these impacts. The information will be anonymous with no link to you or your organization. If you choose to participate in this survey, you should expect to spend 5 to 15 min to answer 5 to 9 questions, depending on whether your organization is from the industry (9), academia (7), or governmental agencies (5). If you have questions about this survey, please contact Drs. Thu Dinh (thu.dinh@msstate.edu; 662-325-7554), Kalyn Coatney (ktc76@msstate.edu; 662-325-7983), or Mohammad Marufuzzaman (mm2006@msstate.edu; 662-325-3865). Please understand that your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue your participation at any time without penalty or loss of benefits. Please take all the time you need to read through this document and decide whether you would like to participate in this research study. If you decide to participate, your completion of the research procedures indicates your consent. Please download this form for your records. The MSU HRPP has granted an exemption for this research (IRB-21-138). Therefore, a formal review of this consent document was not required. Consent for survey Do you agree to proceed with the survey?

#	Answer	%	Count
1	Yes, I agree to proceed with the survey	98.53%	67
2	No, I want to exit the survey	1.47%	1
	Total	100%	68

S1 - Please select the category that best represents your organization.

#	Answer	%	Count
1	Industry	9.38%	6
2	Academia	82.81%	53
3	Government	7.81%	5
	Total	100%	64

I1 - Please specify your commodity group or industry.

#	Answer	%	Count
1	Meat	0.00%	0
2	Poultry	0.00%	0
3	Produce	16.67%	1
4	Dairy	0.00%	0
5	Others	83.33%	5
	Total	100%	6

I2 - Since you chose "Others" in the previous question, please specify your commodity group or industry.

Since you chose "Others" in the previous question, please specify your commodity group or industry
New Product Research & Development
US Farm Raised Catfish
Grain crops

I3 - What is the size of your labor force?

#	Answer	%	Count
1	0 - 50	75.00%	3
2	51 - 200	0.00%	0
3	201 - 1000	25.00%	1
4	1000+	0.00%	0
	Total	100%	4

I4 - At what degree was your labor workforce impacted during the early-stage of the COVID-19 pandemic?

#	Answer	%	Count
1	Severely	75.00%	3
2	Moderately	0.00%	0
3	Not impacted	25.00%	1
	Total	100%	4

I5 - At what degree was your raw material supply impacted during the early-stage of the COVID-19 pandemic?

#	Answer	%	Count
1	Severely	25.00%	1
2	Moderately	50.00%	2
3	Not impacted	25.00%	1
	Total	100%	4

I6 - How would you define your company's overall level of responsiveness against COVID-19?

#	Answer	%	Count
1	Very responsive	75.00%	3
2	Moderately responsive	0.00%	0
3	Not responsive	25.00%	1
	Total	100%	4

I7 - Please briefly describe the major supply chain disruptions by the COVID-19 pandemic on your company (for example regarding labor, regulations, production, order fulfillment, production cost and efficiency, distribution, or others - please specify).

Migration to Online Platforms to generate sales
Labor was and still is our biggest concern---still down 30% from Pre-Covid levels. Have been shorting orders and rationing production for last 8 months. Now we are intentionally choosing which customers/truck routes to drop so we can adequately service remaining customer routes. Initially had some shortages on PPE and sanitation supplies forcing us to seek additional suppliers at 300-400% inflated costs. Some of packaging and box orders were shorted and back ordered which drives up delivery costs. It took us into June before we got ahead and were able to warehouse enough to offset the delayed deliveries.
Minor disruption of distribution of chemical and seed from manufacturers to retailers.
Decrease in labor, increase in demands and not having the tools and resources to expand production or planting.

I8 - Please briefly describe any short-term solutions employed by your company in response to the COVID-19 disruptions described above.

Waiting for the Farmers Market to reopen for the season.
Found additional suppliers for all packaging and supplies, ordered in larger quantities, added some warehouse storage, cancelled most inefficient truck routes and moved or deleted customers, manage production daily to allocate against orders, customers and product mix
none- late but acquired
We connected with other local small farmers and purchased produce to fulfill produce boxes and collectively started a farmers' market and network to work together to get through COVID

I9 - Please briefly describe any long-term solutions implemented in your company as preventative measures for future pandemic disruptions.

The need for capital for outsourcing-Digital Marketing/Ad. companies for more aggressive and penetration into the retail ecosystem.
Evaluated all customers, profitability, volume, delivery routes, pay history, loyalty and demands to keep the "Best". We raised wages, held job fairs, advertised on social media, and contracted with multiple employment agencies to bring/transport more employee candidates from other areas outside our 20-mile zone.
hopefully none
We are implementing strategies to meet our demands. Seeking funding opportunities to support and to increase planting, installing a greenhouse and a mobile refrigerated unit

A1 - What are your discipline(s) and sub-discipline(s) (if applicable)?

Food marketing and consumer behavior
Industrial Engineering
Food safety
Agricultural Economics
Agricultural Economics and Community Economic Development
economics, business management, accounting, marketing, extension education, agricultural research
Veterinary medicine
Horticulture
Rural Sociology
Rural Development
Agricultural Economics, Value Chain and Market Analysis, Gender Analysis
AGRICULTURAL ECONOMICS
Economics and Extension
Agribusiness
Agricultural Economics
Food and agribusiness
Industrial and systems engineering
sustainable agriculture and natural resources
Extension Education
supply chain
Agricultural Economics
Agribusiness, marketing, marketing management, consumer demand, risk
consumer science, agricultural economic
meat and poultry processing
Agribusiness
veterinary medicine, epidemiology

Food Safety Education
economics
Agricultural Economics
Economics
Law
Agricultural Economics
Industrial Engineering
Education
Sustainable agriculture and food systems
Agricultural/natural resource economics
agriculture business and marketing
Extension - Animal Agriculture
Food science, food industry management
Agricultural Economics, Health Economics
Food studies
ag econ
Meat Science

A2 - What area related to the food supply chains are you most familiar with (production, manufacturing, warehousing, distribution, or others - please specify)?

Marketing
distribution/supply chain
production
Cattle production
manufacturing
Food distribution, local food systems, small farms, marketing, risk management, laboratory and greenhouse management
production
production
Production
production
Production
Production
PRODUCTION, MANUFACTURING, FISHING CAPTURE
Production
manufacturing
Production; Retail
institutional oversight and regulation including transparency and traceability
Production, Manufacturing
production
manufacturing and technical services
purchasing
Production
Farm gate through consumer - both large commercial operations and small
consumptions, production
production, manufacturing

production
production
Microbiology and Food Safety
production
Production
Production
Production and manufacturing
Production, supply chain management
Production
production, distribution, warehousing, retail
Production
I work within the full supply chain; production to the consumer
Production
Production, Innovation and technology
Human Capital
Production
production
Production

A3 - Please specify the food industry that is best aligned with your expertise.

#	Answer	%	Count
1	Meat	26.19%	11
2	Poultry	2.38%	1
3	Dairy	2.38%	1
4	Produce	30.95%	13
5	Others	38.10%	16
	Total	100%	42

A4 - Since you chose "Others" in the previous question, please specify the food industry that is best aligned with your expertise.

Peanut
grains, oilseeds, cotton, vegetables
Food chemicals
CPG
food consumption at home, niche markets (farmers markets, local, organic), food insecurity
Meat, Poultry, Dairy, and produce, I deal really with all of them
organic, sustainable, craft, regional
General Retail
Food safety

A5 - Please briefly describe major supply chain disruptions by the COVID-19 pandemic you are most interested in researching (for example regarding labor, regulations, production, order fulfillment, production cost and efficiency, distribution, or others - please specify).

Changes to the working conditions or adaptions to the work environment to address COVID concerns and how COVID may accelerate mechanization.
Labor markets and regulations, unemployment, immigration policy; market structure of food processing capacity.
oversight and regulations
Production, distribution
labor and production
issues with production, food safety, regulations, distribution
NONE
change in consumer habits and it affect on derived demand; risk management efforts; increased cost of production due to COVID responses and who within the supply chain bears that burden
changes in food purchases: categories of food purchases, food expenses, use of online services; labor issues in production, processing and distribution, worker safety; health, sustainability, and resilience of food choices/system
changes in seasonal production caused by unexpected disruptions
pre harvest production
production, processing and distribution
production cost and efficiency, production, labor
Informing production risk management decisions using info from changing trends in markets and labor and trade policy directions.
I'm more interested in the impacts on contract development and changes that arose in contracts to manage the risks associated with a global pandemic.
Entire supply chain management from producer to consumer. In the meat industry understanding the production cost and efficiency and impacts of COVID 19 as well as where we move in the future.
Improved resilience through regional food production and distribution -- diversification of the food system, market access, food access for vulnerable communities (rural/ethnic)

Interested in distribution efficiency in grocery stores
Most interested in researching would be consumers change in purchases and consumption. Recognizing these changes, we would consider short term changes but may have long lasting effects on the supply chain.
Labor shortages on farms and packing plants Distribution of processed meat to retailers and consumers Depopulation of healthy farm animals when processing labor supply is insufficient to keep pace with animal numbers
Production and distribution changes. Adoption of new technologies
Labor, Human Capital, Distribution
distribution

A6 - Please briefly describe short-term solutions you have researched or plan to research in response to the COVID-19 disruptions described above.

Change in net and total revenue related to COVID and how producers and processors adapted.
Measuring resilience in local food system supply chains in response to the COVID-19 shock.
My interest is primarily as the administrator of the agricultural economics and agribusiness programs, including experiment station and extension, that are part of the Ness School of Management and Economics at South Dakota State University.
local labor force involvement because the number of immigrant workers is low. How training the local force is very important especially areas with food deserts and lack of food hubs or pantries
Planning for disasters such as covid and other natural or man-made disasters
NONE
none to date, but may
mobile markets, community/nonprofit responses to address food insecurity
none as yet
economics of raising heifers, bulls rather than sending to harvest
Labor saving tech adoption Labor management to achieve marginal gains from HR Changes in consumer demand for produce
At this point mainly looked at force majeure clauses.
Regional sustainability

I am part of a five-state team investigating regional food resilience response to covid. We intend to pull out some of the short-term strategies that independent businesses are using to stay in business.
None
Short-term solution of promoting community supported agriculture (CSA) and community gardens to help provide a source of fresh fruits and vegetables.
Changing pork processing paradigm to be less processing plant labor intensive Rendering as a useful (albeit imperfect solution) to carcass disposal following depopulation events Instituting stronger worker protection measures to prevent disease spread in plants and on farms
Adoption of current AI and blockchain technologies to improve current weaknesses in the ag supply chain.
Effects of COVID-19 on online food ordering, impact of COVID-19 on worker health.
nutritional impact

A7 - Please briefly describe long-term solutions you have researched or plan to research as preventative measures for future pandemic disruptions

Outreach to and safety nets for workers. Scale adjustments particularly to processing operations.
Un-consolidation of agricultural production and/or processing firms.
Strengthening small farmers cooperatives and engaging Cooperative Extension to train the most forwarding looking groups of cooperatives
Providing education and resources to food entrepreneurs
NONE
none to date, but may
food sovereignty, food justice, agricultural policies, zoning/agricultural land preservation
none as yet
Same as above
None at this point
I work on underlying structural weaknesses in the food system that were exacerbated by covid, such as oversupply, market concentration, price discovery, technology access, . I am working on a perishables food flow project and see a need to investigate seasonal distribution logistics

issues, market fairness, rural food access. We need research that better organizes markets, distribution, production in the public interest.
None
Long-term solution would be assisting policy makers with insight about the potential for a state meat inspection program to allow for value-added meat products for fresh local supply of animal proteins.
Changing pork processing paradigm to be less processing plant labor intensive Rendering as a useful (albeit imperfect solution) to carcass disposal following depopulation events Instituting stronger worker protection measures to prevent disease spread in plants and on farms Find ways to depoliticize public health events like COVID and have NATIONAL plans in-place to mount a unified response. Our President's denial of the seriousness of this disease, and his actions to thwart preventive measures in some states should never be allowed again. Science and medicine should take the lead in responses to future events like COVID-19 pandemic
The long-term framework of data and machine learning to address weaknesses in the ag supply chain to prevent future disruptions in the face of pandemics and/or other disasters.
Long term impact of COVID-19 on worker behavior and safety, effect of COVID-19 on supply chain labor resilience.
infrastructure

G1 - Please specify the commodity group or food industry you represent

#	Answer	%	Count
1	Meat	0.00%	0
2	Poultry	0.00%	0
3	Produce	40.00%	2
4	Produce	0.00%	0
5	Others	60.00%	3
	Total	100%	5

G2 - Since you chose "Others" in the previous question, please specify the food industry that you represent

Development
All of them

G3 - Please briefly describe major supply chain disruptions by the COVID-19 pandemic experienced by your stakeholders (for example regarding labor, regulations, production, order fulfillment, production cost and efficiency, distribution, or others - please specify).

None really
Shortage of labor for crops such as chile. Transportation bottlenecks due to sky rocketing demand.

G4 - Please briefly describe short-term solutions developed by your stakeholders in response to the COVID-19 disruptions described above

USDA is helping covid related issue with different policy programs.
Increase the load limits through our state DOT

G5 - Please briefly describe long-term solutions developed by your stakeholders as preventative measures for future pandemic disruptions

Food connection sites.