Farm system resilience during the COVID-19 pandemic:

A survey-based analysis of impacts and adaptations among farmers in Washington State

Anna Levu Fogel

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Public Health

University of Washington

2022

Committee:

Sarah Collier

Yona Sipos

Program Authorized to Offer Degree:

Nutritional Sciences

University of Washington

Abstract

Farm system resilience during the COVID-19 pandemic:

A survey-based analysis of impacts and adaptations among farmers in Washington State

Anna Levu Fogel

Chair of the Supervisory Committee:

Sarah Collier

Nutritional Sciences

The shock of the COVID-19 pandemic caused many impacts in Washington's farming system including labor, distribution, processing issues coupled with changing economic and consumer practices. In order to cope with these unforeseen issues, the farming sector had to adapt their business practices accordingly. Resilience, or ability of a farm to continue business functionality, is rooted in three primary capacities: robustness, adaptability and transformability. To identify what impacts were most experienced by farms in WA state and adaptations they instated to continue operation a survey was developed and deployed to farm owners and operators in WA state between December 2020 to January 2021. This survey attempted to identify how impacts and adaptations varied amongst farms in WA state based on specific characteristics rooted in resilience attributes blanketed under the three primary resilience capacities. Primary themes from collected data included how impacts varied greatly amongst farms and how different farm characteristics could influence the flexibility, adaptability and rapidity in which businesses were able to respond and/or adapt to these impacts.

Table of Contents

Land and Support Acknowledgement

This study was completed and presented on the traditional land of the first people of Seattle, the Duwamish Tribe past and present, with gratitude and honor to the original descendants of this land. This project was done in partnership with the Washington State Department of Agriculture and Washington State University Extension and I would like to extend gratitude to all partners who played a huge role in the success of this project. I would also like to thank the University of Washington's Nutritional Sciences Program funding for contributing funds to promote the success of this project. I'd also like to extend a huge thanks to family, friends, classmates and UW faculty for their support, especially my sister April who helped me in a multitude of ways.

And a special acknowledgement to all the farmers that participated in this survey!

Introduction

The shock of the COVID-19 pandemic and subsequent social, economic, technological, and ecological challenges affected all demographics throughout the globe on a multitude of levels (Meuweissen, et al. 2020). One system that was severely affected by the issues caused by COVID-19 was the farming system. The ability of farms to cope with and respond to these shocks ensuring system functionality and continued access to food has been of particular interest to a multitude of players globally in federal, social and academic sectors, especially through how farms utilized attributes of change blanketed under 3 resilience capacities (Meuweissen, et al. 2021). Washington state has >35,500 farms in operation and produces ~2% of the nation's agricultural products, making it the perfect location to understand how farms of various types experienced the shock of the COVID-19 pandemic. Utilizing survey data with specific questions related to farm system resilience, this paper attempts to identify what impacts were most experienced by farms of varying characteristics and how different farms were able to adapt to these impacts effectively.

What is COVID-19 and rules/regulations that caused the onset of farm system shock?

The coronavirus disease (COVID-19) caused by the novel coronavirus SARS-CoV-2, is an easily transmissible zoonotic disease that was identified in Wuhan, China in December 2019 (Galankis, 2020). It was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020 (WHO, 2020). To mitigate infection amongst Washington (WA) state's population, recommendations set forth by the Centers for Disease Control (CDC) were enacted

generating a federally mandated lockdown and stay-at-home orders for all residents of WA state on March 25, 2020 (Proclamation 20-25, 2020). This resulted in the closure of schools, workplaces, restaurants and any location that facilitated the congregation of large groups of people (Proclamation 20-25, 2020). Orders eventually extended to include mask mandates and social distancing, causing businesses to require personal protective equipment (PPE) and operate at limited capacities (Reardon, 2020).

The farm system was severely affected by these social distancing mandates as it was considered an essential employment sector required to continue operations in order to facilitate access to food for all populations in mandated lockdown (Galanakis, 2020). The shock of these closures affected both global and domestic food chains. Negative feedback loops caused by the shock of COVID-19 caused labor, processing and distribution issues to name a few (Meuwissen, et al. 2020). The unforeseen impacts caused by these issues affected all farming systems throughout the world (Galanakis, 2020) including WA state, one of the US's leading agricultural producers (US Census, 2017).

Overview of WA state agricultural sector and effects of COVID-19

Due to its diverse climates, rich soils, and historical ability to sustain large-scale irrigation, Washington ranks 14th in the US and accounts for 2% of total US agricultural sales (Cargill, 2016). Currently there are more than 35,500 farms and 14,600,000 acres in agricultural operation statewide (Cargill, 2016), with farms producing over 300 different agricultural products (US Census, 2017). Washington is the #1 producer of apples in the US, making up 70%

of the nation's total apple crop and generating $1.95B in annual revenue (WSDA, 2020). It is also the country's #1 producer of raspberries, blueberries, hops, pears, spearmint oil, sweet cherries, and aquaculture products (WSDA, 2020).

The agricultural sector is an important part of Washington state's economic success, adding $51B/y to the state's gross domestic product (GDP) and making up over 13% of the state's total economy (Cargill, 2016). The market value of agricultural products sold in Washington totaled $9,634,461 in 2017 (US Census, 2017). There are over 200 food processing companies located in Washington state, generating $21.8B in annual revenue (Cargill, 2016). Over 160,000 WA residents are employed in the agricultural and food industry (US Census, 2017). These figures indicate the importance of the agricultural sector not only providing access to food but also providing employment and income for thousands of WA residents.

What is resilience?

The concept of resilience originates in physics and mathematics and was used to describe the capacity of a material or system to return to equilibrium after displacement (Norris, 2008). Resilience as an ecological concept was originally presented by Holling (1973) who defined it as "the amount of disturbance a system can absorb before shifting into an alternative state".

As opposed to stability, resilience is rooted in change and uncertainty causing the need for adaptability to continue system functionality (Holling, 2001). Resilience can also be defined as "the capacity that ensures the adverse stressors and shocks do not have long-lasting adverse

development consequences" (Constas, 2014). In this case, both the shock and the stressor are the COVID-19 pandemic. The importance of this definition is embedded in the fact that resilience is the ability for a system to respond and/or adapt to singulair adverse effects (shocks) or prolonged adverse trends (stressors) within the system.

The idea of resilience has been generically adapted to increase understanding around social-ecological systems and characterized in a multitude of ways specific to the discipline in which each definition has been developed (Constas, 2014). Most definitions of resilience focus on the capacity of a system to withstand or adapt to disturbances over time (Anderies, 2013), including unpredicted shocks such as the COVID-19 pandemic, that are not accounted for in risk management or robustness analyses (Jones, 2013).

What is farm system resilience?

A farming system is made up of any systemic actor who interacts formally or informally in an agro-ecological context, which spans to include local networks all the way to upstream players (i.e. policy makers and lobbyists) (Meuwissen, 2019). Farm system resilience has been defined by Meuweissen (2021) as the "ability to ensure the provision of its desired functions in the face of often complex and accumulating economic, social, environmental and institutional shocks and stresses through anticipating, coping and responsive capacities". These capacities are grounded in adaptive cycles and adaptive governance, identifying the need for flexibility to achieve desired functionality (Meuwissen, 2019). In the context of this study, these 3 capacity definitions adapted from Meuweissen (2021) are as follows:

- **Robustness** - the farm system's capacity to withstand the unanticipated shock of the COVID-19 pandemic, including ex-ante (preshock) attributes and characteristics
- **Adaptability** - the capacity to change composition of inputs, production, marketing and risk management to the shock of COVID-19 while maintaining previously established structures and feedback mechanisms within the system
- **Transformability** - capacity to significantly change feedback mechanisms and internal structure of the farming system in response to impacts caused by COVID-19 that makes it impossible to maintain the "status quo"

These attributes include resourcefulness, rapidity, diversity (responsive and complementary), innovation (conservative and transformative), flexibility, redundancy, tightness of feedback, systems reserves, openness, and modular connectivity (Meuwissen, 2019; Tendall, 2015; Norris, 2008). Farm system resilience can also be affected by an environment that can enable or constrain adaptation (Termeer 2019), particularly institutional arrangements and resource availability (Mathijs, 2020). The three aforementioned capacities define a possible range of actions that maintain functioning of the farming system, affect the actors, institutions and resources involved, and constitute a feedback loop (Meuwissen, 2021).

Farming systems are different when compared to other ecological systems due to the fact that farms are actively trying to control their environment while evading unintentionally induced environmental disruption caused by uncontrollable natural processes (Meuwissen, 2019). Since farms operate in an open agro-ecological system that is linked to different networks and economic processes, their activities have multiple effects and generate public goods (Meuwissen,

2019). Adaptive cycles then become a hands-on approach guiding attention to systemic change and transition focus away from conserving the system's equilibrium (Meuwissen, 2019).

A complementary concept to resilience is sustainability, or the ability to achieve today's goals without compromising future capacity to achieve them (Brown, 1987). Since resilience is the ability to continue to achieve these goals even in the face of a systemic shock such as the COVID-19 pandemic, it is important to establish the connection between these two concepts (Tendall, 2015). But, while these concepts are complementary, sustainability is a measurement of performance whereas resilience is the ability to achieve preserved performance during times of disturbance or uncertainty, which extends to the COVID-19 pandemic (Maleksaedi, 2013; Brand and Jax, 2007).

Why is resilience important?

Identifying resilience as a capacity allows for measurable ex-ante (preshock) attributes that allow for a positive shift during a shock and the corresponding outcome (Constas, 2014). Conventional approaches to dealing with a shock usually revolve around resolving the problem once it has occurred (Constas, 2014). Resilience is important because it indicates an alternative perspective related to planning for and analyzing the effects of shocks and stressors, such as COVID-19, that threaten the livelihood and well-being of vulnerable populations (Constas, 2014). This is particularly important for farmers who play a pivotal role within the food system but operate within a very thin margin that is extremely volatile and affected by a multitude of external factors.

Resilience also allows for the formation of social capital that can act as the building blocks for a sustainable system accomplished through the formation of a virtuous circle of development (Hoddinott, 2014). Social capital can be defined as "individuals investing in access and using resources embedded in social networks to gain returns" (Lin, 2001). Many studies focus on ecological disturbances, but the unexpected shock of COVID-19 identified the role economic and social shocks can play on a very important part of the food system. Measuring resilience effectively allows for actors within the system to identify their unique experiences, in turn illuminating specific farm attributes embedded within the 3 primary resilience capacities that can absorb and accommodate functionality in the face of unexpected future events.

What is the purpose of this study?

Resilience must be identified as the resilience of what, to what, for what purpose, within which resilience capacities that enhances resilience (Meuwissen, 2019). In this case, it is the resilience of farmers in Washington state to impacts caused by the shock of COVID-19 and their adaptive ability to preserve system functionality.

Resilience can be considered a latent property of a system that can only be observed when a system is hit by a shock (Meuwissen, 2021). Assessing the resilience of Washington's farming system was accomplished through identifying a broad range of challenges that were caused by the COVID-19 pandemic. These challenges were then grouped into seven primary categories: revenue, labor, business/operations, production, customer base,

networks/collaborations, and market channels. Impacts embedded within these categories occurred on the basis of differing and at times conflicting information, state and federal mandates and recommendations, and social distancing (Meuwissen, 2021). Since farms are a vital player in the ability to produce food for all populations, understanding resilience in this context is in the best interest of society as a whole.

In this study we attempted to identify the most significant impacts WA farmers experienced due to COVID-19, what adaptations were necessary for ongoing business functionality, and how a diversity of farm characteristics significantly affected variability in farm experiences. The farm characteristics analyzed in this study were product diversity, market channel diversity, size, age, and geographic distribution. Each of these categories embodies one or more of previously established attributes that contribute to enhanced resilience such as diversity, systems reserves, and redundancy.

Analysis of this survey data based on varying farm characteristics identifies what impacts most significantly affected farms of specific characteristics and adaptations most frequently applied by farms of different types. Further breakdown of qualitative responses directly from respondents gives further insight into the experiences of Washington's agricultural sector during the COVID-19 pandemic. By discussing these experiences within the context of farm system resilience we can tell the story of farmers in Washington illuminating the role resilience can play in ensuring business and system functionality.

Methods

Target Population and Setting

The target population for this survey were farm owners and operators over the age of 18 with farms located in Washington (WA) state. The survey was available in both English and Spanish and was accessible online via REDCap survey distribution and analysis software (Harris, P. et al, 2009). Participants were screened on the survey's introduction page through a binary (yes or no) question indicating if they met the specific criteria required to participate.

Survey Development

This survey was developed in partnership between the University of Washington (UW), Washington State Department of Agriculture (WSDA), and Washington State University (WSU). Survey development meetings were held between August 2020 to December 2020. Partners identified what information was needed to better understand COVID-19 impacts to Washington's agricultural sector and adaptations necessary to continue functionality.

National and global COVID-19 agricultural impact surveys deployed between June 2020 to August 2020 were categorized to identify trends in lines of questioning. The 16 categorized surveys consisted of primarily rapid response surveys identifying immediate needs and concerns of farms globally (Appendix A). The following trends in questioning were identified:

1. Respondent Characteristics
2. Financial Needs/Impacts
3. Market Channel Shifts/Consumer Behaviors

4. Technological Support
5. Market Information
6. General Needs
7. Business/Production Impacts
8. Changes in Business Practice
9. Government Need/Support
10. General Population Concerns/Sentiment

Input for survey question development was gathered from stakeholders directly affiliated with Washington's agricultural sector. Stakeholders were identified through networks and working relationships between study partners and Washington's agricultural sector. A total of 48 public and private organizations were contacted via email between August 2020 to September 2020.

Meetings were conducted online with 17 organizations between September 21, 2020 to October 8th, 2020. All meetings were 45 minutes in length. Stakeholders consisted of private businesses (8), non-governmental organizations (6) and commodity commissions (3). A standard questioning guide was generated centered around three main resilience capacities: robustness, adaptability, and transformability (Meuwissen, 2019). Additional probing questions focused on decision making or "why" specific business decisions were enacted. A combination of information and feedback from partner and stakeholder input contributed to the generation of specific question themes (Appendix B).

Survey Design

This survey consisted of 82 questions total and was temporal in design, allowing for identification of 2019 farm attributes and ex-post (post-shock) changes that occurred (Appendix C). Impacts and adaptations that farms experienced and enacted throughout 2020 could then be assessed based on farm characteristics identified by respondents within the survey. The structure of the survey was as follows:

Section #1: General Farm Characteristics

Section #2: Pre-COVID Farm Attributes (2019)

Section #3: Farm Attributes (2020)

Section #4: Comparison of Farm Attributes by Year (2020 vs. 2019)

Section #5: Operation Experiences During COVID-19

Section #6: COVID-19 Resources

Section #7: Future Perspectives for 2021

Section #8: Stress and Mental Health

Section #9: Respondent Demographics

The survey utilized a mixed methods approach consisting of binary (yes or no), Likert scale and qualitative (short answer) responses. Specific questions used branching logic to identify respondent characteristics and branch them to questions relevant to their farm type. Respondents were required to answer all questions for each section except stress and mental health, which they had the option of bypassing completely. The response 'prefer not to answer' was available for each question giving respondents the ability to choose a non-specific answer while allowing them to progress to the next question. In order to clarify the exact time frame in

which the survey was deployed, specific questions were edited in January to reflect the transition from 2020 to 2021. For example, questions pertaining to 2019 that addressed “last year” were adjusted in January 2021 to use language such as “in 2019”.

To incentivize participation, respondents were given the option to enter their email address into a drawing at the end of the survey for the chance to be chosen for a $50 online gift card. Entry was completely optional and a total of 6 online gift cards were distributed to randomly chosen respondents who completed the survey. Winners were identified via Google number generator based on participant ID (PID). Email addresses were cataloged on a separate secured Excel sheet containing no other identifying information.

Survey Distribution

The survey was deployed online from December 1, 2020 to January 31, 2021. It was distributed in both English and Spanish through 82 public and private networks identified using WSDA, UW and WSU contacts. Standard email outreach language was generated for both network stakeholders partners who provided input for question development and any networks affiliated with the Washington state agricultural sector. Standard email outreach language was also developed in both English and Spanish for distribution to individual farm businesses (Appendix D).

Data Aggregation and Analysis

Separate reports for completed surveys in both English and Spanish were generated in REDCap. A total of 523 respondents participated in the survey with 265 of these

respondents completing the survey. Completed responses were identified as respondents who answered “yes” to a binary (yes or no) question of completion on the final page of the survey. Only completed responses were analyzed and merged into one master Excel spreadsheet.

Observed data for each individual question was calculated in Excel using COUNTIF and COUNTA functions. This data included the total number of respondents for each question, breakdown of n based on individual responses, and percent of n for each individual response. A total of 32 survey questions addressing farm impacts and adaptations were selected for analysis and organized into the following categories: revenue, labor, business/operations, production, customer base, market channels, and networks/collaborations. Farm characteristics were indicated by respondents through five specific survey questions and were included in this analysis. These characteristics reflected specific resilience attributes including diversity and systems reserves which included financial resources and experience (Meuwissen, 2019). Characteristics are as follows:

- **Production Outputs**
    - 1 product = Non-diversified Farm
    - >1 product = Diversified Farm
- **Farm Age**
    - Operation <10 years = New Farm
    - Operation 10 years and older = Established Farm
- **Farm Size**
    - Gross-Annual Revenue (GAR) <$250,000/year = Small Farm
    - GAR greater than or equal to $250,000/year = Large Farm

- **Geographic Distribution** - Farms with geographic distribution of total percent of products at 75% and over for specific distribution channels were classified as:
    - National/International (N/I) Farms
    - Local/Regional (L/R) Farms
- **Market Channel (MC) Distribution**
    - Utilized 1 MC = Non-Diversified Farm
    - Utilized >1 MC = Diversified Farm

A total of 32 adaptation and impact questions were stratified by the 5 business characteristics identified by respondents within the survey and categorized to assess significance, or that respondents of differing characteristics were answering the same questions significantly differently. Any responses including ‘prefer not to answer’, ‘unavailable/unknown’, or that were blank due to branching were excluded from analysis. Responses where participants entered in specific numeric values to indicate total percentage that did not equal 100 were also excluded.

Categorical questions using a Likert scale were given integer values (e.g. 1 to 5) based on the number of potential responses. Two-Sample t-tests assuming unequal variance were run in Excel based on integer-valued responses against the five business characteristics. Significant differences between sample means were identified utilizing a 95% confidence interval for the difference in population means. Binary (yes or no) questions were analyzed in Excel using the chi-squared function. Expected data was calculated in Excel and measured against observed data.

To highlight differences in farm operations from 2019 versus 2020 a breakdown of changes in farm practices were identified using descriptive statistics to indicate changes for all respondents. Statistics highlighting farm characteristics and associations with changes based on year were also identified and categorized. Differences were calculated in Excel through replacing ordinal responses with numeric designations and subtracting numeric responses in 2020 versus 2019.

Branched qualitative short answer questions were coded based on trends identified throughout individual responses. Focused codes were generated, n established and codes categorized based on emergent themes. Focused codes were then stratified based on respondent's initial branching answer, either 'increase' or 'decrease' within the initial Likert-scale based responses. Stratified focused codes were then further categorized into themes based on adaptation/impact question categories previously listed. N for each focus code was identified to indicate the number of respondents who encountered similar experiences during the COVID-19 pandemic.

Results

I. Descriptive Statistics

A. General Respondent Characteristics

A total of 265 farm owners and/or operators completed this survey, 263 in English and 2 in Spanish. Respondent ages ranged from 25 to 94 years, with the highest percentage of respondents (25%) falling into the 55-64 year age category. About 52% of respondents identified as female and 48% male. Approximately 82% of respondents identified as white followed by 4% multiracial, 3% Asian, and 3% Hispanic. About 20% of participants identified as new or beginning farmers and 9% as first generation farmers.

Respondents operated in 33 of Washington's 39 counties (*Figure 1*), with 60% farming in Western Washington and 40% farming in Eastern Washington. King County and other Puget Sound counties had the highest number of responses with a large number of responses also coming from Franklin, Spokane, and Yakima counties. About two-thirds of respondents farmed less than 50 acres. The remaining respondents actively farmed a variety of farm sizes including those over 2,000 acres (*Figure 2*).

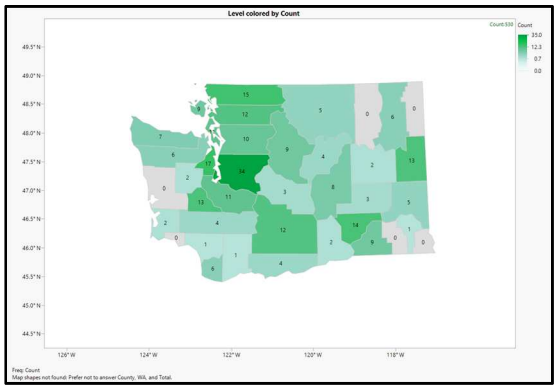

Figure 1: Count of respondents based on county.

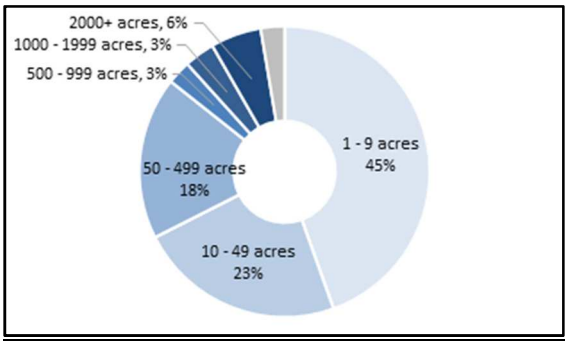

Figure 2: Breakdown of respondents based on total acres actively farmed.

Responses were stratified by 5 specific farm characteristics: product diversity, farm age, farm size, geographic distribution and market channel diversity (*Figure 3*).

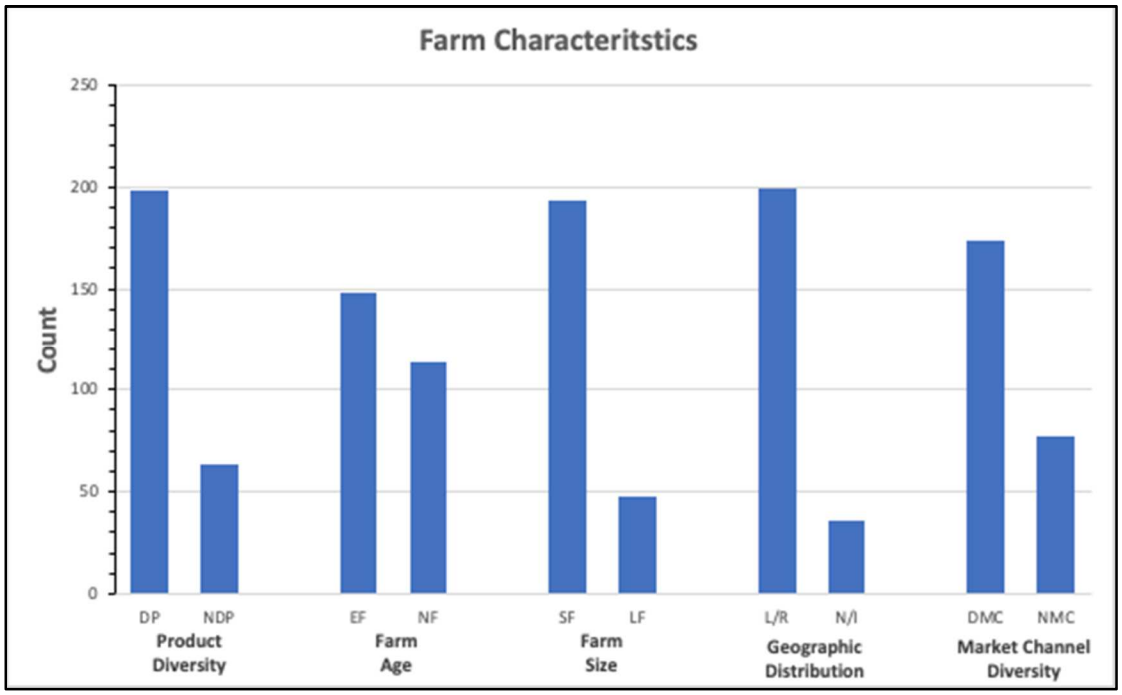

Figure 3: Number of respondents within each characteristic. Breakdown of each category: DP = Diverse Production, NDP = Non-Diverse Production; EF = Established Farm, NF = New Farm; SF = Small Farm, LF = Large Farm; L/R = Local/Regional Distributor, N/I = National/International Distributor; DMC = Diverse Market Channels, NMC = Non-Diverse Market Channels

Out of 261 respondents 75% were identified as diversified producers (DP) and 25% were non-diversified (NDP). A total of 262 respondents specified farm age with 56% identified as established farms (EF) and 44% classified as new farms (NF). Within the 241 respondents who indicated their business's yearly gross annual revenue, 80% were small farms (SF) and 20% were large farms (LF). Of the 235 respondents that specified geographic distribution of market channels, 84% sold their products primarily locally and/or regionally (L/R) while 16% sold primarily nationally and/or internationally (N/I) distributors. Of the 251 respondents who detailed their use of market channels, 69% used multiple (diversified) market channels (DM) to distribute their products while 31% were farms with only one (non-diversified) market channel (NDM).

II. Impact and Adaptation Statistics and Trends Based on Question Category

A. Revenue

Three questions relating to revenue were selected for analysis. These were stratified by the 5 farm characteristics and analyzed for significance (*Table 1*). These questions included changes in net annual revenue (NAR) in 2020 compared to 2019, loss of off-farm-income in 2020 vs 2019, and changes made to sales prices in 2020. Significance was identified for change in NAR based on farm age and loss of off-farm income based on market channel diversity.

Table 1: Significance of farm characteristic for questions related to revenue

	Farm Characteristic				
Question	**Product Diversity**	**Farm Age**	**Farm Size**	**Geographic Distribution**	**Market Channel Diversity**
	---------- *P-value* ----------				
Change in Net Annual Revenue (2020 v 2019)	0.956	0.006*	0.662	0.124	0.100
Loss of Off-Farm Income (2020 v 2019)	0.494	0.567	0.099	0.852	0.049*
Change in Sales Prices	0.594	0.895	0.182	0.547	0.824

(* identifies significance, alpha = 0.05)

A total of 217 respondents adequately indicated a change in NAR in 2020 versus 2019. About 57% of respondents indicated a decrease in NAR in 2020 while 43% cited an increase in NAR in 2020 (*Figure 4*). Within those respondents 64% of established farms identified a decrease in NAR in 2020 compared to 45% of new farms.

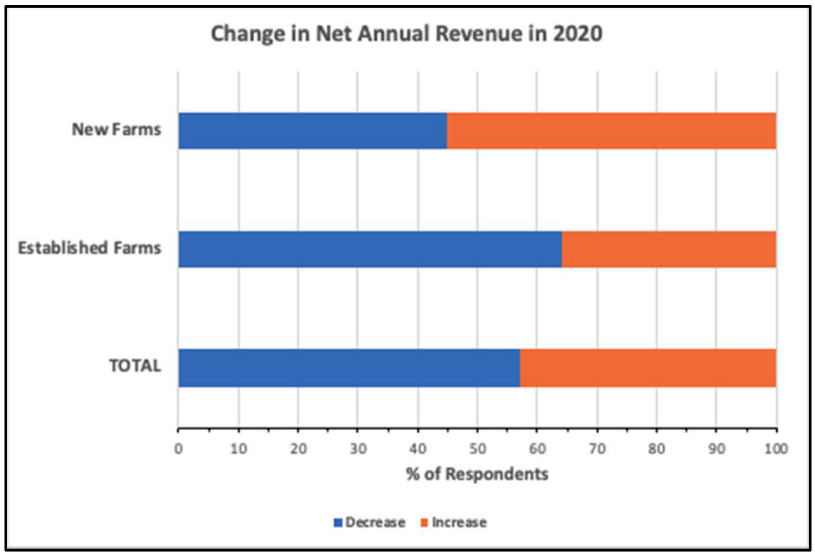

Figure 4: Change in net annual revenue based on total respondents and farm age

Respondents who specified an increase or decrease in NAR were branched to a short answer question and asked to explain why these changes occurred (*Table 2*). Those who identified a decrease in NAR in 2020 most frequently cited COVID-19 regulations/closures, decreased sales, and reduced customer interactions as the primary reasons for this change. Farms who experienced an increase in NAR in 2020 most frequently identified increased sales, changes in consumer purchasing practices, and adjustment of market channels as the main causes for this change.

Table 2: Reasons for Changes in NAR in 2020 vs 2019

Code Category	**Reasons for Decrease (n = 94)**	**Reasons for Increase (n = 73)**
Financial Changes	-Decreased sales (23) -Decreased product prices (3) -Increased sales (2) -Diversified funding provided by collaborative networks (1)	-Increased sales (29) -Increased product prices (5) -Decreased sales (2) -Decreased sales in 2019 (2) -Diversified funding provided by

	-Increased GAR (1) -Shift to off-farm income as primary revenue (1)	collaborative networks (1) -Increased gross annual revenue (3)
Labor	-Issues finding/retaining workers (9) -Reduced number of employees (2) -Increased labor (1)	-Reduced number of employees (1)
Business and Operation	-COVID-19 Regulations and Closures (41) -Increased business costs (8) -Increased costs due to COVID-19 (8) -Altered business practices (5) -Supply chain issues (4) -Decreased inputs (3) -Altered Business Focus (3) -Changes in infrastructure (3) -Distribution issues (2) -Ceased operations (2) -Trade/export issues (2) -Scaled up business (1) -Marketing and advertising (1) -Changes in management (1) -Inability to pivot business practices (1) -New farm growth (1)	-Access to government funding, relief aid, programs (9) -Altered Business Focus (8) -Altered business practices (7) -Scaled up business (6) -Marketing and advertising (5) -COVID-19 Regulations and Closures (4) -New farm growth (4) -Increased business costs (1) -Decreased operating costs (1) -Decreased inputs (1)
Production	-Weather and environmental issues (8) -Unexpected loss of product (due to COVID-19) (6) -Decreased production (4) -Adjusted product type (3) -Production schedule impacts (3) -Decreased production yield (not by choice) (3) -Loss of product (not due to COVID) (3) -Meat production issues (2) -Increased CSA (2) -Increased product diversity (1) -Added a value-added product (1) -Increased production acreage (1) -Decreased production acreage (1) -Processing issues (1)	-Increased CSA (11) -Increased production yield (9) -Adjusted product type (5) -Increased product diversity (5) -Meat production issues (3) -Weather and environmental issues (2) -Increased production acreage (2) -Increased production efficiency (2) -Loss of product (not due to COVID) (2) -Added a value-added product (1)
Networks and Collaborations	-Loss of previous contracts (3)	-Increased interaction with collaborative networks (5)
Customer Base	-Reduced customer interactions (11) -Changes in consumer purchasing practices (6) -Adjusted interactions with	-Changes in consumer purchasing practices (24) -Increased focus on local food producers (19)

	customers (4) -Decreased size of customer base (3) -Increased focus on local food producers (1)	-Increased size of customer base (8) -Adjusted interactions with customers (2) -Reduced customer interactions (1)
Market Channels	-Reduced sales outlets (22) -Decreased previously utilized market channels (10) -Farmer's market issues (10) -Event cancellations (9) -Reduced on-farm sales (7) -Restaurant closures (6) -Adjusted market channels (5) -Increased direct-to-consumer sales (2) -Online marketplace (1) -Diversified market channels (1) -Decreased share of market channel (1)	-Adjusted market channels (16) -Increased direct-to-consumer sales (13) -Online marketplace (9) -Diversified market channels (7) -Reduced sales outlets (5) -Increased sales to food relief programs (4) -Farmer's market issues (4) -Restaurant closures (2) -Decreased previously utilized market channels (1) -Decreased share of market channel (1)

Total n = 169

Respondents were asked to identify the loss of off-farm income in 2020 versus 2019 in the form of a binary (yes/no) question. Of the 195 respondents who accurately indicated a loss of off-farm income, 61% did not identify a loss of off-farm income compared to 39% who did experience a loss of off-farm income (*Figure 5*). About 49% of farms with non-diversified market channels experienced a loss of off-farm income compared to 34% of farms with diversified market channels.

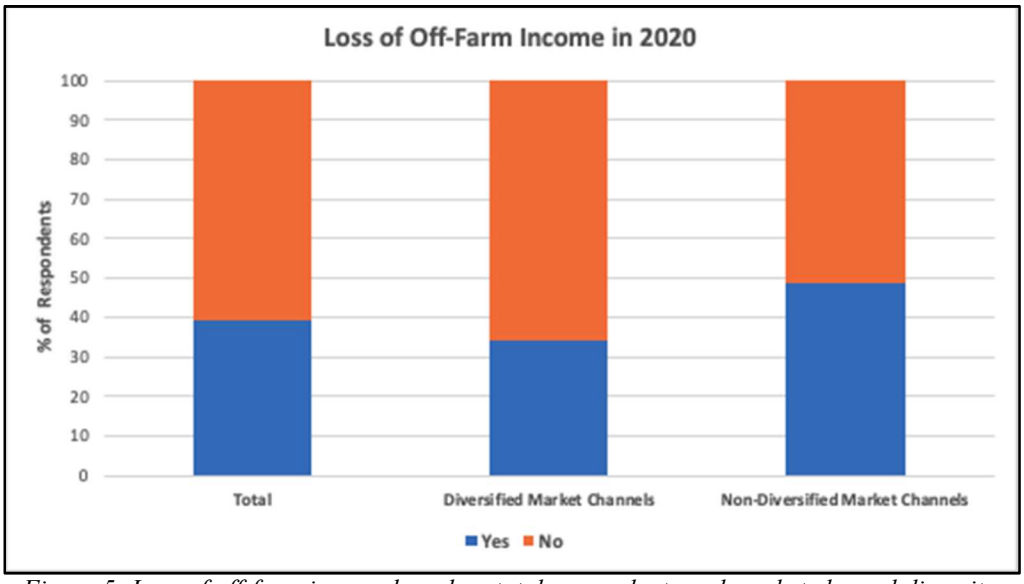

Figure 5: Loss of off-farm income based on total respondents and market channel diversity.

Descriptive analysis identified changes in total annual income (TAI) from farming and gross-annual revenue (GAR) from farming in 2020 compared to 2019 (*Table 3*). Approximately 13% of all respondents identified an increase in TAI from farming in 2020 versus 10% of respondents who experienced a decrease in 2020. Conversely for GAR, 16% of respondents indicated a decrease in GAR in 2020 vs 2019 compared to 14% of respondents who identified an increase in GAR.

Table 3: Percent of respondents within each farm characteristic indicating increase or decrease in 2020 vs 2019

Question	DP	NDP	EF	NF	LF	SF	L/R	N/I	DM	NDM
Increase in TAI from Farming	6%	10%	2%	13%	2%	9%	8%	3%	13%	6%
Decrease in TAI from Farming	12%	6%	9%	11%	6%	12%	2%	3%	9%	4%
Increase in GAR	12%	14%	9%	17%	10%	14%	13%	8%	13%	10%

Decrease in GAR	15%	10%	17%	10%	0	20%	15%	14%	14%	16%

B. Network and Collaborations

Respondents were asked to identify new collaborations due to COVID-19. Of all respondents 47% identified establishing new collaborations due to COVID-19: 16% with other producers, 16% with collaborative networks, 10% with other agribusinesses, and 5% with other entities that were not previously listed (*Figure 6*).

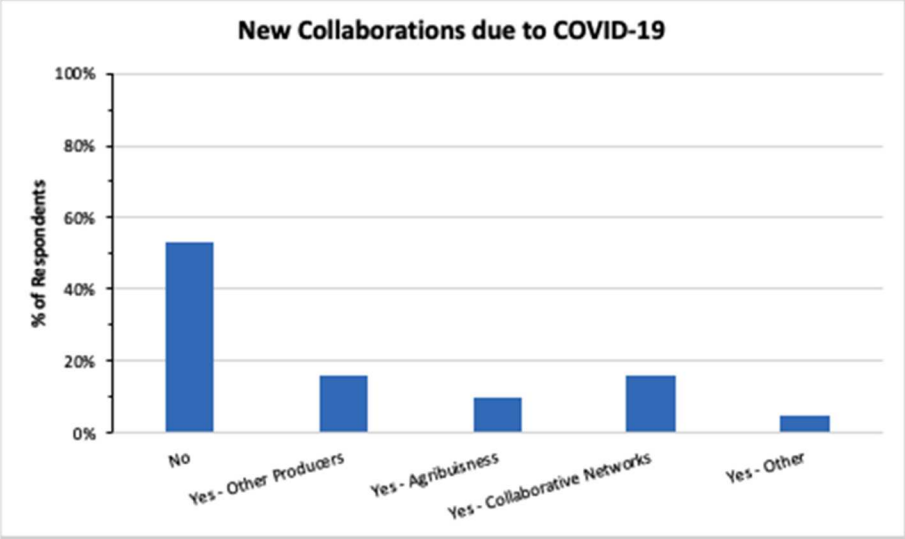

Figure 6: Establishment of new collaborations due to COVID-19 by type.

Significance was identified for all options indicating "yes" to the establishment of at least one of the new collaborations due to COVID-19 when stratified by all 5 characteristics (*Table 4*). Collaborations established with collaborative networks were identified for product diversity, farm age, farm size, and market channel diversity. Significance for new collaborations with other producers was identified for farm age, geographic distribution, and market channel diversity.

Table 4: Significance of farm characteristics for questions based on newly established collaborations due to COVID-19

New Collaborations due to Covid-19	Product Diversity	Farm Age	Farm Size	Geographic Distribution	Market Channel Diversity
Yes - Other Producers	0.250	0.009*	0.150	0.007*	0.010*
Yes - Agribusiness	0.131	0.082	0.098	0.225	0.253
Yes - Collaborative Networks	0.011*	0.545	0.034	0.064	0.0001*
Yes - Other	0.227	0.545	0.772	0.912	0.915

(* indicates significance)

For new collaborations with other producers, 25% of new farms established new relationships due to COVID-19 compared to 13% of established farms (*Figure 7*). A total of 22% of farms who distributed their products L/R established new collaborations with other producers compared to 3% of N/I farms. Of farms who utilized diverse market channels 23% established new collaborations with other producers compared to 9% of farms with non-diverse market channels.

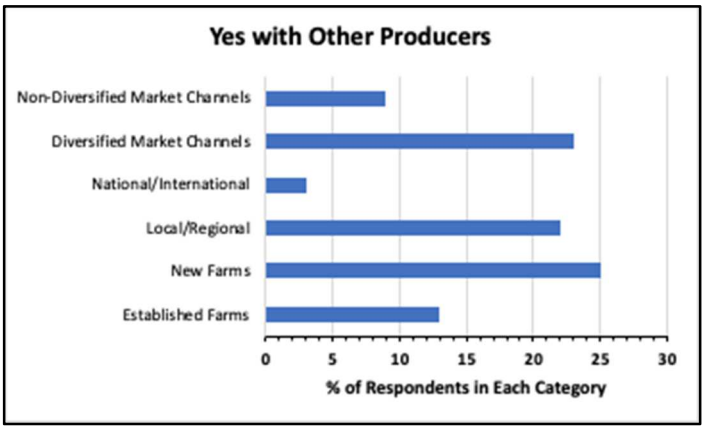

Figure 7: Significant new collaborations established with other producers due to COVID-19 based on farm characteristics.

Of farms with diverse products 21% established new collaborations with collaborative networks compared to 7% of non-diversified farms (*Figure 8*). About 25% of new farms established new collaborations with collaborative networks compared to 12% of established farms. Within respondents operating a small farm 22% established relationships with collaborative networks compared to 8% of large farms. A total of 24% of farms with diversified market channels established collaborations with new collaborative networks compared to 4% of farms with non-diversified market channels.

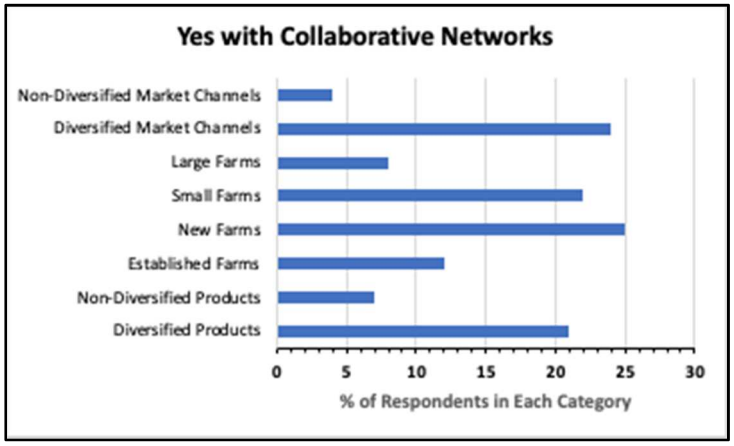

Figure 8 : Significant new collaborations established with other collaborative networks due to COVID-19 based on farm characteristics.

All respondents who identified any type of new collaboration due to COVID-19 were branched to a short answer question and asked to describe who these new relationships were established with, how they were established, and why they were established (*Table 5*). Trends in qualitative analysis indicated that new collaborations were most frequently generated with established food access organizations. These new relationships were most commonly established by consolidating business practices with other producers/food businesses and created due to market channel closures and limited food access.

Table 5: Trends in newly established collaborations due to COVID-19

Who were new relationships established with?	**How** were these new relationships established?	**Why** were these new collaborations established?
-Food access organizations (21) -Like-minded food businesses (8) -Farmer's markets (6) -Businesses w/ pre-existing relationship (6) -Processors (3) -Successful food businesses (2) -Food retailers (2)	-Consolidated business practices with other food producers and food businesses (22) -Consolidated product w/ other farms (15) -Direct communication w/ other farms (13) -Collaborative CSA (13) -Strengthened relationships w/other food businesses (10) -Increased product diversity (8) -Collaborative marketing (7) -Producer "think tank" (discussion to generate new ideas/solutions) (7) -Consolidated online sales with other producers (6) -Established a new market channel w/other producers (6) -Adjusted product type (5) -Adjusted business practices (5) -Diversified business certifications (4) -Increased grant funding (4) -Consolidated purchasing practices w/ other producers (3) -Established new customer relationships (3) -Additional funding for direct purchasing (1) -Adjusted cost output (1) -Diversified input purchases (1) -Diversified geographic distribution (1)	-Market channel closures and limited access to food (9) -Distribution to those in need (5) -Maintain flow of new information (4) -Lower/mitigate risk (3) -Labor issues (2) -Changing consumer practices (2) -Maintain product pricing (1) -Conservation planning (1) -Increased demand for product (1) -Buy local promotion (1) -Minimize product loss (1) -Scheduling conflicts (1)

Total n = 80

To identify changes in sales collaborations or networks in 2020 vs 2019 respondents were asked to identify if they collaborated with other farms or agribusiness in 2020 or 2019 (*Table 6*). Changes were calculated based on these established partnerships and it was identified that 10%

of respondents had increased collaborations in 2020 compared to 2019 while 7% had decreased the number of established networks and collaborations in 2020.

Table 6: Changes in sales or collaborations in 2020 v 2019 based on farm characteristic

Changes in Sales or Collaborations (2020 v 2019)	**DP**	**NDP**	**EF**	**NF**	**LF**	**SF**	**L/R**	**N/I**	**DM**	**NDM**
Increase in 2020	10%	6%	8%	11%	10%	9%	10%	8%	13%	3%
Decrease in 2020	7%	3%	3%	10%	6%	7%	7%	3%	6%	8%

C. Labor

A total of 3 questions related to labor impacts or adaptations were analyzed for significance (*Table 7*). They included COVID-19 related changes to current workforce, reasons for decreasing and/or furloughing employees, and future anticipated number of employees. Changes to current workforce included 6 possible binary responses. If respondents answered affirmatively to reducing the number of existing employees or furloughing existing employees they were branched to a multiple choice question that contained 12 possible answers respondents could identify with a binary (yes/no) response. These questions asked respondents to indicate specific reasons why their labor force had been decreased. Significance was identified for both changes to current workforce and reasons for decreasing and/or furloughing employees within 3 of the 5 farm characteristics: farm age, farm size, and geographic distribution.

Table 7: Significance based on farm characteristic for questions identifying labor issues

Question	Product Diversity	Farm Age	Farm Size	Geographic Distribution	Market Channel Diversity
COVID-19 Related Changes to Workforce		---------- *P-value* ----------			
Reduced # of existing employees	0.950	0.023*	0.014*	0.228	0.171
Furloughed existing employees	0.851	0.342	0.015*	0.260	0.486
Reduced hours of existing employees	0.063	0.006*	0.010*	0.202	0.729
Delayed hiring new employees	0.440	0.653	0.169	0.179	0.388
Hired fewer employees than planned	0.583	0.052	0.143	0.469	0.360
Hired more employees than planned	0.771	0.960	0.007*	0.513	0.274
Increased hours of existing employees	0.225	0.589	0.598	0.336	0.117
No change	0.830	0.404	0.758	0.659	0.061
Reasons for Decreasing and/or Furloughing Employees	---------- *P-value* ----------				
Reduced demand for products	0.535	0.123	0.769	0.112	0.899
Reduced production	0.320	0.458	0.593	0.822	0.816
Lack of payroll funds	0.135	0.706	0.883	0.260	0.486
Increased cost of PPE and sanitation	0.381	0.707	0.516	0.926	0.631
Lack of available workers	0.580	0.267	0.104	0.013*	0.248
Lack of skilled workers	0.839	0.419	0.123	0.769	0.446
Inability to support social distancing and/or safe handling practices	0.982	0.185	0.003*	0.721	0.307
Increased wages	0.454	0.611	0.996	0.588	0.850

required to retain workers					
Issues with immigration /visas	0.419	0.409	0.011*	N/A	0.610
Challenges with farmworker housing	0.604	0.416	0.558	0.809	0.894
Challenges with farmworker transportation	N/A	0.409	0.285	0.866	0.610
Other	0.167	0.467	0.532	0.503	0.307
Anticipated Number of Employees	0.189	0.426	0.368	0.450	0.435

(*indicates significance; N/A indicates there were no responses in 1 or more of the specified farm characteristics, alpha = 0.05)

A total of 64% of respondents identified some sort of change in their workforce compared to 36% of participants who indicated no change. Significance based on farm age was identified for the responses ‘reduced number of existing employees’ and ‘reduced hours of existing employees’ (*Table 7*). About 18% of established farms indicated reducing the number of existing employees compared to 8% of new farms (*Figure 9*). Similarly, 18% of established farms indicated reducing hours for existing employees compared to 6% of new farms.

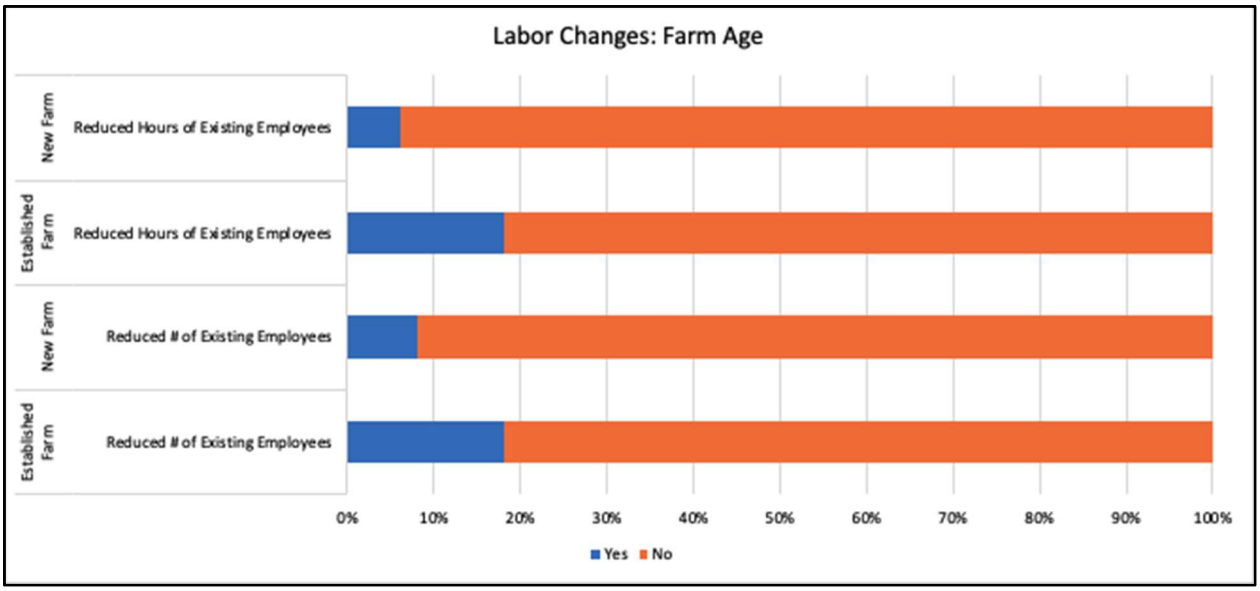

Figure 9: Changes in labor practices based on farm age

Significance was identified based on farm size for the following possible responses for changes to workforce: 'reduced number of existing employees', 'furloughed existing employees', 'reducing hours of existing employees', and 'hiring more employees than planned' (*Table 7*). A total of 23% of large farms indicated reducing number of existing employees compared to 10% of small farms (*Figure 10*). Of respondents who furloughed existing employees 10% of large farms answered affirmatively compared to 3% of small farms. About 23% of large farms reduced hours of existing employees compared to 9% of small farms. Farms who hired more employees than planned included 13% of large farms compared to 3% of small farms.

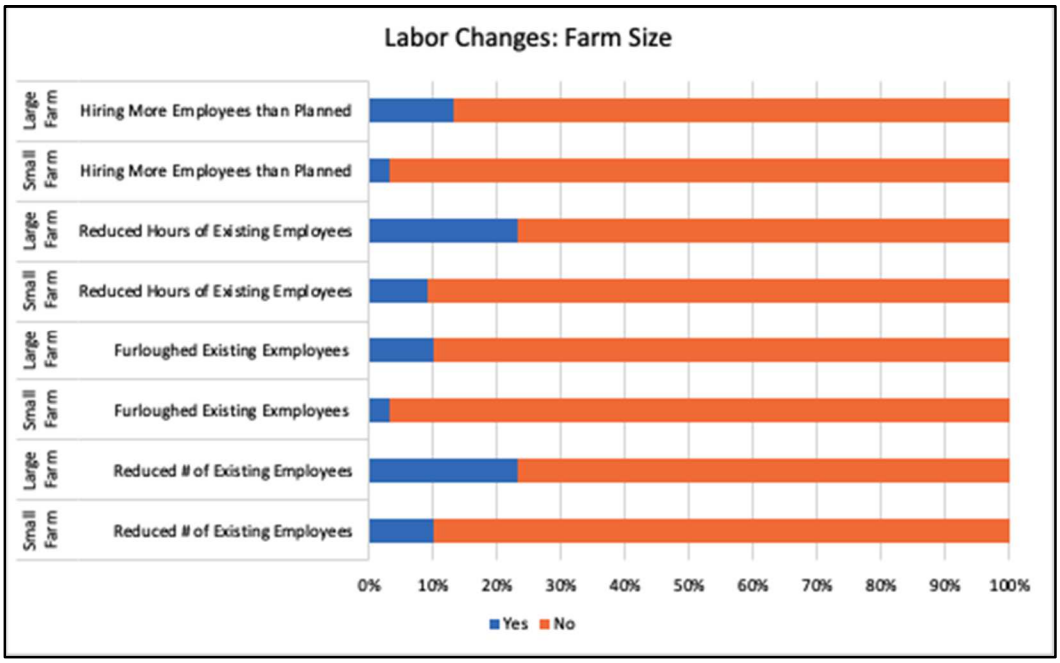

Figure 10: Changes in labor practices based on farm size

Respondents who indicated decreasing and/or furloughing their work force were branched to a question asking them to identify specific reasons for this change. Significance was identified based on farm size for the responses 'inability to support social distancing' and 'issues with immigration visas' (*Table 7*). Of respondents who indicated a decrease and/or furlough in their workforce, about 13% of large farms indicated an inability to support social distancing compared to 3% of small farms (*Figure 11*). About 4% of large farms identified issues with immigration visas as a reason for reducing and/or furloughing their workforce compared to 0% of small farms. Significance based on geographic distribution was only identified for the response 'lack of available workers' (*Table 7*). A total of 11% of N/I farms answered yes to this response compared to 3% of L/R farms.

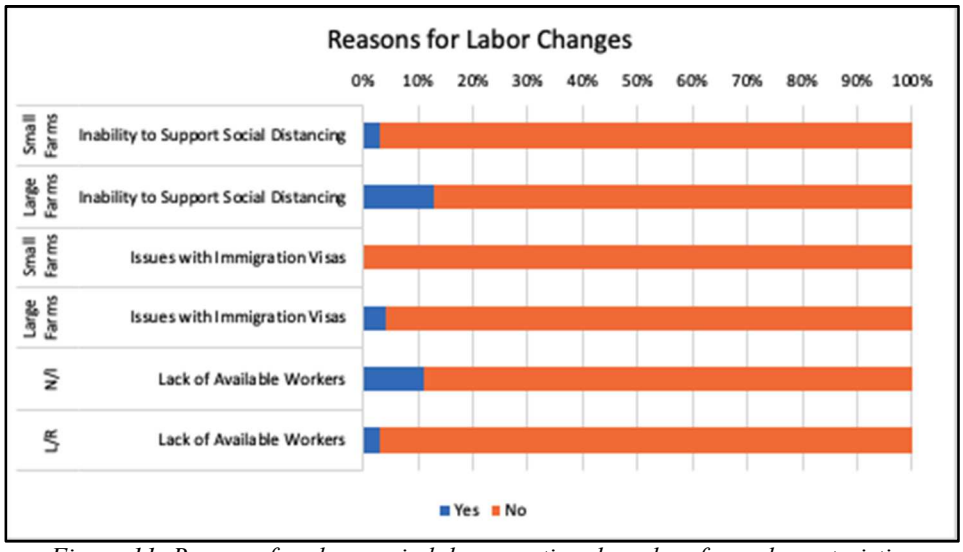

Figure 11: Reasons for changes in labor practices based on farm characteristics

All respondents who answered 'yes' to the response 'hiring more employees than planned' were branched to a short response question which prompted them to identify why they hired more employees than planned in 2020. The most prevalent trends indicated by respondents were increased demand for product, increased production, to meet COVID-19 operating standards, and decrease individual workload.

Participants were asked to identify the number of full-time employees (FTE) that were employed year round in 2020 versus 2019 and the number of full-time employees that were employed during peak season in 2020 versus 2019. A total of 7% of all respondents increased the number of FTE that were employed year round in 2020 versus 2019, compared to 6% of respondents who decreased the number of employees in 2020. Similarly, 9% of all respondents increased the number of FTE they employed during peak season in 2020 versus 2019, while 4% decreased the number of employees during peak season in 2020. Breakdown of the number of

respondents based on farm characteristic for all labor increases or decreases in 2020 is located in *Table 8*.

Table 8: Percent of respondents indicating change in number of FTE based on farm characteristic

FTE Year Round	**DP**	**NDP**	**EF**	**NF**	**LF**	**SF**	**L/R**	**N/I**	**DM**	**NDM**
Increase	10%	6%	4%	9%	4%	7%	7%	6%	7%	5%
Decrease	7%	3%	3%	9%	8%	5%	4%	17%	7%	3%
FTE at Peak Season										
Increase	4%	8%	4%	4%	6%	3%	5%	3%	5%	3%
Decrease	8%	10%	13%	2%	13%	7%	7%	11%	9%	8%

D. Business and Operations

Five survey questions pertaining to business and operation impacts and adaptations were tested for significance (*Table 9*). These questions focused on overall business impacts due to COVID-19, specific COVID-19 business impacts, changes in communication methods with customers due to COVID-19, changes in operational costs due to COVID-19, and concerns for future business issues.

Table 9: Significance based on farm characteristic for business and operation questions

Question	Product Diversity	Farm Age	Farm Size	Geographic Distribution	Market Channel Diversity
Overall Business Impacts due to COVID-19	0.402	0.018*	0.104	3.94E-06*	0.113
Specific COVID-19 Business Impacts	---------- *P-value* ----------				
Low prices	0.238	0.270	0.365	0.067	0.373
Product going to waste	0.425	0.123	0.258	0.218	0.005*
Difficulty finding/retaining workers	0.187	0.016*	0.489	0.246	0.220
Lack of access to working capital	0.211	0.290	0.236	0.361	0.024*
Lack of storage capacity	0.230	0.202	0.144	0.308	0.425
Reduced availability of farm inputs	0.161	0.261	0.162	0.440	0.249
Limited availability of transportation	0.415	0.313	0.316	0.319	0.484
Disruption of distribution systems	0.330	0.208	0.331	0.376	0.111
Closure of direct marketing outlets	0.176	0.226	0.070	0.154	0.125
Closed or reduced capacity of indirect marketing channels	0.096	0.094	0.362	0.142	0.091
Closure and/or decreased access	0.239	0.008*	0.195	0.023*	0.095

to processing facilities					
International trade issues	0.371	0.121	0.139	0.075	0.055
Change in Communication Methods due to COVID-19	---------- *P-value* ----------				
Email	0.026*	0.089	0.025*	0.245	0.010*
Social Media	0.006*	0.307	0.282	0.075	0.007*
Website	0.310	0.408	0.089	0.434	0.0005*
Printed Advertisement	0.415	0.356	0.011*	0.333	0.494
Face to Face	0.375	0.065	0.291	0.304	0.005*
Change in Operational Costs due to COVID-19	0.539	0.112	0.008*	0.266	0.437
Concern for Future Issues (2021)	---------- *P-value* ----------				
Availability of labor	0.136	0.448	0.183	0.336	0.312
Ability to follow workforce and health safety guidelines0.140	0.406	0.163	0.086	0.247	
Ability to offer competitive wages	0.108	0.404	0.034*	0.169	0.022*
Unforeseen expenses	0.018*	0.406	0.009*	0.212	0.059
Disruptions in input supply chain	0.350	0.251	0.098	0.270	0.015*
Capacity of processors	0.198	0.230	0.282	0.134	0.332
Disruptions in distribution channels	0.073	0.424	0.193	0.352	7.38E-05*

Ability to adapt to market uncertainty	0.476	0.458	0.489	0.067	0.001*
Ability to adapt to changing consumer preferences	0.181	0.068	0.073	0.007*	0.008*
Availability of government aid	0.394	0.387	0.390	0.429	0.370
Availability of off-farm income	0.121	0.312	0.394	0.139	0.428
Access to medical and/or mental health care	0.167	0.195	0.199	0.385	0.405

(*indicates significance)

For overall business impacts significance was identified for farm age and geographic distribution (*Table 9*). A total of 256 respondents adequately answered the question with 67% identifying negative impacts, 31% identifying positive impacts, and 7% identifying no impacts. When stratified by farm age 72% of established farms identified negative business impacts in contrast to 54% of new farms (*Figure 12*). Conversely, 40% of new farms indicated positive business impacts compared to 25% of established farms. Within farms distributing their products N/I 82% identified negative business impacts compared to 55% of L/R farms. Comparatively, 37% of L/R farms identified positive business impacts compared to 14% of N/I farms.

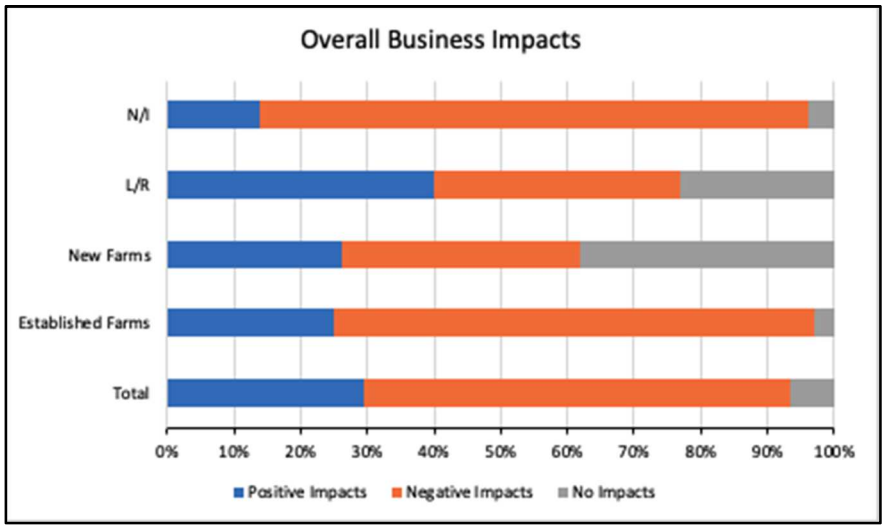

Figure 12: Significant overall business impacts based on farm characteristics

Out of all 255 participants indicating specific COVID-19 issues, significance was identified for the response 'difficulty finding/retaining workers' in which 51% identified no impact, 25% identified minor impact, and 18% identified significant impact. Based on farm age, 67% of new farms indicated no impact compared to 49% of established farms (*Figure 13*). A total of 18% of young farms experienced significant impacts and 15% experienced minor impacts. Out of established farms, 33% experienced minor impacts while 18% experienced significant impacts. Farms who experienced no impact based on geographic distribution were 66% of L/R farms compared to 35% of N/I farms. About 41% of N/I farms indicated minor impacts while 24% indicated significant impacts. A total of 21% of L/R farms identified minor impacts compared to 13% who identified significant impacts.

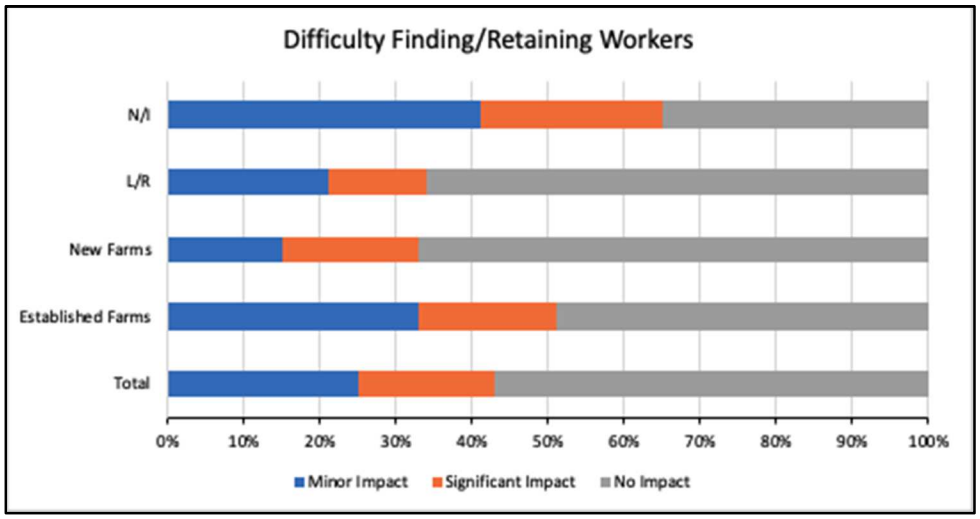

Figure 13: Breakdown of the specific COVID-19 impact of 'difficulty finding/retaining workers' based on farm characteristics where significance was identified

When stratified by market channel diversity significance was identified for the following specific business impacts: 'product going to waste' (PGW) and 'lack of access to working capital' (LAC). For all responses to PGW 61% specified no impact, 24% specified a minor impact, and 15% specified a significant impact (*Figure 14).* A total of 69% of all farms with non-diversified market channels indicated no impact to PGW compared to 29% of farms with diversified market channels. Amongst non-diversified farms 19% experienced a significant impact to PGW and 12% experienced a minor impact. About 57% of diversified farms indicated a minor impact to PGW and 14% indicated a significant impact.

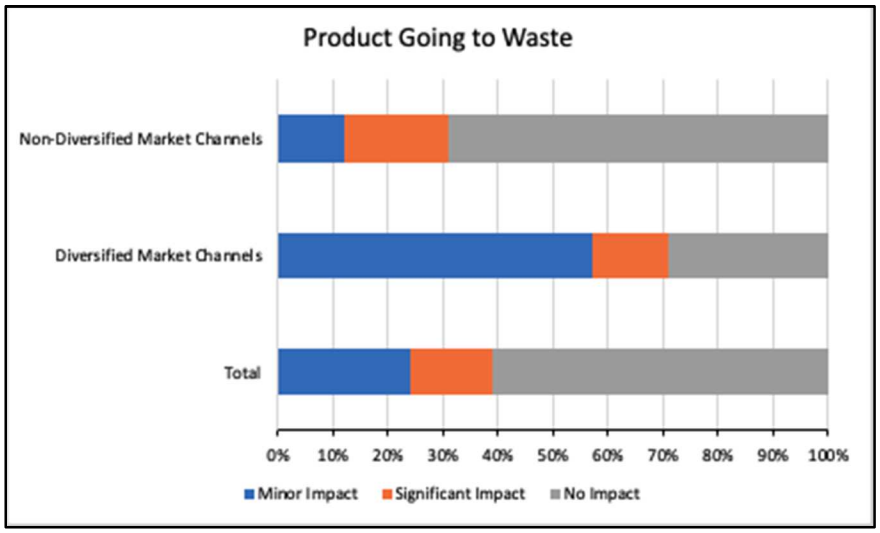

Figure 14: Breakdown of the specific COVID-19 business impact 'product going to waste' based on market channel diversity

Out of all respondents to LAC 67% responded with no impact, 18% with significant impact, and 15% with minor impact (*Figure 15*). A total of 69% of diversified farms experienced no impact to LAC compared to 63% of non-diversified farms. About 17% of diversified farms experienced minor impact to LAC and 14% experienced significant impact to LAC. For non-diversified farms 25% specified significant impact of LAC and 12% specified minor impacts of LAC.

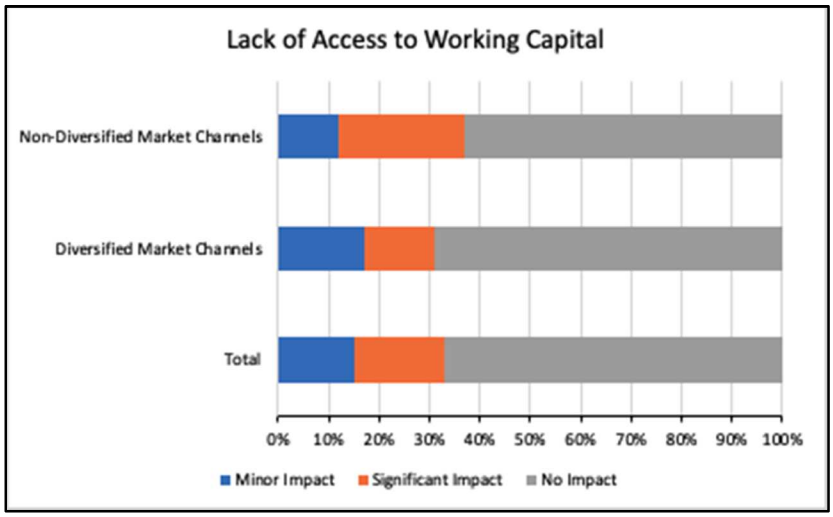

Figure 15: Breakdown of specific COVID-19 business impact 'lack of access to working capital' based on market channel diversity

While significance was not identified for the specific business impact response 'Other: please specify' trends emerged from the type of impacts that were not listed as options in the previous question. These impacts included: limited resources, delays, decreased demand/sales, and increased costs associated with COVID-19 regulations.

Respondents were then asked to identify an increase, decrease, or no change in their use of 5 different communication methods. Significance was identified when responses were stratified by product diversity, farm size, and market channel diversity (*Table 9*).

Out of all respondents 52% reported an increase in email use, 44% no change, and 4% a decrease in email use (*Figure 16*). Significance for email use was identified for product diversity, farm size, and market channel diversity (*Table 9*). Of farms with diversified products 54% experienced an increase in email use, 43% no change, and 3% a decrease. For farms with non-diversified products 48% experienced no change in email use, 44% an increase, and 8% a

decrease. Responses for large farms identified 64% experiencing an increase in email use while 36% experienced no change (no large farms identified a decrease). Small farms experienced changes in email use as follows: 49% increase, 47% no change, and 4% decrease. Farms with diversified market channels identified changes in email use as follows: 58% increase, 39% no change, and 3% decrease. Alternatively, of farms with non-diversified market channels 55% reported no change, 42% an increase in email use, and 3% a decrease.

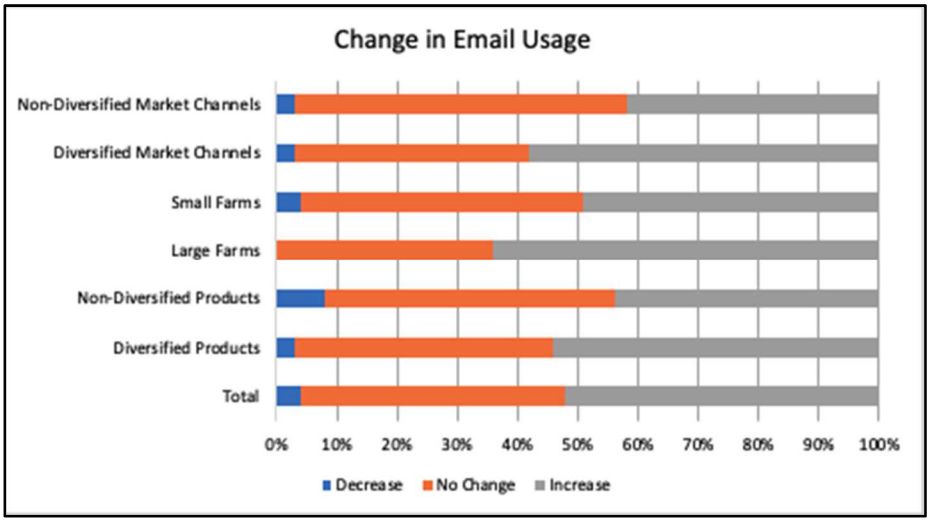

Figure 16: Change in email use due to COVID-19 based on characteristics where significance was identified

Changes in social media use indicated significance based on product diversity and market channel diversity (*Table 9*). Out of all respondents 49% reported no change, 45% increased use, and 6% decreased use (*Figure 17*). About 48% of farms with diverse products experienced no change in social media use, 47% experienced an increase, and 5% a decrease. Similarly, 54% of farms with non-diversified products experienced no change in social media use while 36% indicated an increase and 10% a decrease. A total of 51% of farms with diverse market channels experienced an increase in social media use while 46% experienced no change and 4%

experience decreased use. Alternatively, 59% of farms with non-diversified market channels experienced no change in social media use while 33% experienced an increase and 8% indicated no change.

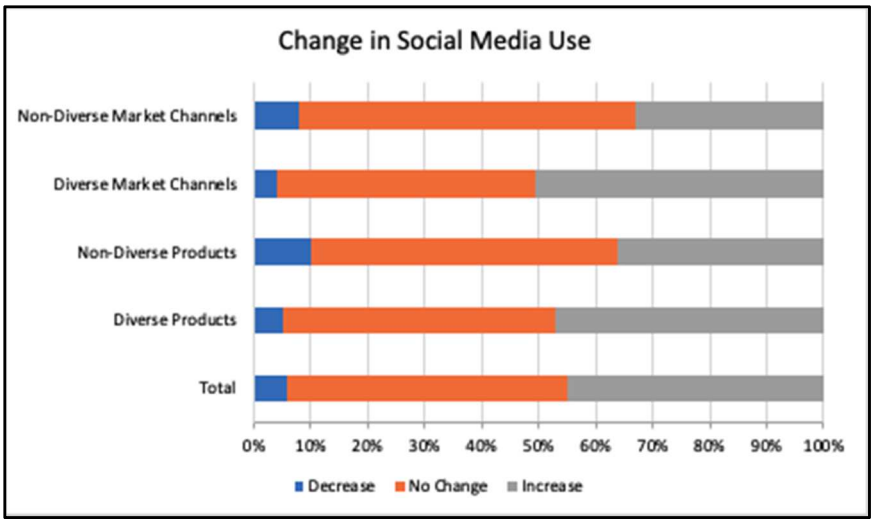

Figure 17: Significant changes in social media use due to COVID-19 based on farm characteristics

Significance for changes in printed advertisements was only identified based on farm size (*Table 9*). Out of all respondents 81% identified no change in their use of printed advertisements, with 5% specifying an increase and 15% a decrease (*Figure 18*). A total of 88% of large farms identified no change in use of printed advertisements while 7% identified a decrease and 5% an increase. The changes for small farms are as follows: 79% no change, 16% decrease, and 5% increase.

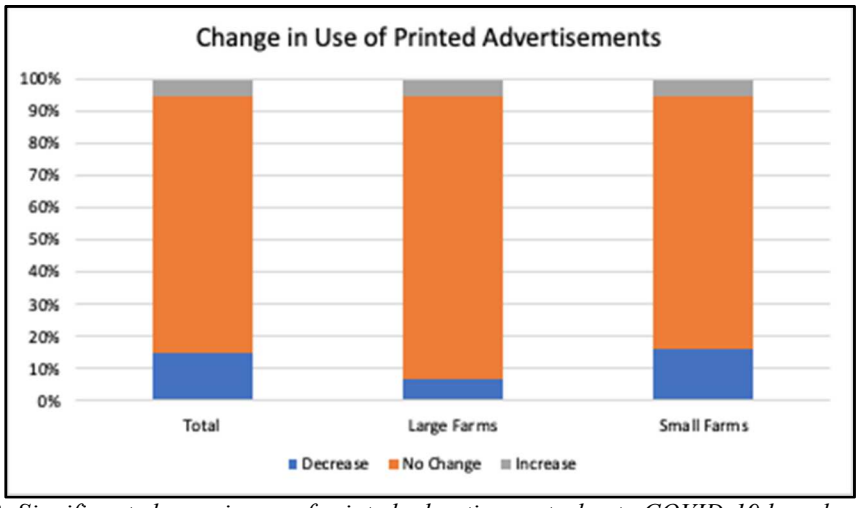

Figure 18: Significant change in use of printed advertisements due to COVID-19 based on farm size

Significance was identified for the following communication methods when stratified by market channel diversity: 'website' and 'face to face' (*Table 9*). For all respondents, 57% reported no change in their use of websites, with 38% an increase and 5% a decrease. A total of 70% of farms with non-diversified market channels reported no change in their use of websites compared to 52% of farms with diversified market channels. About 45% of diversified respondents identified an increase in website use and 3% a decrease (*Figure 19*). For non-diversified respondents 23% indicated an increase in website use and 7% a decrease. For changes in face-to-face communication 64% of all respondents reported a decrease, 21% no change, and 14% an increase. Farms with diversified market channels reported changes to face-to-face communication as follows: 70% decrease, 17% no change, and 13% increase. Within farms with non-diversified market channels 51% reported a decrease in face-to-face communication, 33% no change, and 16% an increase.

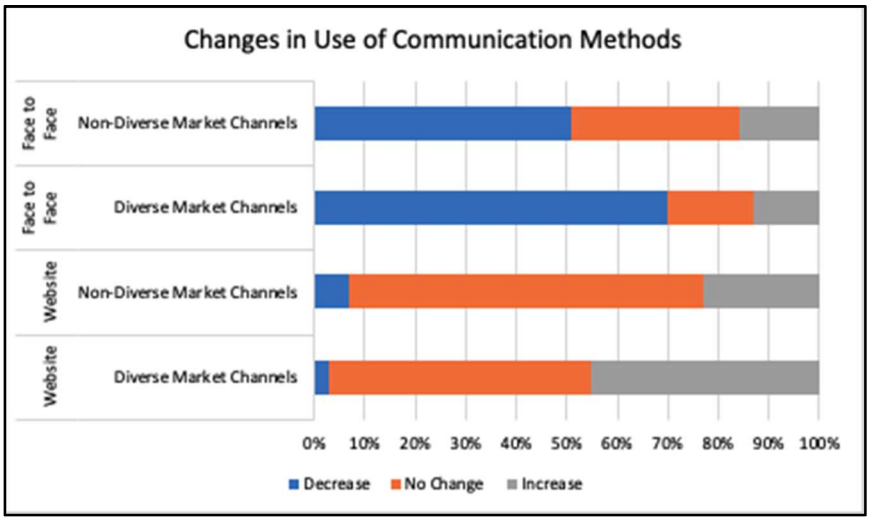

Figure 19: Changes in use of 'website' and 'face to face' communication methods due to COVID-19 based on market channel diversity

A 5-point Likert scale question was utilized to identify changes in operational costs due to COVID-19. Out of all 257 participants 67% of respondents indicated an increase in operational costs due to COVID-19, 26% no change, and 7% a decrease (*Figure 20*). Significance was only identified based on farm size (*Table 9*). Large farms identified a higher increase of operational costs at 77% compared to 64% of small farms. Conversely 29% of small farms indicated no change compared to 19% of large farms. A total of 7% of small farms identified a decrease in operational costs compared to 4% of large farms.

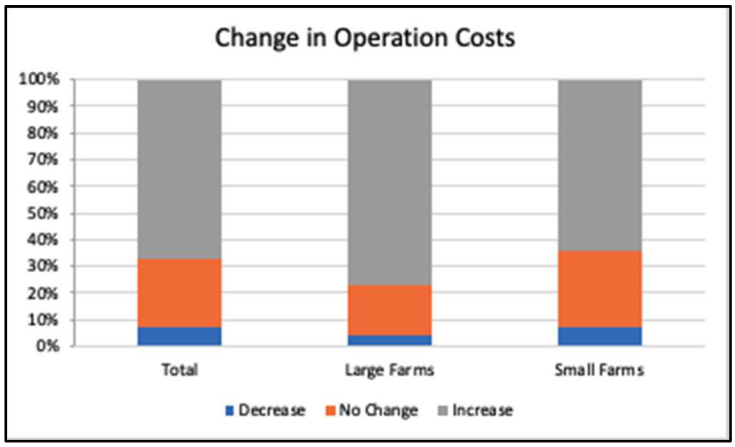

Figure 20: Change in operational costs due to COVID-19 based on farm size

Any respondents who answered either an 'increase' or 'decrease' in operational costs due to COVID-19 were branched to a short answer question asking them to identify the most significant factors contributing to this change. Respondents who identified a decrease in operational costs most frequently cited factors such as labor issues, delays and closures, travel and time, and decreased supply costs (*Table 10*). Those who indicated an increase in operational costs most frequently identified PPE and sanitation, increased supply costs, input costs, and increased labor costs as the primary issues influencing this change.

Table 10: Reasons for changes in operational costs due to COVID-19

Code Category	**Causes for Operational Cost Decrease (n = 15)**	**Causes for Operational Cost Increase (n = 147)**
Revenue		-Decreased sales (1) -Decreased working capital (2) -Loss of OFI (1) -Access to government aid (1)
Labor	-Labor issues (5) -Decreased labor costs (2) -Increased labor costs (1)	-Increased labor costs (30) -Labor issues (22) -Decreased labor costs (1)

Business and Operations	-Delays and closures (4) -Travel and time (3) -Scaled back business practices (2) -Did not expand business (2) -Ceased operations (1) -PPE and sanitation (1) -Shipping/handling costs (1) -Social Distancing (1)	-PPE and sanitation (45) -Increased supply costs (41) -Input costs (36) -Decreased access to inputs and supplies (19) -COVID-19 rules and regulations (18) -Additional Supply Costs (15) -Travel and time (15) -Social Distancing (13) -Distribution/transportation issues (7) -Bulk purchasing (6) -Shipping/handling costs (5) -Supplier altered practices (4) -Expanded business practices (4) -Technical issues (4) -Increased marketing (3) -Delays and closures (3) -Scaled back business practices (2)
Production	-Decreased supply costs (2) -Additional Supply Costs (1) -Increased acreage (1) -Altered product handling practices (1) -Processing Costs (1) -USDA processing facility issues (1) -Decreased production (1)	-Increased supply costs (41) -Additional infrastructure costs (10) -Processing Costs (10) -Altered product handling practices (9) -USDA processing facility issues (2) -Inability to increase product prices (2) -Increased production (2) -Increased product prices (1) -Added VAP (1) -Increased acreage (1) -Storage (1)
Network and Collaborations		
Customer Base	-Decreased customer interaction (1)	-Decreased customer interaction (1) -Increased customer interaction (1)
Market Channels	-Shift to online sales (1)	-Increased DTC sales (3) -Shift to online sales (2) -Increased costs to retail MC (1)

Total = 162

Participants were asked to rank their future concerns for farm business effects using a 3-point Likert scale response for 12 specified impacts. Significance was identified based on product diversity, farm size, geographic distribution, and market channel diversity (*Table 9*).

Significance was established for the future concern response 'ability to offer competitive wages' based on farm size and market channel diversity (*Table 9*). Out of 256 total respondents 49% indicated no concern about the ability to offer competitive wages, 27% were moderately concerned, and 24% were very concerned (*Figure 21*). A total of 59% of small farms expressed no concern about the ability to offer competitive wages compared to 24% of large farms. About 25% of small farms were moderately concerned while 15% were very concerned. Conversely, 46% of large farms were very concerned while 30% were moderately concerned. Based on market channel diversity 60% of non-diversified farms were not concerned about the ability to offer competitive wages compared to 46% of diversified farms. About 31% of diversified farms were moderately concerned in comparison to 15% of non-diversified farms. Inversely, 26% of non-diversified farmers were very concerned compared to 23% of diversified farms.

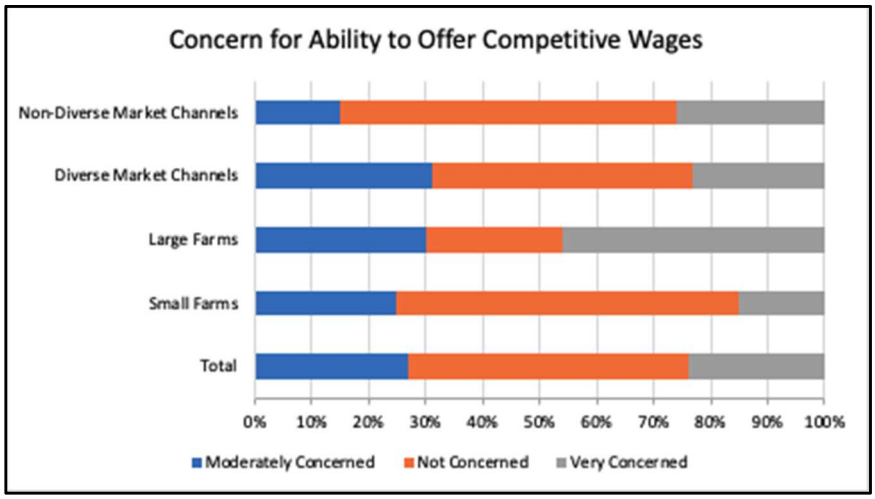

Figure 21: Future concern for the ability to offer competitive wages in 2021 based on market channel diversity and farm size

Significance for the future concern response of 'unforseen expenses' was identified based on product diversity and farm size (*Table 9*). Out of all respondents 48% were moderately concerned, 36% very concerned, and 16% not concerned (*Figure 22*). About 58% of farms with non-diversified products were moderately concerned about future unforeseen expenses compared to 45% of diversified farms. Alternatively, 40% of diversified farms were very concerned compared to 26% of non-diversified farms. Similarly, 16% of non-diversified farms expressed no concern compared to 15% of diversified farms. Based on farm size, 51% of large farms were very concerned about future unforeseen expenses compared to 31% of small farms. Inversely, 51% of small farms expressed moderate concern compared to 38% of large farms. Small farms indicated no concern at 18% compared to 6% of large farms.

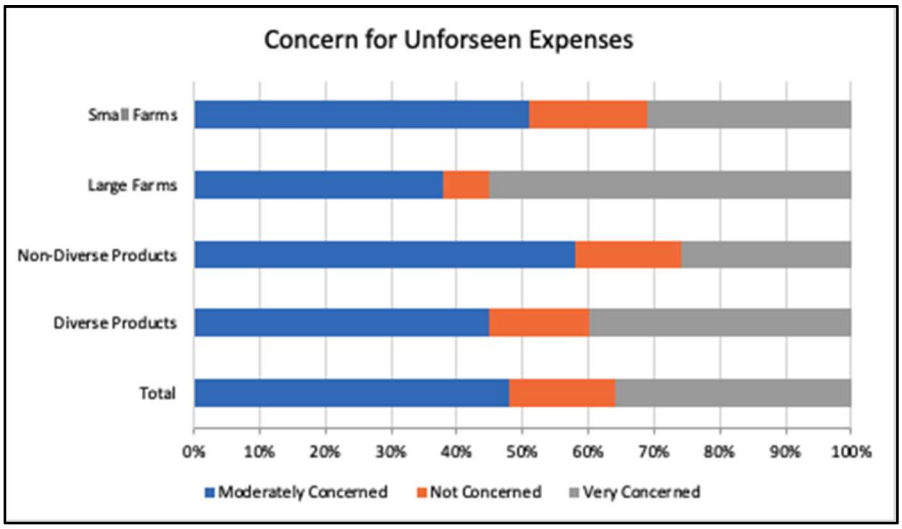

Figure 22: Future concern for unforeseen expenses in 2021 based on farm size and market channel diversity

Significance for the future concern response 'ability to adapt to changing consumer preferences' was identified based on geographic distribution and market channel diversity. Among the 258 total responses 40% were not concerned, 39% moderately concerned, and 21% very concerned (*Figure 23*). Amongst farms who distributed their products L/R 42% identified no concern, 41% were moderately concerned, and 15% were very concerned. In contrast, N/I farms responded with 39% being very concerned, 33% expressing no concern, and 28% as moderately concerned. Based on market channel diversity, 43% of diverse farms expressed moderate concern, 39% no concern, and 18% very concerned. Alternatively, 44% of non-diversified farms expressed no concern, 28% moderate concern, and 28% were very concerned.

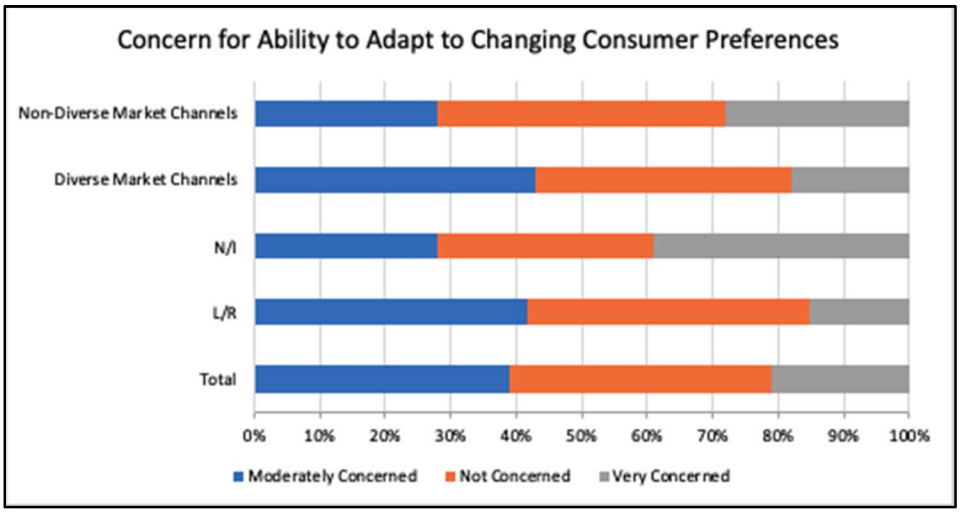

Figure 23: Future concern for the ability to adapt to changing consumer preferences based on market channel diversity and farm size

The farm characteristic of market channel diversity also indicated significance for the responses ‘disruptions in input supply chain’, 'disruption to distribution channels’, and ‘ability to adapt to market uncertainty’ (*Table 9*).

Out of the 257 total respondents that chose the response ‘disruptions in input supply chain’ as a future concern 50% expressed moderate concern, 26% were not concerned, and 24% were very concerned. Farms with diversified market channels responded as follows: 55% expressed moderate concern, 24% no concern, and 21% were very concerned (*Figure 24*). For those with non-diversified market channels 38% expressed moderate concern, 34% no concern, and 28% were very concerned.

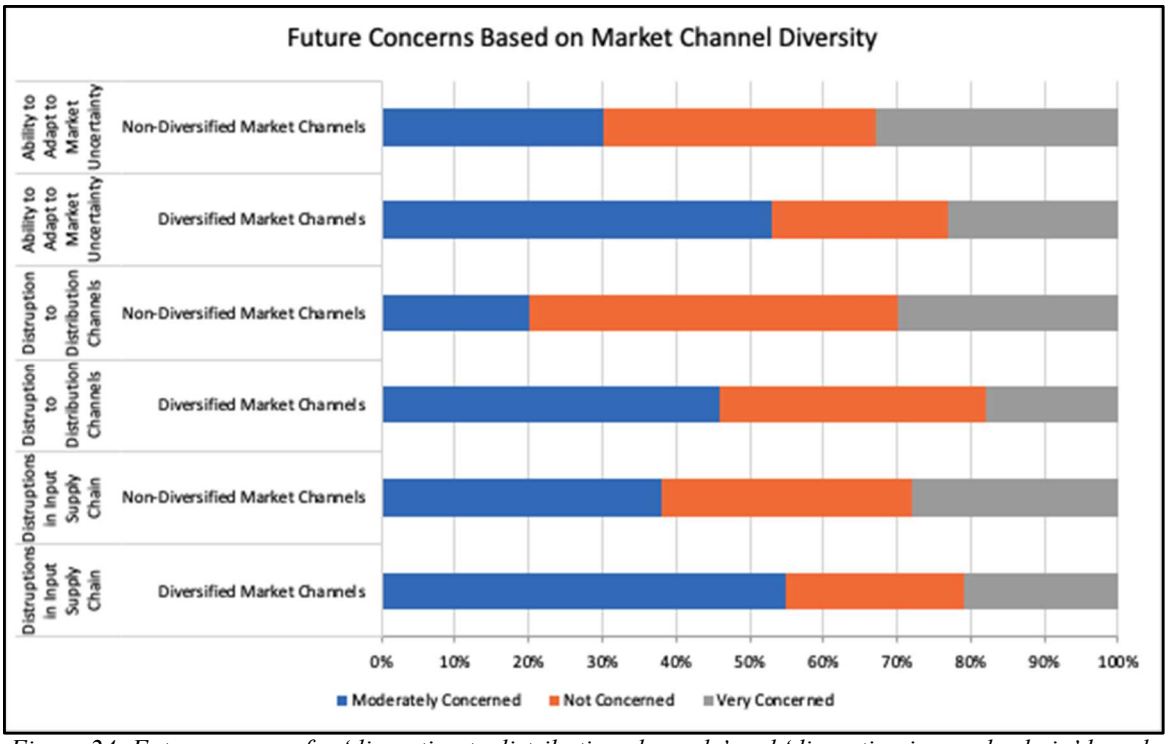

Figure 24: Future concern for 'disruption to distribution channels' and 'disruption in supply chain' based on market channel diversity

A total of 255 respondents chose the response 'disruption to distribution channels' as a future business concern. About 40% were not concerned, 38% expressing moderate concern, and 22% very concerned. Diversified farms indicated a high percent of moderate concern at 46% followed by 36% expressing no concern and 18% that were very concerned(*Figure 24*). Alternatively, 50% of non-diversified farms expressed no concern, 31% were very concerned, and 20% moderately concerned.

Within the 259 respondents who chose the response 'ability to adapt to market uncertainty' as a future business concern 46% indicated moderate concern, 28% no concern, and 26% were very concerned. Diversified farms expressed moderate concern for the ability to adapt to market uncertainty at 53% followed by no concern at 24% and were very concerned at 23%

(*Figure 24*). Farms that were non-diversified expressed no concern for the ability to adapt to market uncertainty at 37%, were very concerned at 33% and identified moderate concern at 30%.

E. Customer Base

A total of 2 questions pertaining to changes in a farm's customer base were analyzed for significance. The only question identifying significance asked respondents to use a 5-point Likert scale response to indicate changes in the size of their customer base due to COVID-19. The only characteristic to indicate significance was based on farm age (*Table 11*).

Table 11: Significance based on farm characteristic for questions identifying changes in customer base

Question	Product Diversity	Farm Age	Farm Size	Geographic Distribution	MC Diversity
Change in Size of Customer Base	0.056	0.009*	0.439	0.085	0.070
Change in Relationship with Customer Base	0.803	0.094	0.647	0.365	0.545

(*indicates significance)

Of the total 225 respondents 46% indicated an increase in the size of their customer base, 37% a decrease, and 17% no change (*Figure 25*). About 57% of new farms identified an increase in the size of their customer base compared to 36% of established farms. Inversely, 42% of established farms identified a decrease in the size of their customer base compared to 32% of new farms. A total of 22% of established farms identified no change in the size of their customer base compared to 11% of new farms.

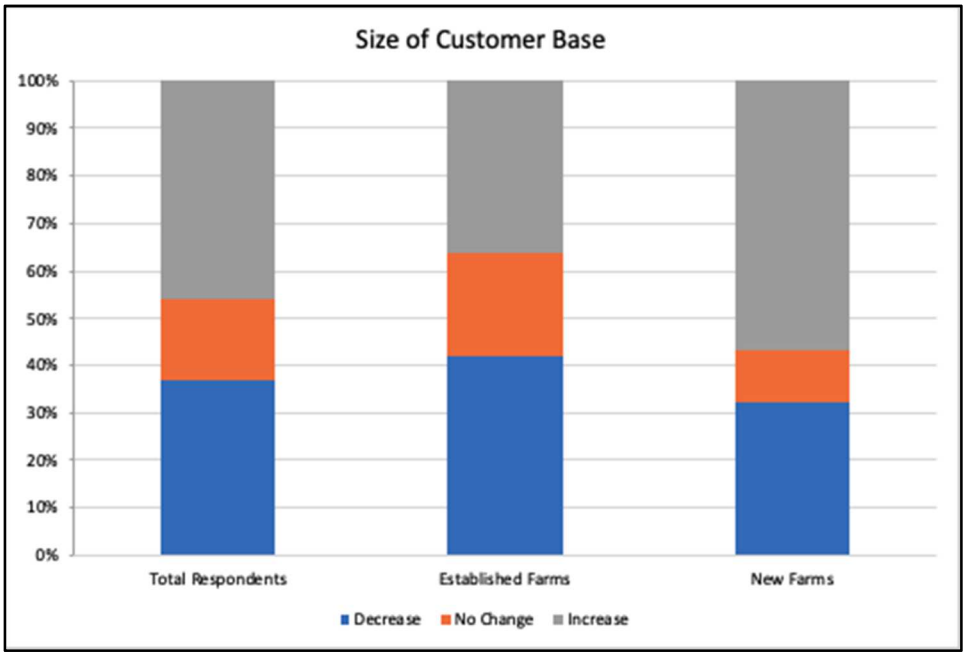

Figure 25: Changes in size of customer base for all respondents and farm size

F. Production

A total of 4 questions centered around production were tested for significance, with 3 indicating significance when stratified by the 5 farm characteristics (*Table 12*). These questions identified changes in production volume in 2020 vs 2019, changes in production volume in response to COVID-19, and inability to make production changes.

Table 12: Significance of contrast by farm characteristic for production related questions

Question	Product Diversity	Farm Age	Farm Size	Geographic Distribution	MC Diversity
Changes in Production	0.228	0.0001*	0.375	0.235	0.004*

Volume (2020 v 2019)					
Changes in Production Volume in Response to Covid-19	---------- *P-value* ----------				
No Change	0.005*	3.3403E-06*	0.062	0.005*	0.082
Produced a greater diversity of products	0.010*	0.014*	0.019*	0.230	0.428
Produced a smaller number of products	0.171	0.079	0.059	0.035*	0.622
Added a new primary product	0.102	0.281	0.383	0.180	0.316
Removed a primary product	0.050*	0.344	0.098	0.201	0.476
Increased volume of product(s) produced	0.053	4.86565E-07*	0.049*	0.033*	0.049*
Decreased volume of product(s) produced	0.961	0.212	0.540	0.412	0.301
Changed timing of production	0.108	0.0003*	0.027*	0.030*	0.101*
Added a value-added product	0.074	0.051	0.991	0.282	0.426
Removed a value-added product	0.331	0.290	0.363	0.480	0.915
Other (please specify)	0.400	0.055	0.772	0.526	0.307
Inability to Make Production Changes	0.087	0.025*	0.038*	0.995	0.991
Production Volume	0.945	0.059	0.526	0.309	0.735

Anticipated in 2021					

(*indicates significance)

Significance was identified for changes in production volume based on farm age and market channel diversity (*Table 12*). Out of 246 total respondents 45% indicated an increased production volume in 2020 vs 2019, while 30% indicated a decrease, and 25% specified no change. About 59% of new farms identified an increase, 21% no change, 20% a decrease in production volume. Established farms primarily identified a decrease in production volume at 37% of respondents followed by 35% indicating an increase and 28% identifying no change (*Figure 26*). Farms who used diverse market channels had the highest rate of production increase at 51% compared to 36% of non-diversified farms. Inversely 36% of non-diversified farms indicated a decrease compared to 27% of diversified farms. Non-diversified farms had the highest percent of no change at 33% when compared to 21% of diversified farms.

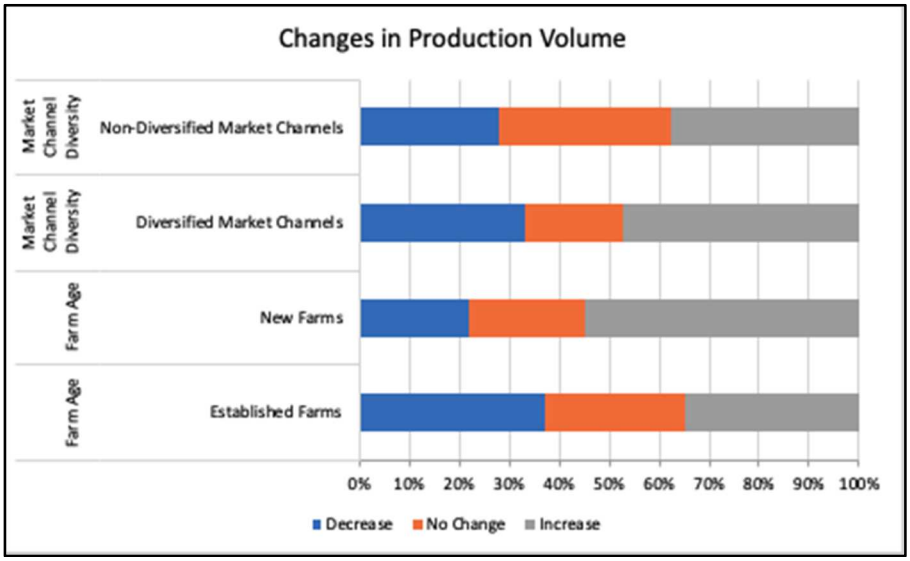

Figure 26: Changes in production volume due to COVID-19 based on farm age and market channel diversity

All respondents who indicated any changes in production volume were branched to a short answer question asking them to specify any reasons for change in their own words. Respondents who identified a decrease in production volume most frequently listed the primary reasons for this change as weather and environmental issues, decreased sales outlets, and issues finding/training new labor (*Table 13*). Participants who indicated an increase in production volume most frequently cited the primary reasons for this change as increased production amount, increased consumer demand and sales, increased farm acreage, and increased production efficiency.

Table 13: Reasons for change in production volume in 2020 versus 2019

Code Family	**Decreased Production Volume in 2020 v 2019 (n = 64)**	**Increased Production Volume 2020 v 2019 (n = 96)**
Revenue	-COVID-19 costs and regulations (7) -Funding related issues (2)	-COVID-19 costs and regulations (3) -Fluctuations in crop prices (1)
Labor	-Issues finding/training new labor (7)	-Increased access to experienced labor (3) -Issues finding/training new labor (1)
Business and Operation	-Increased business efficiency (2) -Shift in business focus (2) -Ceased operations (2) -Focus on business functionality (1) -Focus on infrastructure (1) -Increased safety protocol (1)	-Increased business efficiency (7) -Focus on business functionality (7) -Focus on infrastructure (6) -Increased business scale (6) -Shift in business focus (1) -Federal trade agreements and tariffs (1)
Production	-Decreased production (13) -Weather and Environmental issues (13) -Decreased access to processing facilities (5) -Annual production fluctuations (4) -Crop loss (non-COVID related) (3) -Adjusted product type (2)	-Increased production Amount (31) -Increased acreage (10) -Increased production efficiency (10) -Weather and Environmental issues (10) -Annual production fluctuations (8) -Adjusted production schedule (7) -Increased production (livestock)

	-Decreased acreage (1) -Increased production Amount (1) -Adjusted production schedule (1) -Decreased access to inputs (1)	(6) -Decreased production (4) -Adjusted product type (3) -Diversified product output (3) -1st vs 2nd year production fluctuations (2) -Crop loss (non-COVID related) (1) -Decreased access to processing facilities (1) -Decreased access to inputs (1) -Increased input purchasing (1)
Networks and Collaborations		-New CN (1)
Customer Base	-Decreased consumer demand and sales (6) -Changes in consumer practices (1)	-Increased consumer demand and sales (15) -Changes in consumer practices (7) -Decreased consumer demand and sales (2) -Enhanced customer relationships (2)
Market Channels	-Decreased sales outlets (11) -Decreased on-farm sales and events (5) -Restaurant closures (4) -Farmer's Market issues (3) -Limited capacity of sales outlets (4) -Diversified sales channels (2) -Increased retail sales (1) -DTC marketing (1) -CSA (1)	-Diversified sales channels (4) -DTC marketing (3) -Increased retail sales (3) -Increased sales to food hubs (4) -Decreased consumer demand and sales (2) -Limited capacity of sales outlets (2) -CSA (2) -Farmer's Market issues (1) -Restaurant closures (1)

Total n = 160 (excluded codes)

Respondents were asked to identify changes in production volume in response to COVID-19 based on 11 specified responses. Significance was identified for all 5 characteristics but varied based on response type (*Table 12*). Out of all respondents 80% indicated at least 1 of the specified changes while 20% indicated no change.

For farms that indicated no change in production volume significance was identified based on production diversity, farm age, and geographic distribution (*Table 12*). A total of 54% of farms with non-diversified products indicated no change in production volume compared to 34% of diversified farms (*Figure 27*). About 52% of established farms responded with no change in production volume compared to 24% of new farms. Based on geographic distribution 58% of N/I farms indicated no change in production volume compared to 34% of L/R farms.

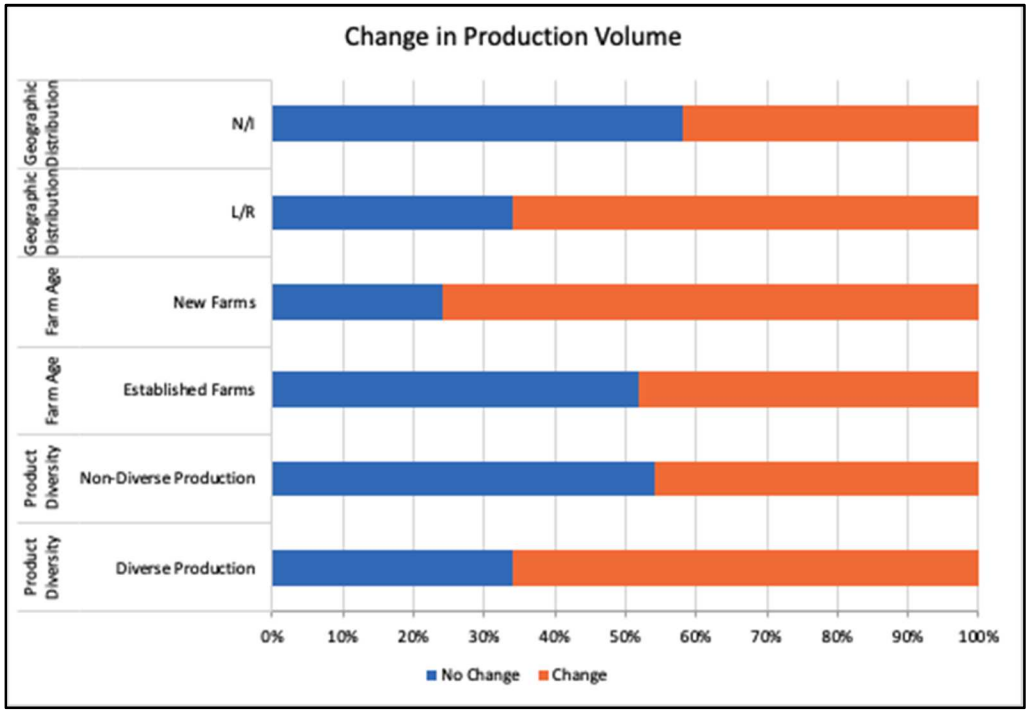

Figure 27: Significant changes in production volume based on farm characteristics. Change is indicated as any respondent who chose 1+ specified response other than 'no change'.

Significance for changes in production volume was also identified for the response 'produced a greater diversity of products' (PDP) based on product diversity, farm age, and farm size (*Table 12*). Out of all respondents who indicated a change in production volume 13%

produced a greater diversity of products. Of farms with diversified products 17% identified PDP as a production change compared to 4% of non-diversified producers (*Figure 28*). Based on farm age 20% of new farms indicated the change of PDP compared to 9% of established farms. In relation to farm size 18% of small farms indicated the change of PDP compared to 4% of large farms.

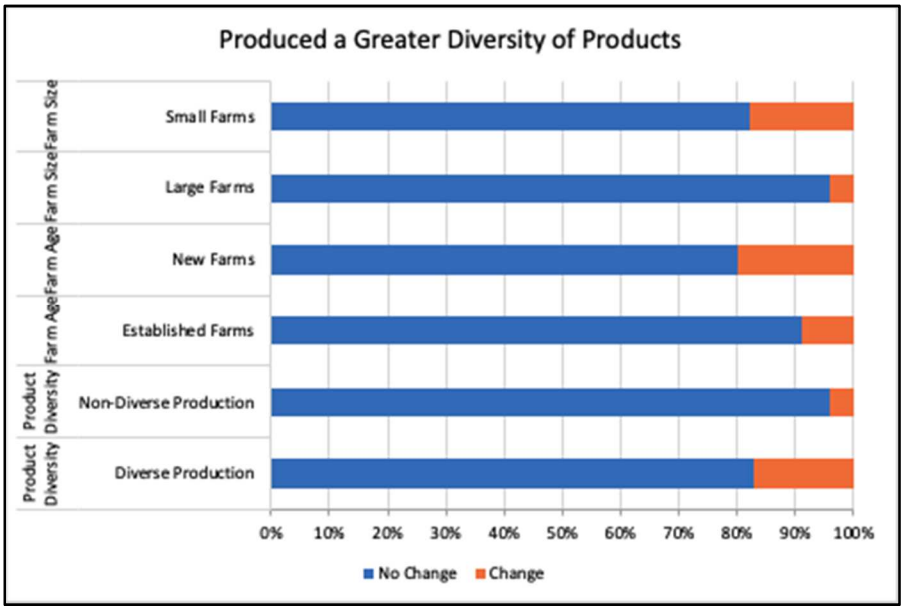

Figure 28: Percent of respondents indicating the production change 'produced a greater diversity of products' due to COVID-19 based on farm characteristics where significance was identified.

Significance was identified for changes in production volume response 'increased volume of product(s) produced' (IVP) based on farm age, farm size, geographic distribution, and market channel diversity (*Table 12*). Of all respondents who indicated some change, 20% identified IVP as a reason for change. Based on farm age, 47% of new farms indicated IVP compared to 11% of established farms (*Figure 29*). A total of 26% of small farms indicated IVP as a change compared to 13% of large farms. About 28% of L/R farms indicated IVP as a change in

production while no N/I farms indicated this change. Of farms with diversified market channels 25% chose IVP as a production change versus 14% of farms with non-diversified market channels.

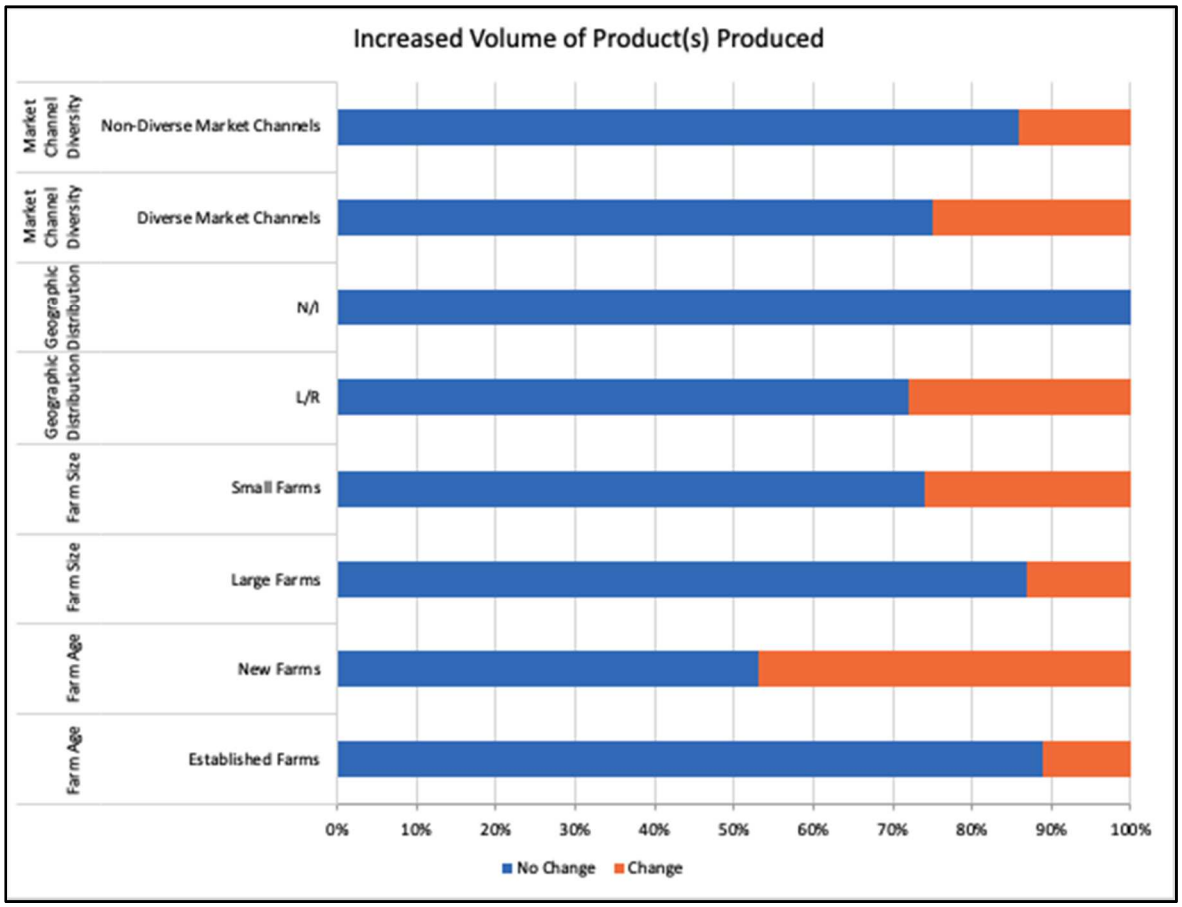

Figure 29: Percent of respondents indicating the production change 'increased volume of product(s) produced' due to COVID-19 based on farm characteristics where significance was identified.

For the changes in production volume response 'produced a smaller number of products' (PNP) significance was only identified based on geographic distribution (*Table 12*). Of all respondents who indicated some sort of change in production 13% chose PNP (*Figure 30*). Based on geographic distribution 16% of L/R farms indicated PNP as a production change compared to 3% of N/I farms.

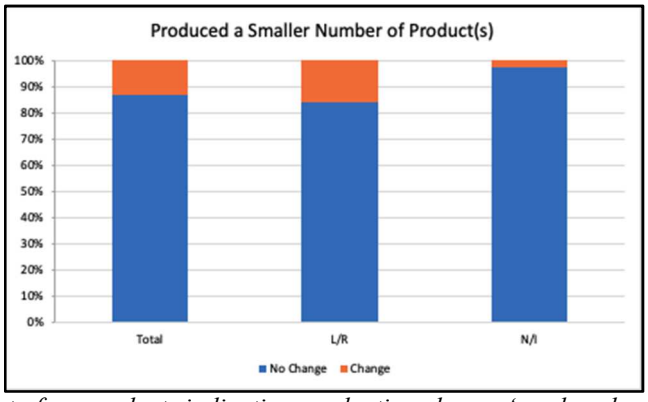

Figure 30: Percent of respondents indicating production change 'produced a smaller number of product(s)' due to COVID-19 based on geographic distribution

The changes in production volume response 'changed timing of production' (CTP) also indicated significance based on farm age, farm size, geographic distribution, and market channel diversity (*Table 12*). Of all participants who responded with some sort of change to production, 12% identified CTP as a specific change. Among new farms 22% identified CTP as a production change compared to 7% of established farms (*Figure 31).* About 17% of small farms responded with CTP as a production change versus 4% of large farms. A total of 17% of L/R farms indicated CTP as a production change compared to 3% of N/I farms. Similarly, 17% of farms with diversified market channels identified CTP as a production change versus 5% of farms with non-diversified market channels.

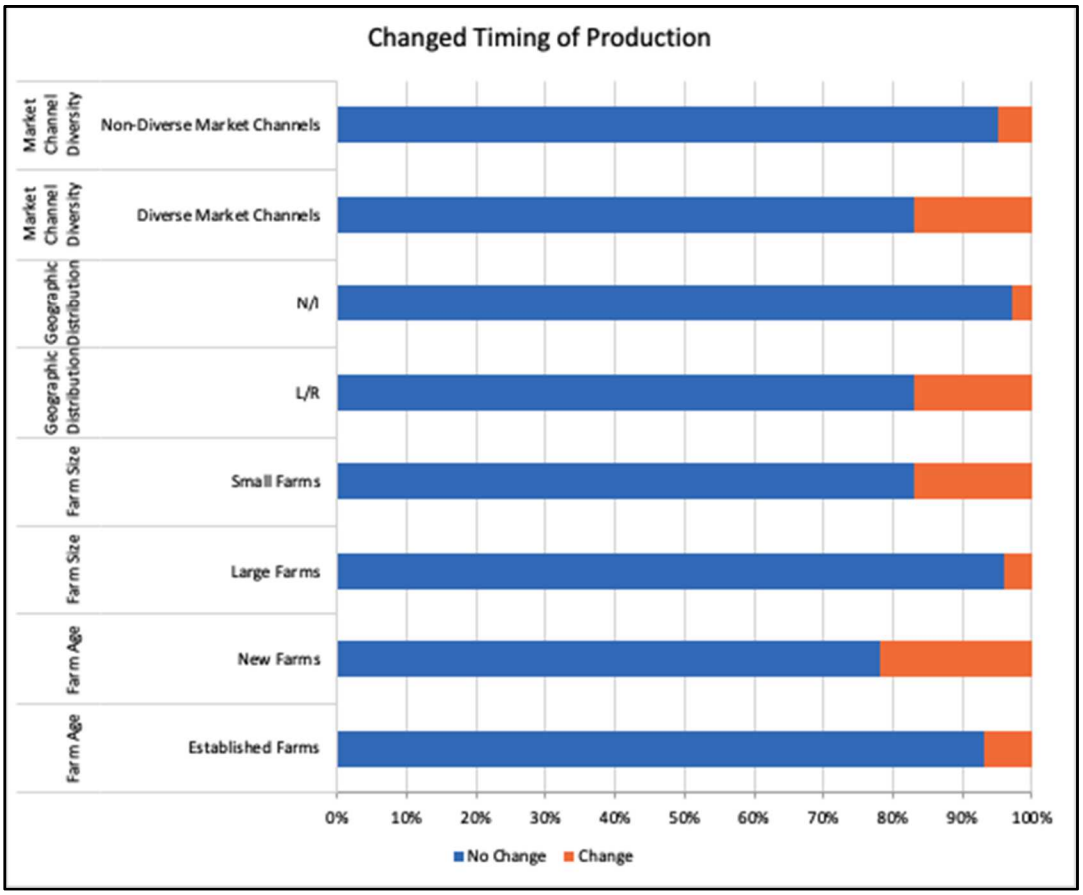

Figure 31: Percent of respondents indicating production change 'changed timing of production' due to COVID-19 based on farm characteristics where significance was identified.

Significance for changes in production volume response 'removed a primary product' (RPP) was only identified based on product diversity (*Table 12*). Of all respondents 10% identified RPP as a production change (*Figure 32*). A total of 13% of farms with diversified products identified RPP as a change made to production compared to 4% of farms with non-diversified products.

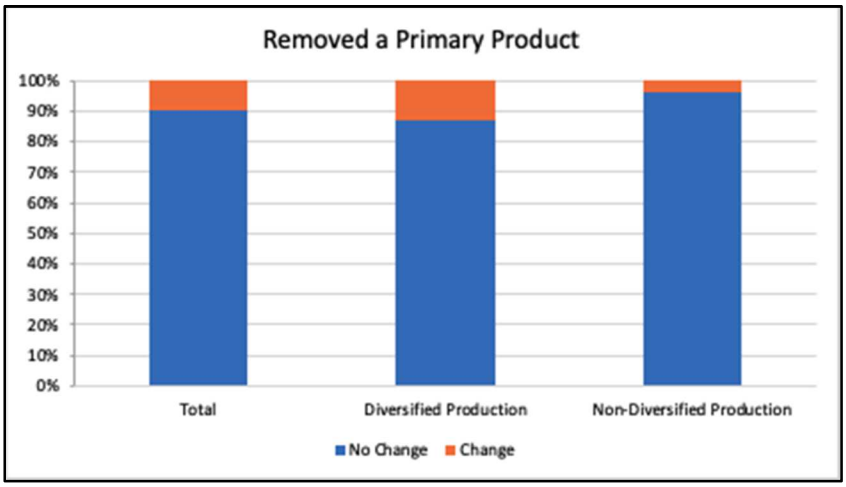

Figure 32: Percent of respondents who indicated production change 'removed a primary product' due to COVID-19 based on total respondents and production diversity.

When respondents were asked to identify their ability or inability to make production changes in 2020, 38% indicated 'yes' they were unable to make production changes while 62% responded with 'no'. Significance was identified based on farm age and farm size (*Table 12*). A total of 45% of new farms indicated an inability to make production changes in 2020 compared to 31% of established farms (*Figure 33*). Based on farm size 40% of small farms identified an inability to make production changes in 2020 compared to 24% of large farms.

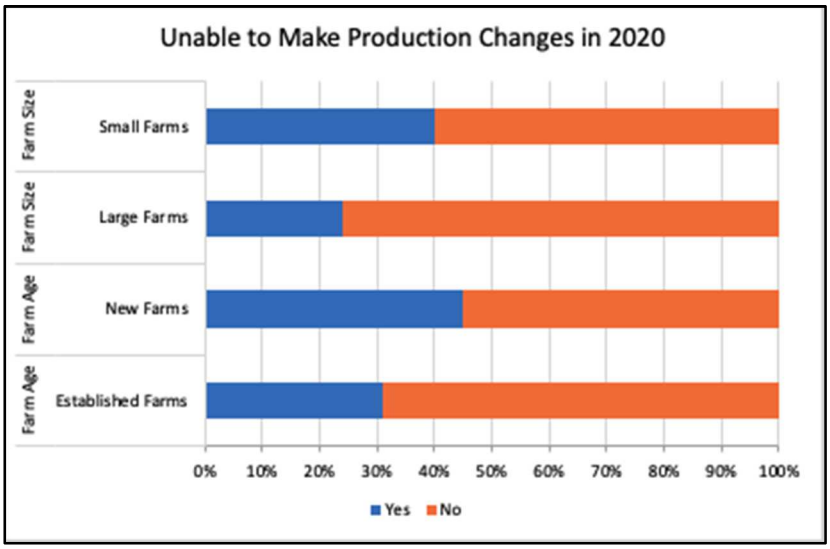

Figure 33: Percent of respondents who were able or unable to make production changes in 2020 based on farm size and farm age.

All participants who were unable to make production changes in 2020 (answer = 'yes') were branched to a short answer question asking them to specify in their own words what inhibited them from making production changes (*Table 14*). The most frequent reasons respondents cited were infrastructure, production scheduling, labor related issues, and closures/delays.

Table 14: Reasons for inability to make production changes in 2020

Code Family	**Reasons for Inability to Make Production Changes in 2020**
Revenue	-Lack of revenue (7) -Lack of funding (3)
Labor	-Labor related issues (16)
Business and Operation	-Infrastructure (17) -Shift in business focus (10) -Financial instability (8) -COVID-19 rules/regulations (7) -Allocated expense funding (5) -Increased costs (5) -PPE costs (2)

	-Federal guidelines/regulations (2) -Contracting difficulties (2)
Production	-Production scheduling (16) -Crop rotation (9) -Decreased production (7) -Lack of inputs (6) -Inability to diversify products (3) -Distribution issues (3) -Issues establishing VAP (2) -Land access (2) -Increased production (2) -Product loss (COVID related) (1) -Environmental/weather issues (1)
Network and Collaboration	-Limited access to services (8) -Lack of support (7) -Limited access to technical assistance (1) -Emergency food programs (1) -Limited community interaction (1)
Customer Base	-Increased demand (2) -Decreased demand (1)
Market Channels	-Closures/delays (16) -Inability to diversify MC (3)

Total n = 57

The addition or removal of a value added product (VAP) between 2020 vs 2019 was identified for production changes (*Table 15*). Respondents were asked if they added a VAP in 2020 or 2019 and changes between years were calculated. Out of all 247 respondents 5% indicated the addition of a VAP in 2020 compared to 3% who decreased the number of VAP they offered in 2020.

Table 15: Changes in the addition of a value added product (VAP) in 2020 versus 2019 based on farm characteristic

VAP in 2020 v 2019	DP	NDP	EF	NF	LF	SF	L/R	N/I	DM	NDM
Increase	5%	3%	3%	7%	8%	4%	6%	0	4%	6%
Decrease	3%	2%	2%	4%	0	3%	3%	0	3%	3%

G. Market Channel

Descriptive analysis was utilized to identify changes in market channel use in 2020 compared to 2019. Two separate mirrored questions (in survey sections 2 and 3) asked respondents to identify the percent of their products marketed at the following geographic scales in 2020 versus 2019: local, regional, national, and international (*Table 16*). Out of all 241 respondents 10% indicated an increase in the use of local distribution channels compared to 9% identifying a decrease. Inversely, 12% of all respondents identified a decrease in the use of regional distribution channels compared to 10% identifying an increase. About 10% of all respondents indicated an increase in the use of national market channels in 2020 compared to 4% of respondents identifying a decrease. Finally 6% of respondents identified a decrease in the utilization of international market channels in 2020 compared to 3% indicating an increase.

Table 16: Changes in percent of products distributed in specific geographic regions in 2020 v 2019 based on farm characteristic

Change in Geographic	DP	NDP	EF	NF	LF	SF	L/R	N/I	DM	NDM

Distribution										
Increase										
Local	10%	6%	9%	9%	10%	9%	9%	6%	10%	6%
Regional	10%	10%	11%	7%	19%	6%	8%	6%	13%	3%
National	8%	14%	14%	4%	10%	8%	3%	33%	10%	8%
International	2%	5%	3%	3%	4%	4%	2%	11%	3%	1%
Decrease										
Local	8%	10%	9%	7%	10%	7%	8%	3%	12%	1%
Regional	11%	10%	12%	9%	17%	5%	9%	19%	13%	8%
National	4%	3%	5%	3%	13%	2%	4%	6%	4%	4%
International	4%	11%	5%	6%	8%	4%	1%	28%	6%	4%

Respondents were then asked to identify the percent of their total sales that were marketed through specific marketing channels in 2020 versus 2019 respectively (*Table 17*).

Table 17: Percent of all respondents who increased or decreased their use of specific market channels in 2020

Market Channel	**Increase in 2020**	**Decrease in 2020**
On-farm Sales	21%	11%
Farmer's Market Sales	4%	19%
CSA Sales	9%	6%
Online Direct-to-Consumer Sales	17%	5%
Direct-to-Restaurant and Food Service	4%	3%
Direct-to-Institutions	3%	2%
Direct-to-Grocery or Other Retailers	10%	8%

Direct-to-International Customer/Importer	0	2%
Food Hubs and Co-ops	10%	7%
Distributor/Broker/Packer	6%	6%
Processor	3%	5%
Other	4%	5%

Discussion

This paper assesses the significant impacts affecting farms that fell into the categories of revenue, labor, business/operations, network/collaboration, customer base and production for farms located in Washington state. It also identifies which significant adaptations farms instituted to increase functionality. All questions analyzed these impacts and adaptations within the scope of farm system resilience. Significance in this case identifies how a diverse array of impacts were experienced by farms significantly differently and any adaptations that were instated by farms at significantly differing rates. In many individual questions, both impacts and adaptations were addressed. With this in mind, it is important to identify similar experiences farms of diverse characteristics faced in which significance was indicated to tell the story of farmers in Washington.

Experiences based on farm characteristics

Farm characteristics contributing the most to significant differences in impacts and adaptations due to COVID-19 were those related to market channel diversity and farm age. Significance was then identified for the following characteristics in descending order: size, geographic distribution and production diversity (Tables 1, 4, 7, 11, and 12).

Diversity as a farm characteristic has been a primary focus in resilience literature, and is considered an attribute which enhances all 3 farm resilience capacities (Meuweissen et al, 2020).

Market channel diversity has been identified in other studies as enhancing both coping and responsive capacities, specifically to COVID-19 (Coopmans, et al. 2021). The significant impacts and adaptations experienced by farms with diverse market channels and production models within this study, both in negative and positive contexts, underscores the role of diversity in altering resilience capacities and therefore a farm's experience in conjunction with this attribute.

Inversely, production diversity had the lowest rate of significance out of all five farm characteristics that were analyzed. In other words, while farms differed in the diversity of their products produced, they experienced the shock of COVID-19 more similarly than farms falling within the aforementioned characteristics. This could be due to many confounding factors such as the timing of COVID-19 shutdowns and production schedules (Coopmans, et al. 2021). Initial impacts to the global food system included issues affecting food security, labor availability, supply chain and processing disruptions, and shifts in market prices (Stephens, E. 2020).

In previous studies, farms with diverse production models have identified increased ability to cope and respond to initial impacts caused by COVID-19 (Coopmans, et al. 2021). This indicates that while diversity can affect impacts and adaptations a farm experiences or enacts, it is important to consider what type of diversity is being studied and understand how these varying characteristics based on diversity in specific regional locations can in turn change the experiences of farms.

Impacts and adaptations based on farm age were also identified with high rates of significance. This is of particular interest since farms were most evenly distributed across this categorization (Figure 3). Age can be most readily correlated with the resilience attribute of systems reserves, where experience is considered the attribute contributing to enhanced ability to magnify any of the three resilience capacities. This makes it understandable that established and new farms would have very different experiences during the pandemic, based on differing sizes of 'reserves' of experiences they had available in order to respond to the initial shock of COVID-19. To truly quantify how these experiences differed in the future it could be beneficial to identify impacts and adaptations based on specific years of experience (i.e. 1 year vs 5 years vs 10 years in business).

Impacts and adaptations by question type

To establish trends in experiences among farms of differing characteristics, questions were analyzed based on specific categories in which impacts and adaptations were most frequently identified (Appendix A). These categories were: revenue, network/collaborations, labor, business/operations, customer base, production, and market channels. This organization is to understand what types of impacts and adaptations affected this diverse respondent pool in specific areas of different farm business functionality and trends throughout these categories that warrant further study.

Revenue

Revenue impacts where significance was identified included changes in net annual revenue (NAR), total annual income (TAI) and gross annual revenue (GAR) in 2020 vs 2019 as well as loss of off-farm income. The two farm characteristics associated with a significant difference in experiences were based on farm age and market channel diversity (Table 1).

A higher percentage of established farms indicated a decrease in NAR and GAR in 2020 compared to new farms. Inversely, new farms identified a higher rate of increase for both TAI and GAR in 2020 when compared to established farms. The association between new farms and more positive impacts to revenue streams in 2020 could be correlated with typical growth experienced by new businesses early in their existence. To explain why established farms experienced more negative impacts to their revenue streams in 2020 even with more systems reserves (e.g. “experience”) than new farms, more in-depth revenue questions should be established to identify why these types of specific revenue changes occurred.

A higher percentage of respondents who lost off-farm income was associated with farms who had established non-diversified market channels compared to those with diversified market channels. This could more negatively affect the ability of farms with non-diversified market channels to pivot their business's revenue streams. But, what this also indicates is that there are many facets in which diversity amongst producers can be established and studied. While farms with non-diversified market channels identified a higher rate of loss of off-farm income, this establishes that even farms which utilize one market channel gather income from a diverse stream of employment.

Network and Collaborations

Significant differences in establishment of new collaborations due to COVID-19, specifically with other producers and collaborative networks, were experienced by farms based on market channel diversity, geographic distribution, age and product diversity. Respondents identified these new relationships were most commonly established with food access organizations and other like-minded food businesses. This was accomplished through the consolidation of business practices and products in response to market channel closures and limited access to food, primarily food insecurity experienced by individuals at a consumer level. New collaborations were also established to distribute food to those in need and maintain the flow of new information within the farming sector (Table 5). These reasons identified by respondents demonstrate that while collaborations were a necessary adaptation to continue business functionality, they also served as a conduit of information between farms of different types. This function during a time of continuously changing guidelines and recommendations emphasizes the importance of collaboration in enhancing adaptability and therefore farm resilience.

Trends among farm types indicate that diversified producers (both in market channel and production) had a higher rate of establishing new collaborations due to COVID-19, specifically with other collaborative networks. This association of diversity increasing social capital is in line with diversity improving the adaptive capability of farms, primarily through the resilience attributes of flexibility and rapidity (Coopmans, et al. 2021). Similarly, a higher percentage of farms with diversified market channels and products indicated an increase in collaborations with other networks in 2020 compared to 2019. This is correlated with the trend of diversified

producers having the flexibility to increase collaborations and therefore social capital or farm robustness (Meuwissen, et al. 2021). This also establishes increased diversity in collaborative networks, which in turn increases overall business diversity and aids in both enhancing adaptability and transformability.

New farms also had a higher rate of new collaborations in 2020 due to COVID-19, which could be associated with increased flexibility through the ongoing development of newly established business practices. While not identified based on farm age, this aligns with previous findings in which enhancing established collaborations amongst pre-existing players in the system allows for a more coordinated response to market shifts, therefore increasing adaptability (Coopmans, et al. 2021).

Labor

The most significant differences in impacts to labor were primarily associated with differences in farm age, farm size, and geographic distribution. The changes to workforce due to COVID-19 in which farms had significantly different experiences were reducing the number of existing employees, reducing hours of existing employees, and furloughing existing employees (Table 7). A higher percentage of large farms and established farms identified having to enact one or more of these labor adaptations. These types of labor adaptations are associated with more negative consequences, as a reduction in labor force reduces the ability to keep up with specific production models (Coopmans, et al. 2021).

The significant reasons for farms reducing or furloughing employees were lack of available workers, inability to support social distancing and/or safe handling practices, and issues with immgration visas (Table 7). Significantly different experiences were identified by farms based on size and geographic distribution. Specifically, large farms experienced a much higher rate of inability to support social distancing amongst their workers and issues with immigration visas compared to small farms. These changes have been previously associated with specific farm types and affected by confounding factors such as the type of labor these businesses employ (Reardon and Swinnen. 2020). Negative changes in labor practices are correlated with other studies in which specific sects of the agricultural sector were disproportionately affected through the loss of a valuable robustness attribute: skilled labor (Coopmans, et al. 2021). So, while large farms have enhanced robustness through a higher yearly revenue than small farms, this does not protect them from other labor issues caused by system shocks such as COVID-19.

A higher percentage of large farms experienced a decrease in the number of full-time employees retained year round in 2020 compared to 2019. Similarly a higher percentage of national/internationally-marketing farms identified a decrease in full-time employees year round and at peak season in 2020. This decrease amongst national/international farms trend with a significantly higher percentage of them indicating a lack of available workers being one of the biggest reasons for a reduction or furlough of existing employees. Negative effects to the workforce have previously been associated with the number of workers these farms employ coupled with the type of employees hired (i.e. migrant workers) (Meuwissen, et al. 2021). These impacts indicate that while a larger labor force can increase streams of revenue, additional costs associated with a drastic systemic shock could actually cause more negative and detrimental

effects to business functionality and therefore decreased ability to ensure resilience capacities in the future (Meuwissen, 2020).

A significant specific business impact based on farm age was difficulty finding or retaining workers, where a higher percentage of established farms indicated a moderate impact compared to new farms. This aligns with labor trends amongst established farms in which a higher percentage of established farms reduced the number and hours of existing employees and decreased their peak season workers at a higher rate. Increased negative labor issues could be associated with tightness of feedback loops affecting established farms more readily, resulting in negative labor stressors to the system (Coopmans, et al. 2021). These impacts could also be correlated with a lack of flexibility amongst established farms, which has been identified as an important attribute in adaptability (Meuwissen, et al. 2020).

Business and Operations

Significance for overall negative or positive business impacts due to COVID-19 was identified based on geographic distribution and farm age. A higher percentage of established farms and farms distributing >75% of their product at a national/international level indicated negative impacts to their business compared to new farms and those distributing the bulk of their product at local/regional levels. This association of less negative impacts and more positive impacts to new farms and local/regional farms can indicate a few resilience attributes including tightness of feedback loops and/or increased flexibility amongst these farm types, both important attributes enhancing resilience capacities (Coopmans, et al. 2021). While this indicates the potential utilization of resilience attributes to positively impact business functioning it brings up

more nuanced questions warranting further study. Line of questioning could include specific reasons why these types of farms were less negatively impacted and how agricultural systems on these different levels were or were not able to respond to the immediate shock of COVID-19 (Stephens, et al. 2020).

The most significant specific business impacts due to COVID-19 associated within farms of differing market channel diversity and were identified as product going to waste and lack of access to working capital. A higher percentage of farms with diversified market channels indicated product going to waste as a moderate impact compared to farms with non-diversified market channels. But, a higher percentage of non-diversified farms identified this as a significant impact to their business. Similarly, a higher rate of farms with non-diversified market channels identified lack of access to working capital as a significant impact while a higher percentage of diversified farms identified it as a minor impact. These effects indicate that diversity within business practices does not necessarily protect a farm from experiencing adverse business and operations impacts (Coopmans, et al. 2021). While diverse producers experienced a higher rate of moderate impacts, non-diverse farms indicated a higher rate of significant impacts, which have the potential to become a long-lasting stressor on these farms or have more significant impact to overall business functionality (Meuwissen, et al. 2021).

In order to respond to business pivots and keep an open line of communication with consumers, changes in communication methods were vital. The most significant changes in communication methods were specifically to email and social media. A higher percentage of farms with diversified market channels and diversified products indicated an increase in the use

of email due to COVID-19. Interestingly, more large farms identified an increase in email use compared to small farms. These changes could be based on how frequently email was used pre-pandemic, but what this indicates is the ability for flexibility amongst these business types. It has been identified in previous studies that any issues with correspondence pre-COVID-19 can persist and/or worsen after the initial shock (Coopmans, et al. 2021). This indicates that increased diversity amongst communication methods could enhance adaptability to fluctuations in communication methods.

Significant changes in social media use was identified based on market channel diversity and product diversity. Both farms with diverse market channels and diverse products indicated a higher rate of increasing social media use in response to COVID-19. Falling in line with diverse producers pivoting types of interaction with customers, this can be associated with more flexibility exhibited by these farm types resulting in them adapting their communication methods to fit the changing experiences of the consumer and sustaining effective communication.

Changes in operation costs were most significantly different based on farm size. A higher percentage of large farms indicated an increase in operational costs compared to small farms. These increased business costs amongst large farms are interesting considering that labor, which can contribute to a percentage of overall business costs, was most decreased amongst these types of farms. So, while increased business costs are correlated with changes in business practices, further research is necessary to identify which business costs constituted the greatest percentage of costs.

The primary future impacts respondents were most concerned about were the ability to adapt to market uncertainty, ability to offer competitive wages, ability to adapt to changing consumer practices, disruptions in supply chains, and unforeseen expenses. A greater proportion of large farms expressed concern for the ability to offer competitive wages and unforeseen expenses. This aligns with the significantly higher increase in operational costs indicated by large farms as well as specific labor impacts they experienced such as difficulty finding or retaining workers. This trend indicates that farms with a higher stream of revenue (and therefore system reserves) are not necessarily protected against system shocks and can continue functionality as established pre-COVID-19 (Coopmans, et al. 2021).

A higher percentage of farms with diverse market channels indicated significantly higher concern for the ability to adapt to market uncertainty, the ability to offer competitive wages, ability to adapt to changing consumer practices, and disruptions in supply chains. While it has been established that diversity increases adaptability, what this illuminates is that it does not negate the fear farmers experience based on potential future issues.

Customer Base

Significant differences in the size of the customer base was identified based on the characteristic of farm age. A higher proportion of new farms indicated an increase in the size of their customer base whereas a higher rate of established farms identified a decrease. This associates a negative impact to business functionality and could be correlated with the aforementioned decrease in both NAR, TAI, and GAR experienced by established farms. What these impacts indicate is that flexibility in responding to consumer demands is important in

expanding the size of a farm's overall customer base, and identifies the role flexibility can play in adapting to these changing consumer demands (Meuwissen, et al. 2021).

Production

A higher percentage of farms with diverse market channels indicated a significant increase in production volume in 2020 compared to non-diversified market channels. This correlation between diversity increasing the ability for businesses to adapt to changing consumer practices could have been enhanced through the increase in social capital and adaptation of communication methods diversified farms established, both indicating flexibility and diversity as important attributes increasing adaptability (Coopmans, et al. 2021).

Significance was also identified for changes in production volume based on farm age, where a higher percentage of new farms indicated an increase in production volume in 2020 compared to established farms. This change could be associated with a decrease in the size of the customer base that established farms experienced at a significantly higher rate. But, this change could also be correlated with typical business growth experienced by new farms.

The primary adaptations in production due to COVID-19 where significance was identified were increased volume of products produced, changing timing of production, produced a greater diversity of products, producing a smaller number of products, and removing a primary product. The ability for specific producers to adapt their production in response to COVID-19 can be associated with increased flexibility enhancing adaptability and transformability. It has also been indicated that timing of the shock of COVID-19 and production schedules could play a

huge role in how adaptable specific production models are, which is important to consider when identifying production adaptability (Meuwissen, et al. 2021).

A higher percentage of farms with diversified market channels or products were able to increase production volume, change timing of a product, or produce a greater diversity of products. This indicates increased flexibility to adapt production practices amongst diversified farms. A higher rate of farms with diversified production indicated removing a primary product but were still able to diversify their products at a higher rate than non-diversified producers. These changes can be associated with the resilience attributes of rapidity and resourcefulness needed to adapt to changing production needs as they occur.

A higher proportion of farms distributing >75% of their products locally/regionally indicated an increase in production volume compared to no national/international respondents, while also producing a smaller number of products compared to national/international farms. Local/regional farms also had the ability to change the timing of production more rapidly than national/international farms. This experience identifies increased flexibility in already established production models and redundancy within production practices. These attributes enhance the potential for these businesses to more readily adapt to market shifts, in turn enhancing their resilience overall (Coopmans, et al. 2021).

A higher percentage of new farms were able to adapt production changes such as changing the timing of production and producing a greater diversity of products. These

adaptations can be associated with less negative impacts including a decrease in production volume that were more frequently experienced amongst established farms.

A higher rate of production adaptations were indicated by a greater proportion of small farms which included increased volume of products produced, changed timing of production, and produced a greater diversity of products. This associates better flexibility amongst small farms to adapt changes in response to changing market demands while in turn continuing farm functionality.

The aforementioned adaptations counters significance identified when respondents were asked if there were changes to production volume that they were unable to make. A greater number of new farms and small farms indicated the inability to make the production changes they wanted, which disputes the previously established production changes they enacted at a significantly higher rate than established farms or large farms. This data recognizes that while new farms and small farms exhibited more flexibility, they were still unable to enact some of the production goals they had previously established. What this establishes is that there is no 'one size fits all' response when identifying resilience attributes within the farm system (Meuwissen, et al. 2021).

Respondents who indicated a change in production were branched to a short answer question to identify why these changes were made. They were separated into farms who indicated a decrease in production volume in 2020 and those who experienced an increase. For farms who identified a decrease the primary reasons listed for this change were weather and

environmental issues, decreased sales outlets, and issues finding/training new labor (Table 13). Labor issues coincide with previously established specific labor effects experienced by established farms in which they had more negative labor experiences when compared to new farms. Interestingly, weather and environmental issues were the primary reason for production decreases, not issues caused by COVID-19. This indicates that prolonged stressors such as climate change could confound adverse effects when combined with an economic or social system shock (Meuwissen, et al. 2019).

Inversely, farms who experienced an increase in production volume most frequently cited increased consumer demand and sales, increased farm acreage, and increased production efficiency as the primary causes for this change (Table 13). This indicates that diverse changes to infrastructure and flexibility in order to enact these changes can have a positive effect on production practices. In turn, increased efficiency streamlines these changes and allows for increased adaptability and transformability.

Market Channels

Descriptive analysis identified any adaptations that were made to market channel distribution in 2020 compared to 2019. It was identified that most respondents identified an increase among regional and national distribution channels as opposed to national and international marketing channels (Table 16). These increases were most frequently identified amongst established farms, large farms, and farms with diversified market channels. These shifts in market channel utilization could be due to pre-existing connectedness amongst players within

the farm system and their ability to support a new geographic level of production distribution (Meuwissen, et al. 2021).

Decreased distribution through international market channels was experienced by a higher percentage of national/international farms and coincides with an increase in national distribution these farms experienced (Table 16). International distributors are a part of a tightly connected system that were severely affected by closures and international trade issues, both of which arose quickly and without warning during shutdown (Coopmans, et al. 2020; Stephens, E. 2020). While this association does not indicate a negative or positive impact, it does establish a decrease in the diversity of geographic distribution these farms utilize, in turn decreasing the resilience capacity of robustness to future shocks or stressors (Stephens, E. 2020).

Primary themes and future routes of study

Through this survey we were able to identify which impacts were experienced significantly differently by farms of various types and what adaptations they were able to establish at significantly different rates. The primary themes that emerged after testing for significance and descriptive data identifying differences in 2020 vs 2019 are as follows:

- **Diversity within production and business models is correlated with an increase in social capital particularly with the establishment of new collaborations in response to system shock.**

- **Increased flexibility based on farm production and operations is more frequently associated with farms who utilize diverse business practices that are built into their farm's business model.**
- **A higher revenue stream does not ensure the ability to sustain labor practices and specific business model functionality.**
- **More experience does not necessarily protect against negative business impacts or increase a farm's adaptability.**

Identifying these themes allows for the ability to develop metrics to successfully dive into the nuances about why these impacts were more frequently experienced and specific adaptations enacted amongst farms of various types. These themes also address previously established resilience questions which include how market shift impacted geographic distribution, what types of farms were most affected by changing labor practices, and how Washington's agricultural system responded to large scale changes caused by shifting consumer practices (Stephens, E. 2020).

This study also identifies that while analyzing survey data utilizing a mixed-methods approach it is important to identify different respondent characteristics to gain a deeper understanding of differing impacts caused by COVID-19. It is difficult to get a more detailed picture of what is truly occurring within the farming system when a 'one size fits all approach' is utilized (Meuwissen, et al. 2019). Identifying resilience attributes and capacities within a complex system affected by specific shocks and stressors is difficult to measure, illuminating the importance of utilizing specific farm characteristics to craft a detailed survey in order to

understand exactly where in the system positive and negative effects are occurring and subjective data directly from the farmers perspectives outlining their experiences in their own words (Coopmans, et al, 2021; Tendall, et al. 2015).

Farm characteristics that could be stratified in future research include farm expenses based on farm size, farm acreage, government funding, breakdowns based on specific agricultural products or counties, total percentage of yearly total annual income, type of ownership (i.e. family run), and the identity of farm owners/operators (Tendall, et al. 2015). Stratifying data based on these types of agricultural producers in which census data is readily available, allows for a more diverse picture of the experiences an array of farmers experienced during COVID-19 and how they are they are adapting or transforming their business practices in response to the stressors these shocks have caused (Coopmans, et al. 2021).

There were multiple strengths within this study. First, there were 265 completed responses, a sufficient population size to identify significance. Second, question development based on feedback provided by a diverse array of stakeholders helped to identify more positive and negative responses and give a more detailed view of the experiences farmers faced. This differs from many surveys where questions were overarching and not as detailed. Third, mirroring questions on pre-established resilience capacities and attributes enable more connections to be established between farm experiences and the role resilience plays within these experiences.

It is important to identify the limitations within this study to effectively develop future routes of study. First, while the size of the respondent pool was large enough to calculate significance it may not be representative of all farmers in Washington state. This was identified among specific demographics including identity and gender. Particularly, the distribution of farm types amongst the different characteristics were unequal within each category except for farm age. While this may be indicative of Wasington's agricultural sector as a whole, a survey that was able to reach farmers of a more diverse demographic could aid in illuminating disparities within resilience capacities such as robustness and adaptability based on these characteristics. Second, survey bias amongst respondents could have impacted overall responses. This could have impacted specific questions where significance was identified. A third limitation was timing of this survey, which was deployed in fall of 2020. At time of deployment multiple surveys had been deployed and could have led to survey fatigue, in turn affecting participants' responses. It has also been indicated in previous studies that COVID-19 may have more significantly affected farms that generated specific products based on their production timelines (Meuwissen, 2020). This in turn could have also impacted specific responses leading to inaccuracy in significance testing.

It is not surprising that various farms in Washington state were impacted differently by the shock of COVID-19 and adapted their practices in a multitude of ways to continue business functionality. This survey only scratches the surface of these experiences and future studies should focus on asking pointed questions that can be easily quantified to continue to monitor the role resilience capacities and attributes play in the ability of farms in Washington to continue to thrive. By discussing trends identified throughout these experiences future methods for

quantifying farm resilience can be established and refined. This allows for a more cohesive and concentrated approach to gathering data that can support farms in the best way possible when unforeseen shocks such as COVID-19 occur.

References

Anderies, J.M., Folke, C., Walker, B., Ostrom, E., 2013. Aligning key concepts for global change policy: robustness, resilience and sustainability. Ecol. Soc. 18 (2), 8.

Cargill, C. (2016). Agriculture: The cornerstone of Washington's economy. Washington Policy Center, March, 1–7.

Constas, M. A., Frankenberger, T. R., & Hoddinott, J. (2014). Resilience Measurement Principles: Toward an agenda for measurement design. Resilience Measurement Technical Working Group. Technical Series No. 1. Food Security Information Network. Available at http://www.fsincop.net/fileadmin/user_upload/fsin/docs/resou. 1, 31.

Coopmans, I., Bijttebier, J., Marchand, F., Mathijs, E., Messely, L., Rogge, E., Sanders, A., & Wauters, E. (2021). COVID-19 impacts on Flemish food supply chains and lessons for agri-food system resilience. *Agricultural Systems*, *190*(February), 103136. https://doi.org/10.1016/j.agsy.2021.103136

Galanakis C. M. (2020). The Food Systems in the Era of the Coronavirus (COVID-19) Pandemic Crisis. *Foods*, *9*(4), 523.

Hoddinott, J. (2014). Resilience for Food and Nutrition Security: Looking at development through a resilience lens. Resilience for Food and Nutrition Security, Holling 1973, 19–26.

Holling, C.S. Resilience and Stability of Ecological Systems: Annual Review of Ecology and Systematics (1973). Vol . 4 pp. 1-23. Retrieved from https://www.jstor.org/stable/2096802.

Holling, C., 2001. Understanding the complexity of economic, ecological, and social systems. Ecosystems 5, 390–405. https://doi.org/10.1007/s10021-001-0101-5.

Inslee, J. (2020). Proclamation by The Governor Amending Proclamation 20-05 Stay Home – Stay Healthy. *Office of the Governor*, *3*, 1–5. www.governor.wa.gov

Harris, P., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., Conde, J., Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support, J Biomed Inform. 2009 Apr;42(2):377-81.

Jones, M., 2013. What does resilience mean to food security and poverty allevia- tion? Policy Brief. SIANI, Stockholm, Sweden, p. 4.

Lin, N. (2001). Social capital: A theory of social structure and action. New York: Cambridge University Press.

Mathijs, E., Wauters, E., 2020. Making Farming Systems Truly Resilient. EuroChoices 19 (2), 72–76.

Meuwissen, M. P. M., Feindt, P. H., Spiegel, A., Termeer, C. J. A. M., Mathijs, E., de Mey, Y., Finger, R., Balmann, A., Wauters, E., Urquhart, J., Vigani, M., Zawalińska, K., Herrera, H., Nicholas-Davies, P., Hansson, H., Paas, W., Slijper, T., Coopmans, I., Vroege, W., … Reidsma, P. (2019). A framework to assess the resilience of farming systems. Agricultural Systems, 176(May), 102656. https://doi.org/10.1016/j.agsy.2019.102656

Meuwissen, M. P. M., Feindt, P. H., Slijper, T., Spiegel, A., Finger, R., de Mey, Y., Paas, W., Termeer, K. J. A. M., Poortvliet, P. M., Peneva, M., Urquhart, J., Vigani, M., Black, J. E., Nicholas-Davies, P., Maye, D., Appel, F., Heinrich, F., Balmann, A., Bijttebier, J., … Reidsma, P. (2021). Impact of Covid-19 on farming systems in Europe through the lens of resilience thinking. Agricultural Systems, 191(December 2020). https://doi.org/10.1016/j.agsy.2021.103152

Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F., & Pfefferbaum, R. L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology*, *41*(1–2), 127–150. https://doi.org/10.1007/s10464-007-9156-6

Paas, W., Coopmans, I., Severini, S., Ittersum van, M.K., Meuwissen, M.P.M., Reidsma, P., 2021. Participatory assessment of sustainability and resilience of three specialized farming systems. Ecol. Soc. 26 (2), 2. https://www.ecologyandsociety.org/vol26/iss2/art2/.

Reardon, B. Y. T., & Swinnen, J. (2020). COVID-19 and resilience innovations in food supply chains. 1–7. https://www.ifpri.org/blog/covid-19-and-resilience-innovations-food-supply-chains

Stephens, E. (2020, May 20). Impacts of COVID-19 on agricultural and food systems worldwide and on progress to sustainable development goals [Editorial]. *Agricultural Systems*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237936/

Tendall, D. M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q. B., Kruetli, P., Grant, M., & Six, J. (2015). Food system resilience: Defining the concept. Global Food Security, 6, 17–23. https://doi.org/10.1016/j.gfs.2015.08.001

Termeer, C.J.A.M., Dewulf, A., Biesbroek, G.R., 2017. Transformational change: governance interventions for climate change adaptation from a continuous change perspective. J. Environ. Plan. Manag. 60, 558–576.

US Census Bureau (2017). Washington State Profile. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/cp99053.pdf

"WHO Director-General's Opening Remarks at the Media Briefing on COVID-19." (11 March 2020). Retrieved from https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media- briefing-on-covid-19---11-march-2020 (accessed on 13 April 2020).

Washington State Department of Agriculture (WSDA). (2020). Agriculture: A Cornerstone of Washington's Economy. Retrieved from https://agr.wa.gov/washington-agriculture

Appendix A

Table of immediate impact farm surveys deployed nationally and globally during the first 6 months of the COVID-19 pandemic.

Survey Name	Organization of Deployment	Date of Deployment	Target Population	Additional Information
Young Farmers COVID-19 Survey	National Young Farmers Coalition	February 2020	All US farmers and ranchers	Authors: Martin Lemos and Sophie Ackoff National survey to farmers and ranchers to learn about challenges they are facing on farms and within their communities resulting from the coronavirus.
American. Farm Bureau Federation Survey	American Farm Bureau	N/A	General population (not farmers)	Deployed by: Mike Tomko - Director, Communications USDA estimates $50B in total production loss for 2019, 2020, and 2021 - does not include agricultural loss Farm bankruptcy over the 12-month period ending in March 2020 increased from 23% in the previous year.
National Association of Farm Broadcasting Survey	NAFB	N/A	All US farmers and ranchers	Deployed by: Tom Brand - NAFB executive direction 220 responses, 186 completed surveys
Beginning Farmer Resource of Maine Survey	Beginning Farmer Resource Network of	First survey: 3/18/20-3/2720 Second (revised)	Farmers in Maine	First Survey - 179 responses Second Survey - 79

	Maine Community partners consolidated through the University of Maine	survey: April - May 2020		responses Data analysis done through Maine Organic Farmers and Gardeners Association, University of Maine, Maine Farmland Trust
WAYFC (Anonymized) Farm Resilience Webinar Survey	Washington Young Farmers Coalition (WAYFC)	March 16-31, 2020	Farmers in Washington State	This survey was a registration requirement for the Farm Resilience & COVID-19 in WA State webinar. Survey was developed by WAYFC, SnoValley Tilth and several other orgs Initially - 560 responses More here
ResourceED (Good to Eat)	Stone Barns Center	8 week period in April - May 2020	Farmers through the US primarily in Northeast	240 responses Designed by Andrew Luzmore, market forager for Blue Hill's restaurants Laurie Freyer - author on survey and manager for Stone Barns Center a NGO that partners with Blue Hills restaurants Network compromised of “alumni farmers” who completed the young farmers program

				and “organic farmers who provide high-quality specialty varietals to chefs as part of their diversified markets” Farms are small and independent, primarily selling to restaurants.
California Farm Bureau Federation COVID-19 Survey	CFBF and Farm Employers Labor Survey	4/7/20 - 4/21/20	Farm Bureau Members and FELS Newsletter subscribers	510 responses Primarily to quantify impact of pandemic Questions intended to capture overall, macroeconomic impacts on farmers and ranchers in general, farm employers, and economic well-being of farm families.
Farm Journal Survey	Farm Journal	3/16-3/24	National farmers and ranchers representing 43 states	Exploratory survey 679 responses from farmers, ranchers and agricultural workers
Ag Economy Barometer - Farmer Sentiment Rebounds Amidst Ongoing COVID-19 Concerns	Purdue University/CME Group	First Tuesday of every month July 20-24, 2020	400 national agricultural producers through telephone interview Includes quarterly index of 100 agriculture and agribusiness	National measure of health of US agricultural economy through the use of an index value Development of this tool to help producers, economists, traders, finance industry professionals and journalists to gain a better understanding of the agriculture community and broader

				global context. https://ag.purdue.edu/commercialag/agecono mybarometer/ This survey is conducted every month and varies enabling it as a tool to develop questions relevant to farmers after the busy growing season.
Farm, Food, and Agribusiness COVID-19 Impact Survey	Ohio Farm Bureau and Ohio commodity organizations	4/10/20 - 4/14/20	Agricultural producers, retailers, and food processors in Ohio	>1100 respondents Primary goal to broadly gauge the uncertainties and concerns felt by agriculturally related businesses in Ohio. https://ofbf.org/app/uploads/2020/04/Farm-Food-and-Agribusiness-COVID-19-Survey-web.pdf
Washington State Agricultural Producer COVID-19 Economic Impact Survey	Washington State Department of Agriculture (WSDA)	5/4/20 - 5/14/20	Farmers, ranchers, aquaculture and other agricultural producers within WA state	789 agricultural participants This survey is a generalized understanding of the economic impacts farmers faced due to the COVID-19 pandemic, specifically within the agricultural industry. Focused on small to mid-scale producers whose primary markets were local and regionally based.

				While agricultural farmers including aquaculture producers were targeted, participation was open to any farmer within WA state. Many larger-scale fruit tree producers took the survey. Therefore the data should not be interpreted as a comprehensive look or strictly representative of WA's agricultural industry.
Impacts of COVID-19 on Small- and Medium-Sized Enterprises in the Food System	Global Alliance for Improved Nutrition World Food Programme	4/29/20 - 5/19/20	Owners and/or managers of micro, small and medium sized businesses (SME's) in the FS in low and middle income countries17 countries	363 responses - primarily micro or small-sized firms Respondents primarily worked in farms focused on food processing and distribution as well as supporting services such as agricultural inputs and cold chain services: grains, vegetables, and fruit value chains. Questions were framed around how COVID-19 pandemic and control measurements had affected their business through referencing the period before the pandemic. Survey shared via email through FS networks approved by

				GAIN and/or WFP. Data analyzed using Stata SE15: no subgroup analysis and presented in anonymised form. https://www.gainhealth.org/sites/default/files/publications/documents/impacts-of-covid-19-on-small-and-medium-sized-enterprises-in-the-food-system.pdf Primary conclusions: -Local financial services providers should develop a comprehensive package of financial support for SMEs (i.e. grants, short term low interest bridge loans) in order to meet critical needs, prevent bankruptcy, and support investment in production post-lockdown. -Gov providing subsidies to banks for them to waive loan fees or extend payment deadlines therefore injecting capital into the agri-food sector helping workers stay afloat. -Ensuring free movement of food related goods and equipment within and

				across national borders is also essential.
Farm and Agribusiness COVID-19 Impact Survey	New York Farm Bureau	6/8/2020 - 6/17/2020	Agricultural farmers, employees and agribusiness owners in NY state	531 farmers, employees, and agribusiness owners https://www.nyfb.org/application/files/9715/9533/5039/6-20_NYFB_COVID_Survey_Report.pdf
Impact Report: COVID-19 Agriculture Survey	Farm Bureau Georgia; Georgia Foundation for Agriculture; University of Georgia	5/1/20 - 5/21/20	Agricultural farmers in Georgia	862 Respondents Average farm size (acres) - 563 Average farm income - $184,808 https://www.gfb.org/skins/userfiles/files/casestudy-COVID%2019%20Survey-v7%5B1%5D(1).pdf
Survey Report on the Impact of COVID-19 on the Massachusetts Agricultural Community	Massachusetts Dept of Agricultural Resources	5/1/20 - 6/1/20	Agricultural farmers in Massachusetts	Developed by: Myron Inglis 311 respondents representing 4.29% of farms in Massachusetts
Farmers and Markets in the Pandemic	LocalHarvest - online directory service connecting customers with farmers/ranchers Stanford	Survey 1: mid-May 2020 Survey 2: mid-June 2020	Nationally distributed farmers and producers May survey targeted direct-to-consumer facing	-Farmers in the LocalHarvest network who sell directly to consumers are experiencing an increase in the consumer demand for local farm products since the COVID-19

	University Department of Management Science		farms (CSA) June survey targeted broad range of growers/producers	outbreak. Meat and poultry were the products most often cited as being out of stock. Logistical challenges identified: -Virus control and protection for employers/employees -Meat processor shortages (primarily due to processing incapacity) -Pickup/dropoff location shortages for direct-to-market and CSAs

Appendix B

Memorandum released to the Washington State Department of Agriculture (WSDA) identifying stakeholder trends.

MEMORANDUM

TO: LAURA RAYMOND AND MADISON MOORE

FROM: ANNA FOGEL, YONA SIPOS, AND SARAH COLLIER

SUBJECT: IDENTIFYING WIDESPREAD COVID-19 IMPACTS AND SHIFTS IN THE FARMING SECTOR: KEY TRENDS AND TAKEAWAYS FROM AUTUMN 2020 DISCUSSIONS WITH AGRICULTURE AND FOOD SYSTEM PROFESSIONALS IN WASHINGTON STATE

DATE: FEBRUARY 24TH, 2021

Background

In order to gain a better understanding of what issues have most impacted Washington state farmers and to inform development of the subsequent WA Farm COVID-19 Survey, interviews were conducted with agricultural and food system stakeholders between September 21st and October 8th, 2020. A total of 17 interviews were conducted with professionals representing private businesses (8), non-governmental organizations (6), and commodity commissions (3). Interviews focused on observed trends within the industry, sector, or demographic that each interviewee represents or interacts with regularly, with emphasis on the ability or inability for Washington producers to effectively respond to the COVID-19 pandemic. The primary line of questioning revolved around three resilience capacities: robustness, adaptability, and transformability[1]. Supplementary questioning included a focus on decision making factors. All interviews were conducted by researchers from UW, WSU, and/or WSDA.

Key Trends and Takeaways

The following themes were independently identified by at least five interviewees each:

1. Shifting market channels from wholesale to direct-to-consumer (DCT) sales meant a heightened focus on regional distribution and required significant pivots in business practices and production models.
2. Business pivots into online and DCT markets resulted in the development of a "new middleman" in which networking and consolidation have reduced the need for traditional third-party distributors.
3. Increased networking and community involvement has led to enhanced communication and collaboration between multiple sectors of the food system, supporting local food production and/or distribution and helping to sustain farm functionality.
4. Government support is vital for farms of all scales to adjust to an ever changing and unpredictable market. Enhanced accessibility and assistance for farms of all scales in applying for funding is needed.
5. Enhanced consumer education and outreach is needed to sustain the trend of increased local and regional purchasing.
6. Labor-related challenges and uncertainties due to COVID-19 have increased interest in automation and other technological upgrades to production models in order to reduce reliance on human labor.
7. Lack of infrastructure is one of the primary barriers inhibiting many producers from adapting and/or expanding practices (e.g. limited storage or distribution capacity).
8. Uncertainty about the next growing season is a leading concern for producers.

Suggested Citation

Fogel, A., Sipos, Y., and Collier, S. Memorandum to: Laura Raymond and Madison Moore. 2021 Feb. 24. Identifying widespread COVID-19 impacts and shifts in the farming sector: Key trends and takeaways from autumn 2020 discussions with agriculture and food system professionals in Washington State. https://nutr.uw.edu/cphn/wafarm/memo1

---

[1]Meuwissen M.P.M., Feindt P.H., Spiegel A., et al. (2019) A framework to assess the resilience of farming systems. Agric Syst 176:102656. doi:10.1016/j.agsy.2019.102656

Appendix C

Email outreach language used for survey deployment to the agricultural sector.

EMAIL LANGUAGE FOR <u>PREVIOUSLY CONTACTED</u> STAKEHOLDERS <u>WITH LISTSERVS</u> (2020 deployment)

WA Farm COVID-19 Survey

Dear <partner_name>,

Thank you so much for your input earlier this fall into the development of the WA Farm COVID-19 Survey. **The survey is now live and will remain open until January 31st.** We would greatly appreciate your assistance distributing it among your producer networks.

Attached are documents containing both English and Spanish versions of outreach language with links to each version of the survey. We have also included shortened versions suitable for use on social media. The survey itself is available in both English and Spanish, should take approximately 20-30 minutes to complete, and is both computer and smartphone-friendly. Respondents will not be asked for identifying information, but will have the option to enter their email into a drawing for one of six $50 online gift cards.

We look forward to sharing back results from the survey early in the new year.

Please don't hesitate to contact me with any questions or concerns. We are so grateful for your help!

Sincerely,
<Name> - *On behalf of the WAFarm team:*

Anna Fogel, University of Washington
Sarah Collier, University of Washington
Yona Sipos, University of Washington
Laura Lewis, Washington State University
Laura Raymond, Washington State Department of Agriculture
Madison Moore, Washington State Department of Agriculture
Taya DeLong, University of Washington

DRAFT EMAIL LANGUAGE FOR PREVIOUSLY CONTACTED STAKEHOLDERS WITHOUT LISTSERVS -- (survey live deployment)

WA Farm COVID-19 Survey

Dear <partner_name>,

Thank you so much for your input earlier this fall into development of the WA Farm COVID-19 survey. The survey is now live and ready for completion. Please access the survey here. We greatly appreciate your participation, and look forward to sharing back results of the survey early in the new year.

We would also greatly appreciate it if you could distribute the survey widely among your own networks. Simply copy and paste or forward the below portion of this email. It is important to gather input from as great a diversity of WA farms and ranches as possible in order to gain meaningful insight into how COVID-19 has affected all farms in WA state.

Thank you for your assistance and your participation!

Sincerely,

<Name> - *On behalf of the WAFarm team:*

Anna Fogel, University of Washington
Sarah Collier, University of Washington
Yona Sipos, University of Washington
Laura Lewis, Washington State University
Laura Raymond, Washington State Department of Agriculture
Madison Moore, Washington State Department of Agriculture
Taya DeLong, University of Washington

<INSERT ENGLISH EMAIL OUTREACH LANGUAGE>

DRAFT EMAIL LANGUAGE FOR ORGANIZATIONS NOT PREVIOUSLY CONTACTED -- (survey live deployment)

WA Farm COVID-19 Survey

Dear <partner_name>,

<Insert introduction if necessary, and/or personal message> I am writing to share information about a survey geared towards assessing COVID-19 impacts, adaptation, and resilience in WA agriculture, and to ask for your assistance with distribution.

The University of Washington has partnered with Washington State University and the Washington State Department of Agriculture to develop a survey of Washington state farms and ranches to better-understand how COVID-19 has impacted farm business, what adaptations farmers and ranchers have made to increase business resilience, and priorities and concerns for the coming year.-We hope that the results of this end-of-season survey will not only shed light on the impacts and recovery pathway from the current pandemic, but will also aid in enhancing the resilience of Washington agriculture to future challenges.

During development of the survey, our project team solicited input from numerous agricultural organizations representing a wide range of producers in the state in order to ensure that questions would be applicable to farms and ranches of varying types and scales, and that the information gathered would be relevant and actionable. It is important now that the survey reaches as wide a diversity of producers as possible, which is why I have contacted you.

Would it be possible for you to help in distributing this survey among your producer networks? You can simply copy and paste or forward the below portion of this email. I have also attached a document containing both English and Spanish versions of outreach language and survey links that can be used in email sharing, text blasting, social media posting, and website posting. If you feel that any of this language would benefit from tweaks to better suit the communities you serve, please feel free to say so! I'd be very happy to work with you to craft language that best fits the communities that you work with.

The survey is now open and will remain open until December 31st. It is available in both English and Spanish, should take approximately 20-30 minutes to complete, and is both computer- and smartphone-friendly. Respondents will not be asked for any identifying information, but will have the option to enter a drawing for one of six $50 online gift cards.

Please let me know if you have any questions or concerns. We greatly appreciate you taking the time to read this over, and if it is workable, we appreciate your assistance in distributing the survey!

Sincerely,

<Name> - *On behalf of the WAFarm team:*

Anna Fogel, University of Washington
Sarah Collier, University of Washington
Yona Sipos, University of Washington
Laura Lewis, Washington State University
Laura Raymond, Washington State Department of Agriculture
Madison Moore, Washington State Department of Agriculture
Taya DeLong, University of Washington

<INSERT ENGLISH EMAIL OUTREACH LANGUAGE>