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Online tools helped direct market farmers during the COVID-19 pandemic, but resources are needed for equitable adoption

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Abstract

This paper examines the use by California's direct market farmers (DMFs) of online sales and marketing during the early onset of the COVID-19 pandemic in the United States, from March through December 2020. The pandemic caused market disruptions that accelerated the trend toward market digitalization. This paper reports quantitative findings based on 364 responses to an online survey of

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DMFs in California and qualitative findings from participant observation and 33 semi-structured interviews with DMFs and technical assistance providers. We found that online sales and marketing tools, such as social media and websites, were important for withstanding economic disruptions associated with the pandemic, and farmers who had an online presence were more likely to increase their sales and profitability during its early onset. However, we also found that many farmers lacked the necessary resources to access these tools and use them effectively, and that technical assistance providers experienced challenges in helping farmers with online technology use. We argue that DMFs need reliable access to the internet, as well as advice, resources, and training to access and benefit from online sales and marketing tools. These resources must be available in languages other than English (e.g., Spanish). Research-informed programs and policies can help DMFs navigate market digitalization and strengthen their resilience to future economic disruptions.

Keywords
food systems, direct market farmers, COVID-19, pandemic, online technology, digital markets, sustainability, resilience, California, technical assistance

Author Note
The findings presented in this article are part of Sasha Pesci's doctoral dissertation. This article also presents findings from a broader research study about direct market farmers' experience of the COVID-19 pandemic, implemented by the Food Systems and Sustainability lab (Ryan Galt's lab) at the University of California, Davis.

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Acronyms and Abbreviations

CAFF	Community Alliance with Family Farmers
DMFs	Direct market farmers
KTA	Kitchen Table Advisors
Online tools	Online sales and marketing
Tech Hub	CAFF Small Farm Tech Hub

Introduction

The COVID-19 pandemic led to numerous economic disruptions in the agri-food system and accelerated the trend toward market digitalization in the U.S. In this paper, we examine how direct market farmers in California used online sales and marketing tools during the early months of the COVID-19 pandemic, from March through December 2020. We define direct market farmers (DMFs) as farmers who sell at least some of their products through direct-to-consumer markets (e.g., at farmers markets, community supported agriculture programs[1] [CSAs], or farm stands), directly to retailers (e.g., supermarkets and restaurants), or directly to institutions (e.g., hospitals and schools) (U.S. Department of Agriculture National Agricultural Statistics Service [USDA NASS], 2016). Many farmers leveraged their use of online sales and marketing tools during the early onset of the pandemic to continue selling their products when market channels were disrupted. However, not all farmers had equal access to or interest in using these tools.

Consumers increasingly use the internet to find information about products and buy groceries. In the U.S., this trend accelerated with the onset of the COVID-19 pandemic, when consumers' concerns over food safety and personal health led them to avoid grocery stores and prioritize online shopping instead (Keyes, 2021; Thilmany et al., 2021b). Many DMFs built on these trends during the pandemic by increasing their use of online sales and marketing. We refer to online sales and marketing tools (henceforth "online tools") as internet-based communication and information technologies that farmers can use to advertise their products, communicate with customers, sell products,

[1] CSA is a type of direct marketing that "consists of a community of individuals who pledge support to a farm operation so that the farmland becomes, either legally or spiritually, the community's farm. The growers and consumers provide mutual support and share the risks and benefits of food production" (U.S. Department of Agriculture [USDA], n.d., para. 1).

and manage CSA subscriptions. Examples of online tools include social media, websites, and online sales platforms.

Recent research revealed that DMFs who increased their online sales and marketing use were more resilient to market disruptions caused by the pandemic (Bachman et al., 2021; Durant et al., 2023; Liang & Tarpeh, 2021; Schreiber et al., 2022; Thilmany et al., 2021a). Specifically, DMFs who used online tools in 2020 were statistically significantly more likely to increase their sales and profitability from March through December 2020 than those who did not (Pesci et al., 2023).

Despite the competitive advantages of using online tools, some farmers lacked the resources or interest to use them. Previous research has found disparities in the use of these tools based on farmer demographics, farm characteristics, and available resources (Durant et al., 2023; Pesci et al., 2023; Schreiber et al., 2022). For example, research using the same dataset as this paper found that DMFs with an owner or manager who identified as white, female, and under 55 years old were more likely to have an online presence (Pesci et al., 2023). In addition, DMFs with higher annual gross incomes and those not growing vegetables were more likely to sell products online (Pesci et al., 2023). Because of these disparities, we wanted to further understand the barriers and challenges that DMFs, particularly those who are marginalized (non-white and non-English speakers), experience in using online tools. We also wanted to understand which factors might determine whether online tools are appropriate for DMFs.

To this end, this article explores the following questions: (1) To what extent did the context of the pandemic change DMFs' use of online tools? (2) Which online tools were associated with changes in gross farm sales and profitability for DMFs during the first 10 months of the pandemic? (3) What challenges did DMFs, particularly those who are monolingual Spanish speakers, experience in adopting and using online tools? (4) What resources do DMFs need to access and effectively use online tools, or to determine if online tools are a fit for their farm? Considering the growing consumer trend toward online shopping and the likelihood of future market disruptions, documenting farmers' experiences with online technologies during economic disruptions like the pandemic can help government agencies, nonprofit organizations, and extension agents develop adequate strategies to support them.

Research Methods

This article reports findings from a mixed-methods research project implemented by members of the Food Systems and Sustainability Lab (Galt Lab) at the University of California, Davis. This section provides an overview of the data collection and analysis methods.

Data collection

Data collection for this research involved four methods: (1) an online survey, (2) semi-structured interviews with farmers and technical assistance providers, (3) participant observation at farmer workshops and one-on-one technical assistance meetings, and (4) review of secondary sources.

We first administered an online Qualtrics survey from January to April 2021 (see Appendix A for a detailed description of our survey data collection). Sampling focused on agricultural producers in California who sold at least some of their products through direct-to-consumer or direct-to-institution market channels. The survey questions focused on DMFs' experiences during the COVID-19 pandemic and how they responded to its disruptions from March to December 2020. The survey had a total response rate of 16.1% (n = 364), out of which 360 responses were in English and 4 in Spanish. The geographic representativeness of our survey is shown in Figure 1. Looking at the maps together highlights areas that were oversampled (including Marin and San Diego counties) and undersampled (including Fresno and Tulare), based on data from the 2017 census of agriculture.

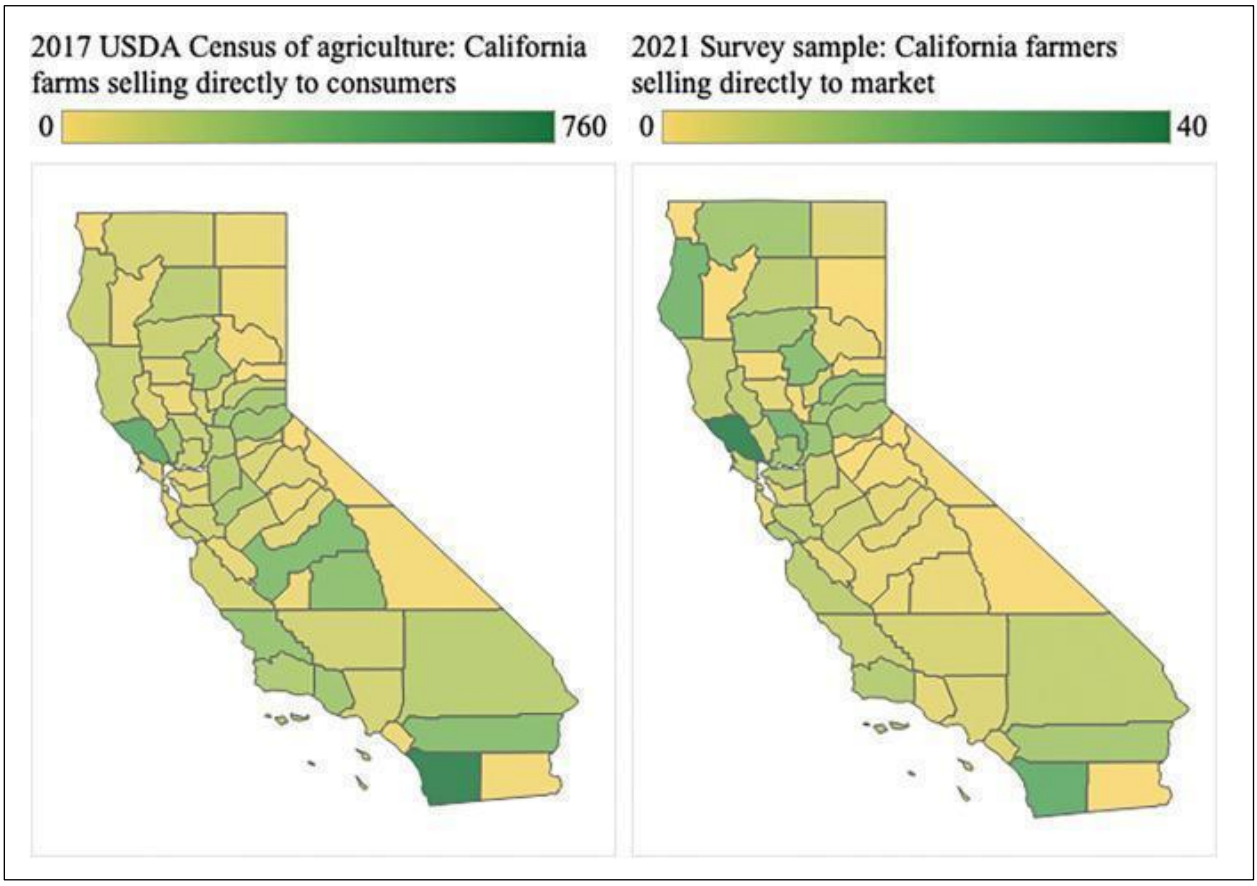
To add depth and context to our survey findings, we conducted 28 semi-structured interviews with the owner-operator, owning partner, or hired managers of direct market farms in California. Interviews were conducted via Zoom or phone between September 2021 and February 2023. Interviewees were identified through three sources: (1) respondents of the online survey who indicated

they would be interested in participating in a follow-up interview; (2) California nonprofit organizations that work with small-scale farmers: Community Alliance with Family Farmers (CAFF) and Kitchen Table Advisors (KTA); and (3) the California Certified Organic Farmers (CCOF) directory. (See Appendix B, Tables B1–B3 for demographic breakdowns of the survey and interview samples.)

We also interviewed five technical assistance providers who support family farmers or small-scale farmers in California (which includes the sample population for this research). This included two individuals who work at the CAFF Small Farm Tech Hub (hereafter referred to as the "Tech Hub"), one sustainable agriculture coordinator at the University of California Agriculture and Natural Resources (UC ANR), and two small-farm advisors at UC ANR. We conducted these five interviews to validate the data and analysis from the farmer interviews, and through them, we were able to understand some of the gaps in farmer support services and triangulate findings from farmer interviews (Given, 2008).

In addition to surveys and interviews, we used participant observation to inform and provide context to our research. From April 2022 through March 2023, one of the authors (Pesci) worked as a contractor at the Tech Hub, which provides small-scale farmers in California with technical assistance and training related to online tools. Through participant observation at program meetings, one-on-one technical assistance meetings with farmers, and farmer workshops, we were able to better understand (1) how the different online tools can be used by DMFs, (2) the main challenges and

Figure 1. Geographic Distribution of Direct Market Farmers in the 2017 USDA Census of Agriculture (Left) Compared to the Distribution of our Research Sample (Right)



Source: Authors' data and USDA NASS (2017) (Durant et al., 2023).

barriers DMFs face in adopting or using these tools, and (3) the main challenges that technical assistance providers face in supporting DMFs with these tools.

Finally, we used the Young Farmer Coalition's *Farmer's Guide to Direct Sales Platforms* (National Young Farmers Coalition, 2020), MyDigitalFarmer website and newsletters (MyDigitalFarmer, n.d.), and the CSA Innovation Network's Farmer-to-Farmer Exchange eCommerce Platforms Report (Strader et al., 2020) to gather qualitative data that helped contextualize our survey and interview results. These internet-based research sources provided information about the different online tools available for DMFs and how they use these tools. Internet-based research also informed the findings of Table 2.

Data analysis

In this section, we first provide an overview of our quantitative analysis methods, including the dependent and independent variables used and then we describe our qualitative analysis methods.

Quantitative analysis

The quantitative analysis results reported in this paper are based on descriptive statistics and correlation tests of our survey data. Specifically, we used Spearman's test of correlation because it is a non-parametric measure of rank correlation, which is appropriate for analyzing statistical association with ordinal dependent variables in a sample that does not necessarily follow a normal distribution. In other words, this type of correlation test is the most appropriate for the types of dependent variables we have, which are based on ranked categories (e.g., decreased, no change, increased). We analyzed the quantitative data using *R* software (version 2022.02.3). Below, we describe the dependent and independent variables used.

We used the **dependent variables** *change in profitability* and *change in gross farm income* to assess how the use of different online tools (Table 1) interacted with farmers' sales and profitability from March through December 2020. These variables were based on farmers' responses to the question: "From March 2020 through December 2020, how did the following change overall?" This question listed statements related to the farm's overall profitability and annual gross farm income. For each statement, the farmer had three Likert-scale options: "decreased," "no change," and "increased." We coded these responses as 1, 2, and 3, respectively.

To identify if survey takers had an online presence, we asked: "Did your farming operation use online sales and/or have an online presence in 2020?" This variable was binary, where farmers who responded "yes" were coded as 1, and farmers who responded "no" were coded as 0. We created the **independent variable** *having an online presence* based on these responses. Another question in the survey asked, "Which market channels did you use at any time in 2020 (including the months before the pandemic)? Select all that apply." This question included a list of options for various market channels that farmers might use, including "online sales." We used the responses to this question to create another binary independent variable for *use of online sales*.

We also created independent variables for each of the online tools farmers used so that we could identify which tools were most associated with changes in sales and profitability. These were individual binary variables (used = 1, did not use = 0) based on farmers' responses to the question: "Which of the following online sales and marketing tools did your operation use at any point from March 2020 through December 2020? Select all that apply." This question included the following list of options, which became our independent variables: Online sales platform for farms (e.g., Harvie, WhatsGood); a website built through a farm-specific platform (e.g., CSAware, Farmigo); a website built through a non-farm-specific platform (e.g., Squarespace, Wix, WordPress); Facebook; Instagram; email listserv; a LocalHarvest listing; aggregator delivery services (e.g., Farm Fresh to You); and other. These options were selected through the review of secondary sources conducted during September–December 2020.

Different types of online tools can serve distinct purposes and uses for farmers. We grouped online tools that DMFs utilize into seven categories (Table 2) based on our participant observation and

review of secondary sources. Below, we define these tools and specify the names of the independent variables used.

We use the variable *online sales platform for farms* for websites where a farm, usually for a fee, can set up a profile for sales or CSA subscriptions. In most cases, the platform managers provide technical support and assist farmers with customer service.

We distinguish between websites built through software specifically designed for farmers with the variable *farm-specific website,* and websites built through programs or software that are not specifically for farmers with the variable *generic website*. Several companies provide website design services that cater to DMFs. In addition to web hosting fees, these sites often take a percentage of sales generated through their platform (for example, via an online storefront or CSA subscription). In contrast, generic websites are typically cheaper but do not have as many farm-specific features. Some of these sites include options for sales, but they are often used by farmers for nonsales marketing functions, e.g., to showcase and provide information about their farms and, in some cases, to promote farm events.

DMFs use social media and email listservs for information sharing, advertising, and sales. Common uses include updating customers on current crops and farm events, and providing education related to farming. In our analysis, we used *Social media: Facebook* and *Social Media: Instagram* as separate independent variables to test the differences

Table 1. Dependent and Independent Variables

Variable	Type	Description and coding	
Change in profitability	Dependent / ordinal	Farm's change in profitability from March through December 2020.	1 = "decreased" 2 = "no change" 3 = "increased"
Change in gross farm income	Dependent / ordinal	Farm's change in gross farm income from March through December 2020.	1 = "decreased" 2 = "no change" 3 = "increased"
Having an online presence	Independent / binary	Whether a farm had an online presence in 2020.	1 = "yes" 0 = "no"
Use of online sales	Independent / binary	Whether a farm used online sales as a market channel from March through December 2020.	1 = "yes" 0 = "no"
Online sales platform for farms	Independent / binary	Whether a farm used an online sales platform for farms from March through December 2020.	1 = "used" 0 = "did not use"
Farm-specific website	Independent / binary	Whether a farm used a farm-specific website from March through December 2020.	1 = "used" 0 = "did not use"
Generic website	Independent / binary	Whether a farm used a generic website from March through December 2020.	1 = "used" 0 = "did not use"
Social media: Facebook	Independent / binary	Whether a farm used Facebook for sales or marketing from March through December 2020.	1 = "used" 0 = "did not use"
Social media: Instagram	Independent / binary	Whether a farm used Instagram for sales or marketing from March through December 2020.	1 = "used" 0 = "did not use"
Email listserv	Independent / binary	Whether a farm used an email listserv from March through December 2020.	1 = "used" 0 = "did not use"
Online farm directory: LocalHarvest	Independent / binary	Whether a farm was listed on LocalHarvest from March through December 2020.	1 = "used" 0 = "did not use"
Virtual food hub / aggregator	Independent / binary	Whether a farm sold products through a virtual food hub or aggregator from March through December 2020.	1 = "used" 0 = "did not use"
Other	Independent / binary	Whether a farm used another online sales platform for farms from March through December 2020.	1 = "used" 0 = "did not use"

between these two social media sites. We also made *email listserv* an independent variable, since some farmers use online mailing platforms for outreach and sales purposes.

DMFs may add a listing to an online farm directory, most of which are free for farmers, to increase their farm's online visibility. Several online farm directories include direct market farms in California or the U.S. We listed *LocalHarvest* as an option in the survey and used it as a separate independent variable because it is one of the most comprehensive online directories for DMFs and farmers markets in the U.S. (Galt, 2011). In addition, we wanted to track the responses of LocalHarvest users, since it was used as one of our outreach strategies for data collection.

Virtual food hubs or aggregators, another independent variable, are farm sale websites that combine products from multiple farms and typically provide home delivery services. Finally, we created the independent variable *other* to capture online tools not listed in our survey. Through write-in responses and follow-up interviews, we learned of several additional tools used by DMFs, including public e-commerce, classified advertisement sites, and social networking platforms. These platforms help farmers post items for sale without needing to set up a website or profile for their farm or deal with additional fees.

Table 2. Categories of Online Sales and Marketing Tools (Online Tools) for Direct Market Farmers

Category	Description	Examples	
Online sales platform for farms	Direct market farms display a profile on the website, and customers can choose from various farms.	1000Ecofarms Food4all Harvie WhatsGood	
Farm-specific website	Companies that design websites specifically for direct farm sales or CSA subscriptions.	Barn2door Cropolis CSAware (By LocalHarvest) EatFromFarms Farmers Web Farmigo Grazecart	Grownby Harvesthand Local Food Marketplace Local Line Local Orbit MyRealFoods Open Food Network Online Farm Markets
Generic website	Companies that offer website building (not specific for farms).	Squarespace Wix WordPress (and WordPress plugins such as WooCommerce)	
Social media	Social media–based sales and marketing through pages or groups.	Instagram Facebook (page, groups, marketplace) Reko (consumer buying club online that uses Facebook groups) Twitter	
Email listserv	Direct market farmers use email listservs and email marketing platforms for customer outreach.	Mailchimp SendinBlue GetResponse	
Online farm directory	Online directories of direct market farms.	LocalHarvest CAFF Farm directory (California) USDA Local Food Directories	
Virtual food hub or aggregator	An online product delivery service that combines products from multiple farms to sell directly to consumers.	Good Eggs Farm Fresh to You	
Other	Includes e-commerce or classified advertisement sites or apps where direct market farmers can post items for sale or announcements without needing to set up a website or profile.	eBay Craigslist Nextdoor App	

Qualitative analysis

The data collected from interviews and participant observation activities were analyzed using a grounded theory approach (Given, 2008), including coding and memoing to identify recurring themes and patterns. The grounded theory approach to data analysis involves coding the data based on emerging themes, rather than using pre-existing codes based on theory (Given, 2008). This approach was helpful because there is little existing literature on this research subject. By coding with emerging themes, we developed theoretical conclusions based on our novel data. We used MAXQDA software version 12 for coding.

Results and Discussion

In this section, we report results from quantitative analyses of survey data and qualitative analysis of interviews and participant observation. The first five sections primarily focus on quantitative findings and use qualitative findings to contextualize and analyze these quantitative findings, while the sixth and seventh sections exclusively report qualitative findings. We combine the results and discussion section because we use qualitative data to contextualize and make sense of survey and interview findings throughout the results section.

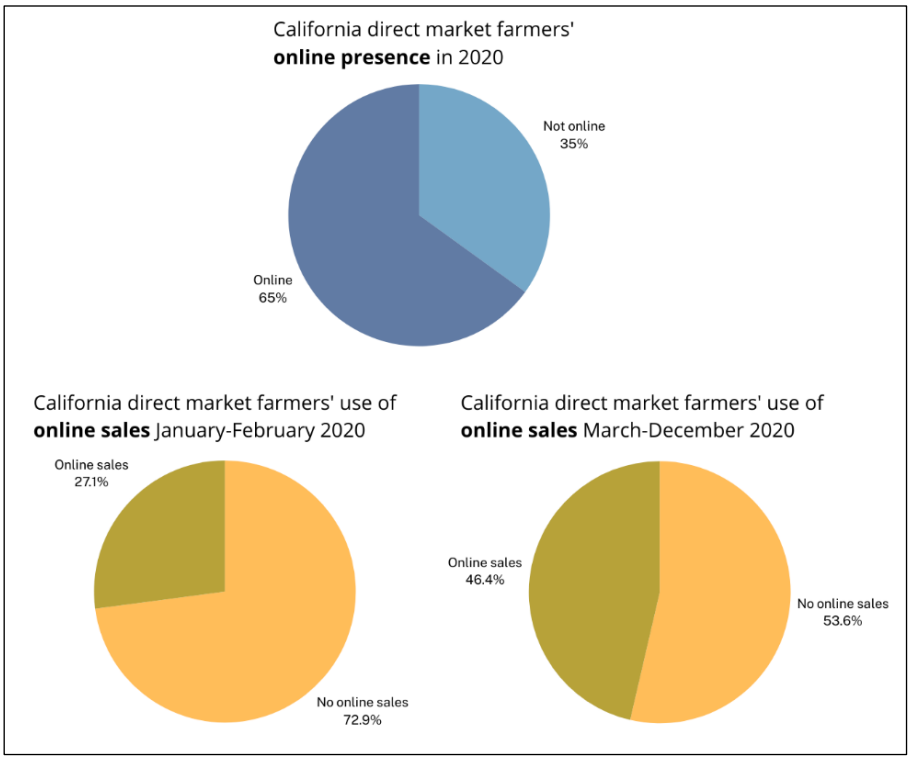
A note about terms: farmers with an **online presence** used internet-based tools listed in Table 2 to promote their farms, do outreach to customers, provide information, or conduct sales. Farmers who used **online sales** conducted sales transactions through the internet, which can include home deliveries, deliveries to neighborhood pick-up spots, shipping, or a pre-order system. The majority (74%) of DMFs in our sample who had an online presence also used online sales from March through December 2020.

California's direct market farmers' online presence and use of online sales in 2020

Out of the total survey responses (N = 364), 65% (n = 225) of farmers indicated that they had an online presence at some point in 2020, and 46% (n = 166) of farmers used online sales as one of their market channels sometime in 2020 (Figure 2).

Figure 3 provides a breakdown of specific tool use among online tool users. The most popular tools were social media, including Facebook (66% of users, n = 146) and Instagram (60% of users, n = 133), followed by a generic website (60% of users, n = 134). The other online tools that farmers used include a listing on the LocalHarvest directory (24%, n = 54), an online sales platform (n = 34, 15%), a website built through farm-specific software (11%, n = 24), and aggregator delivery services (6%, n = 14). Farmers who selected "other," used Craigslist (n = 4), eBay (n = 1), Nextdoor (n = 1), or other platforms (unspecified).

Figure 2. California Direct Market Farmers' Online Presence and Their Use of Online Sales in 2020 (N = 364)



Direct market farmers increased their use of online tools after the onset of the COVID-19 pandemic

Of the total number of DMFs with an **online presence** in 2020 (N = 225), the majority (60%, n = 135) reported in the survey that they increased their use of online tools after March 2020, and 84% (n = 114) attributed this increase to the pandemic. Among farmers who had an online presence in 2020, 34% (n = 77) indicated that they did not change their use of online tools after March 2020. Only 6% (n = 13 out of 225) of farmers who had an online presence decreased their use of online tools during March–December 2020.

Among **online sales** users (n = 166), the majority (55%, n = 91) already used online sales prior to March 2020 and continued using them at least until they completed the survey. On the other hand, 42% (n = 69) started using online sales after March 2020. Of the group that started using online sales after March 2020, 26% (n = 18) indicated that they started using online sales specifically due to the pandemic. In other words, many farmers started using online sales after the onset of the pandemic, some of whom attributed their adoption of online tools to the pandemic. Only three farmers reported that they stopped using online sales between March and December 2020, out of which two were "temporary" losses and the other was "indefinite."

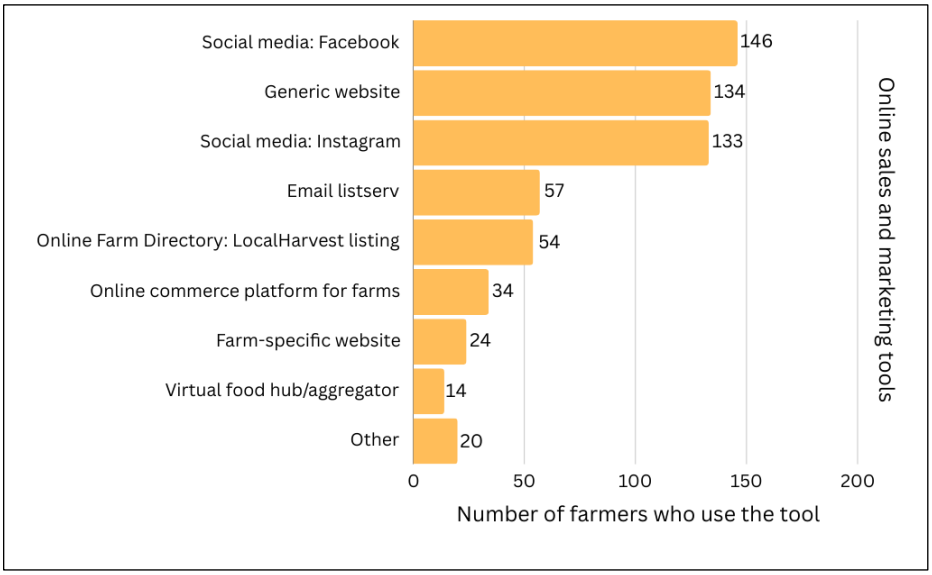
Our findings align with media reports of an overall increase in the use of online tools among DMFs prompted, in part, by market disruptions associated with the pandemic (Held, 2020; Kean, 2020). Online tools such as websites, social media, and online sales platforms became key intermediaries between farmers and consumers when other market channels were shut down (Lamb, 2020).

Having an online presence helped some farmers increase sales and profitability during the pandemic

To better understand which online tools were most helpful during the early onset of the pandemic, we analyzed how specific online tools changed a farming operation's gross income and profitability. We created a subset of our sample that included only farmers who had an online presence in 2020 (n = 225).

We found that no specific tools were associated with an increase in profitability; rather, just having an online presence was statistically significantly associated with increased profitability (Table 3). In contrast, an increase in gross sales between March and December 2020 was statistically significantly associated with having an online presence generally (p = 0.001), as well as with the use of Instagram (p = 0.001) and Facebook (p = 0.04),[2] which

Figure 3. Online Tools Used by Direct Market Farmers in March-December 2020



[2] It is important to note that not all DMFs who used social media and a generic website were necessarily using them for sales. Within the group of farmers who used Facebook, 68% (n = 99) used online sales; among those who used Instagram, 73% (n = 133) used online sales; and among the group who used a generic website, 65% (n = 134) used online sales. However, we were not able to

Table 3. Online Tools Used by Direct Market Farmers, as a Percentage of Total Users, and the Statistical Association (Spearman's Correlation, *rho*) Between Each Tool and Change in Profitability and Gross Sales [a]

Variable	*n*	% of total farmers with online presence (*n* = 225)	Change in profitability (March-December 2020)			Change in gross income (March-December 2020)		
			Spearman's *rho*	*S*	*p*-value	Spearman's *rho*	*S*	*p*-value
Total farmers with an online presence	225		0.18	5663793	**0.00**	0.21	5474956	**0.00**
Social media: Facebook	146	66%	0.05	1798229	0.43	0.13	1642767	**0.04**
Generic website	134	60%	0.05	1803519	0.46	0.12	1669247	0.07
Social media: Instagram	133	60%	0.10	1706567	0.13	0.22	1486319	**0.00**
Email listserv	57	26%	0.01	1882149	0.90	0.08	1755943	0.26
Online farm directory: LocalHarvest listing	54	24%	0.01	1881850	0.90	0.03	1837872	0.63
Online sales platform for farms	34	15%	0.06	1776316	0.34	0.05	1811513	0.49
Farm-specific website	24	11%	0.00	1888972	0.94	0.13	1658548	0.06
Virtual food hub or aggregator	14	6%	0.03	1849920	0.70	0.01	1884441	0.91
Other	20	9%	–0.05	1991903	0.46	–0.07	2029719	0.30

[a] The percentages do not total 100 as the categories were not exclusive.

were among the most used online tools during this time (Figure 3). These quantitative findings align with our findings from interviews, which suggested that social media helped farmers attract customers to their in-person farm stands or booths during the pandemic from March through December 2020.

No other online tools were statistically significantly associated with an increase in gross farm sales. However, using generic websites and farm-specific websites was associated with an increase in gross farm sales at an almost statistically significant level ($p = 0.07$ and $p = 0.06$, respectively). This suggests that having an online presence through a website was likely helpful in increasing gross sales in 2020, which aligns with interview data and other research that found websites to be helpful outreach tools (Kalaitzandonakes et al., 2020).

Having a social media presence and a stable internet connection helped farmers access online tools in 2020

Survey participants who indicated they had an online presence in 2020 ($N = 225$) were asked what helped them access online tools (Figure 4). Most importantly, a stable internet connection (50%, $n = 112$) and a pre-existing online presence (50%, $n = 111$) enabled farmers to access and use online tools. Following this, many farmers indicated that having knowledge of online tools (39%, $n = 87$) and having someone able to manage online tools (29%, $n = 65$) were also helpful resources.

Data from interviews with 28 DMFs revealed similar themes to the survey data discussed above with respect to what helped them access online tools. Half of the farmers interviewed identified their skills and knowledge of online tools as helpful resources ($n = 14$). Of these, 50% ($n = 7$) attributed their skills and knowledge to having a professional background in technology, communications, or related fields, while 29% ($n = 4$) attributed their skills and knowledge to their age, and 21% ($n = 3$) attributed their skills and knowledge to being "tech-savvy."

ascertain whether the farmers who were both using social media and doing online sales were specifically using these or other sites for sales. Addressing this issue with more granular data (exactly what each site is used for) could help future studies determine the impacts of each tool on sales and profitability.

Of the farmers interviewed (N = 28), 30% (n = 9) identified having reliable access to internet connection as the second-most important resource. The third most identified resource was receiving help from a younger relative, their partner, or an organization (28%, n = 8). Finally, one farmer identified being able to hire someone to create a website for them as an enabling factor.

Figure 4. Direct Market Farmer-Reported Factors that Helped Them Access Online Sales and Marketing Tools in 2020 (Survey Responses, *N* = 225)

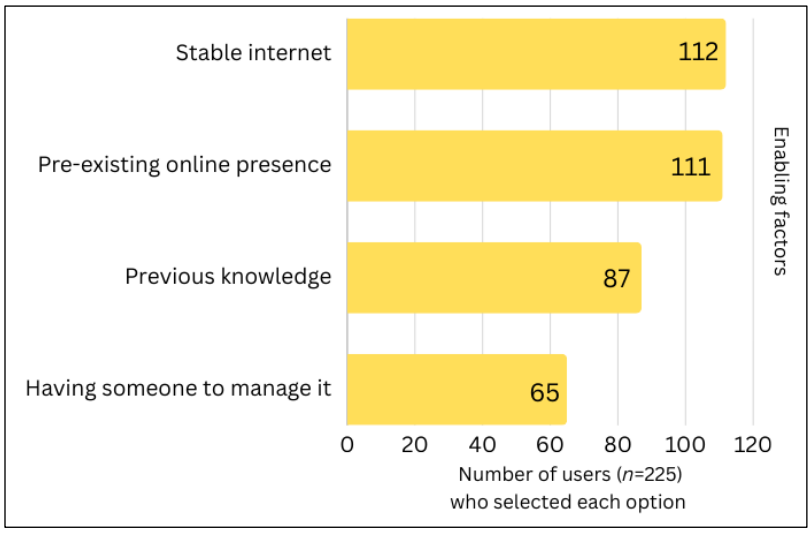
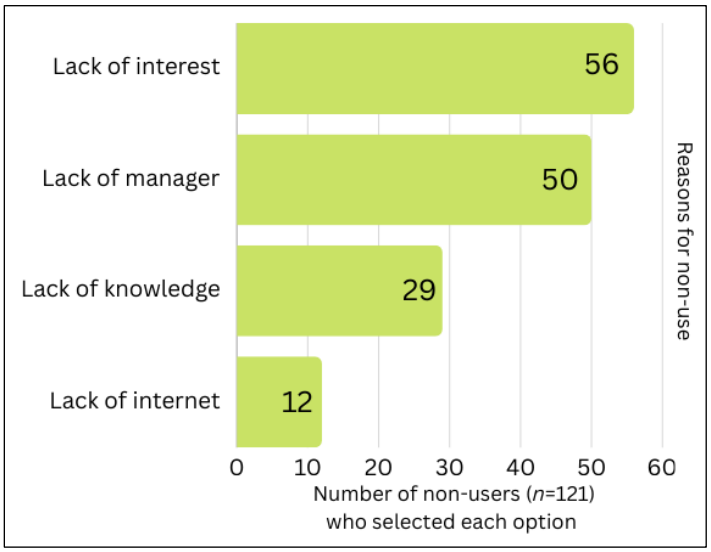


Figure 5. Farmer-Reported Reasons for Not Using Online Sales and Marketing in 2020 (Survey Responses, N = 121)



Farmers experienced barriers that prevented them from having an online presence and using online sales

Through interviews, we found that lacking an online presence or not using online sales caused farmers to miss market opportunities during the COVID-19 pandemic. This section gives an overview of the main reasons farmers did not use online tools in 2020 and the barriers that farmers experienced.

In the online survey, farmers who indicated that they did not have an online presence in 2020 (33%, n = 121) were asked, "which of the following statements best describe the reasons your operation did not use online sales and marketing in 2020? Select all that apply" (Figure 5).[3] Among those farmers (N = 121), the most common response (46%, n = 56) was that they had no interest in using online tools (Figure 5). Some of these farmers commented in the open-text response option that they did not have enough product volume to sell online (n = 6); that their product was too perishable for it (n = 1); that they were "focused on local customers" (n = 1); or that they did not think it was profitable (n = 1). Based on interviews (N = 28), we found that some farmers were not interested in expanding their online presence (n = 4) or adopting online sales (n = 6) because they highly valued in-person relationships and did not want to replace them with online transactions. Additionally, uncertainty about whether an online tool was worth the time and monetary investment may have led some farmers to be uninterested in adopting it.

[3] This was a multiple-answer question, so some respondents indicated that they lacked interest and also selected additional answers relating to lack of resources.

The second most common reason farmers did not use online tools was that they lacked someone to manage them (41%, *n* = 50) (Figure 5). This suggests that non-users are more likely to perceive online tools as labor-intensive, particularly if they lack knowledge about those tools. Interestingly, only 29% of online tool users (*N* = 225) indicated that "having someone to manage [the online tool]" was a helpful resource (Figure 4). This could indicate that many farm owners and managers take responsibility for this work instead of delegating it to someone else in their operation.

The third most frequently cited reason farmers did not use online tools was due to a lack of the knowledge and skills necessary to use online tools (24%, *n* = 29) (Figure 5). Choosing which tools to use requires the knowledge of at least one available tool that fits their business model, as well as the resources and capacity to learn and effectively integrate this tool. There are over 20 platforms that U.S. farmers can choose from, with varying services and fees. Interview and participant observation data suggest that farmers often get overwhelmed by the number of choices, and identifying the right platform for their business can take considerable time and energy.

Lacking technological literacy may be a substantial barrier for farmers who are older, less formally educated or trained, or non-English speaking. Many monolingual Spanish speaking farmers at online technology workshops facilitated by Pesci (*N* = 11) had low technological literacy and a low level of comfort with using online tools.[4] For example, in one of these online technology workshops for Spanish-speaking farmers, nine of the 11 participants had never heard of the Venmo app[5] (many farmers use Venmo and other online payment systems to collect payments at farmers markets when customers do not have cash).

Finally, some farmers who did not use online tools reported that they did not have a stable internet connection (9%, *n* = 12). Lack of available broadband or the financial resources to have reliable internet service on the farm, at home, or on their cell phones structurally prevents farmers from accessing online tools. This issue is particularly acute for farmers in rural areas and historically marginalized communities. In California, for example, Black or African American, Latinx, Native American, and low-income households have lower access to broadband internet (Hayes et al., 2024; Howard & Morris, 2019).

While only 12 survey respondents indicated that lacking a stable internet connection was a barrier to having an online presence, it is likely that farmers who lack regular access to the internet also missed or did not receive our survey outreach email and thus are not well represented in this data set. For this reason, the proportion of farmers facing this barrier may be considerably higher.

Challenges that direct market farmers experienced using online sales and marketing tools

Through interviews with farmers (*N* = 28), we gathered in-depth data on the main challenges that farmers faced in adopting and using online tools. While the above section addresses the barriers preventing farmers from adopting online tools, this section describes the challenges farmers experienced using online tools. Additionally, while previous sections report quantitative findings, this section and the next exclusively report findings from qualitative analysis of interviews and participant observation.

The majority of interviewed farmers (64%, *n* = 18) expressed challenges related to how time-consuming learning about, establishing, and maintaining online tools for their farms can be. Some of these farmers shared that it is difficult to prioritize updating their online presence and posting on social media given how much time and energy they must put into farming.

[4] While working as a contractor at CAFF's Tech Hub, Pesci facilitated three workshops in collaboration with another California nonprofit organization, Kitchen Table Advisors (KTA). These workshops were designed and facilitated in Spanish by Pesci in Salinas, California, for Spanish-speaking farmers of Mexican origin. The participants were identified through KTA since the farmers receive KTA's services. KTA supports "farmers and ranchers who use regenerative agricultural practices and are leaders for social and environmental change within the food system" (Kitchen Table Advisors, n.d., "Who do we serve," para. 1; see also Bachman et al., 2021).
[5] Venmo is a mobile payment system based on an app, through which individuals can send payments directly to others. This app was created and is commonly used in the U.S.

The second most mentioned challenge for farmers in using online tools was lacking the appropriate knowledge and skills (54%, $n = 15$). One of the interviewed farmers, Farmer 5, attributed this lack of skill to their age: "Someone who is younger than I, with the same kind of talents that I have, could do even better because they would do Instagram or they would do some kind of Twitter thing." Because online technologies change much faster than on-farm technologies, it is difficult for farmers to keep up with these changes.

Lacking English fluency can also be a challenge in using online tools. For example, writing posts and messages in English is a substantial challenge for non-English speakers. Interview and participant observation data showed that what often enables monolingual Spanish-speaking farmers to have a website or social media presence is having an English-speaking relative who helps them. Lacking English fluency can also make using online sales platforms more challenging. Even when a farmer has the funds and capacity to start an online store for their farm, it can be very difficult to navigate and effectively use the different platforms without being able to speak fluent English. Online sales platforms offer customer support to set up and maintain an online store. However, through participant observation at the Tech Hub, we found that many of these platforms exclusively offer customer support in English.

Just over half of the interviewed farmers shared that managing online tools can be very tedious, stressful, and exhausting for them (54%, $n = 15$). When it comes to social media, some farmers felt that they must post consistently to do it well, which requires a lot of additional effort and time spent on the platform. Two farmers noted that their dislike of social media made it challenging to spend time on those platforms. Other challenges associated with using social media included dealing with inappropriate or offensive comments on posts and sorting through spam messages.

Farmers who have a farm website through a generic platform (e.g., Wix or Squarespace) expressed challenges associated with technical glitches. Farmers "hack," or modify, web templates to create ordering and payment systems that meet their needs. Navigating these website-building platforms and editing them can be very stressful. One of the farmers, Farmer 27, shared that he would rather be working outside in the field than getting stressed out trying to figure out how to build or update a website.

A quarter of the interviewed farmers ($n = 7$), particularly those who use websites or other online platforms for sales, discussed the challenges associated with having to pay fees. Farmers who offer shipping or deliveries must deal with associated expenses, including the cost of packaging, shipping, and fuel. Some online platforms charge fees to host the farm's online store, in addition to collecting a percentage of each transaction. Several farmers ($n = 5$) shared their dislike for such fees, considering they often also must pay for credit card payments or other payment app transactions. Farmer 10 shared, "One thing that I'm not too happy about is all the fees. Every time you turn around, there's a fee, and it's easy to forget all those when you're doing your cost estimates."

One of the farmers shared that an online sales platform for farms ("Barn2Door") reached out to them in 2020 and convinced them to try the site for their sales. Although they saw an increased demand during the first months of the pandemic in 2020, after several months of using the platform, demand for their online products dropped and the farm had to pay more fees than what they were making from sales. Because it is so difficult to switch platforms, the farmer did not have the capacity to leave the platform and continued to pay for the fees at least until the interview took place in January 2022 (approximately 10 months), losing money as a result.

Challenges faced by technical assistance providers

In California, several programs from nonprofit organizations aim to support small-scale and family farmers by providing direct technical assistance. Many of these programs support farmers with business-related concerns and ways to increase business resilience, such as identifying appropriate market channels. One program, CAFF's Tech Hub, supports farmers by identifying right-fit technologies, navigating technological resources, and expanding market opportunities. The Tech Hub focuses on on-farm and digital technology and is

part of a nonprofit organization that supports family farmers' various needs (e.g., policy advocacy, ecological farming practices). There are other initiatives that support farmers with online marketing and farm technology, but most are private for-profit companies.

The University of California Cooperative Extension also supports California's farmers with business development. Small farm advisors focus on supporting small-scale farmers in California. Although their role is not specifically focused on supporting farmers with online technologies, small farm advisors often find themselves teaching farmers how to use specific online tools or helping farmers identify online tools to expand their market opportunities.

Through interviews with technical assistance providers ($N = 5$), we identified several challenges these programs face in supporting farmers with online technologies. First, some technical assistance providers ($n = 3$) reported that they did not identify themselves as "experts" in online technologies or indicated that they may not have all the answers for farmers who have questions about online tools. As Technical Assistance Provider 3 said, "I have to admit … I don't have an encyclopedic knowledge of these things … Certainly not enough to say, 'you should really use Square as your processor as opposed to PayPal.'" With so many options available, it is very difficult for technical assistance providers to be sufficiently familiar with all of them enough to confidently help a farmer make the best decision. This lack of expertise among technical assistance providers makes providing support to farmers more difficult.

Second, teaching people how to use online tools—especially when their level of technological literacy is limited—can be challenging. Some of the farmers they work with have flip phones (as opposed to smart phones) and they often have difficulty using Google Docs and Adobe Reader, which limits their ability to fill out and sign forms. A small farm advisor (Technical Assistance Provider 5) suggested that some farmers are embarrassed about their lack of knowledge, which prevents them from asking for help or being more willing to learn. Two of the technical assistance providers posited that this is particularly true for some of the farmers who are older and did not grow up with online technologies. To illustrate this challenge, a small farm advisor (Technical Assistance Provider 5) shared, "It's like me supporting my parents. So sometimes I laugh, but sometimes I cry a little bit inside. … Even if you show them, sometimes they will forget."

Another challenge that Technical Assistance Provider 1 mentioned was related to farmer retention in support programs. In some cases, farmers request support from a program but they do not necessarily follow up and accomplish the goals they set out initially. Since farmers are generally more likely to prioritize their agricultural production, they are less likely to prioritize their marketing efforts, which makes it challenging for technical assistance programs to see their support come to a fruitful result.

Finally, although some programs, such as CAFF's Tech Hub, have resources and support available in Spanish, the availability of Spanish resources and Spanish-speaking technical assistance staff could be improved. A lack of English fluency can be a prominent barrier for farmers to access support and informational resources to help them navigate online technologies. As Technical Assistance Provider 2 shared, "I think that we could do a better job maybe in what's available to farmers and … being more inclusive of farmers whose English is not their first language … I feel like the online tech world can do better, but I think also [our program] could do better to be more inclusive."

Conclusion and Recommendations

Online sales and marketing tools present an opportunity for DMFs to increase efficiencies and sales, particularly during market disruptions such as those caused by the COVID-19 pandemic. However, certain online tools may contribute to enhancing sales more than others and, for some farmers, there are significant barriers to adoption. Our study found that (1) an online presence and the use of specific social media (Instagram and Facebook) helped DMFs increase their gross farm sales; however, (2) the type of online presence a DMF has may not make a difference in their profitability (i.e., their net income). This suggests that

DMFs who already have an online presence can continue using whatever tools work best for them.

These findings are directly applicable to DMFs, nonprofit organizations, extension agents, and private companies that develop online sales tools for DMFs. Our findings can help online sales platforms and farm-specific website designers understand some of the main difficulties that their users experience with their tools and use this knowledge to design more user-friendly and accessible products. Technical assistance providers can also use these findings to identify which support areas to prioritize.

Given this broad applicability, we provide five recommendations for technical assistance providers and others aiming to help farmers adopt and use online tools:

1. Because DMFs require diverse types of online tools for sales and marketing, technical assistance providers should advise farmers on factors to consider (e.g., budget, goals, and time investment) to determine whether an online tool is appropriate for them. Informational resources, such as flowcharts or diagrams, could help farmers assess whether certain sales platforms are appropriate for their operation.
2. When planning a workshop or training session, facilitators should first assess participants' technological literacy. In some cases, it might make sense to divide farmers into different groups according to their skill levels. These varied levels could be considered when deciding on the modality of the workshop. While some farmers can learn how to use online tools through a virtual webinar on Zoom, many farmers require direct support in person. In addition, some workshops might require a high ratio of facilitators to farmers so that participants can receive direct support from facilitators when they fall behind.
3. Along these lines, technical assistance providers should ensure that farmers have the technical literacy to maintain an online tool. For example, many farmers, particularly family farmers and DMFs, do not own or use computers and some do not own or know how to use smartphones. Some DMFs also lack basic knowledge of digital technology or English fluency, making learning how to use online tools more challenging. This is often the case for DMFs who are older or of lower educational attainment, and immigrant farmers who are not English speakers. If a farmer lacks the necessary technical literacy, technical assistance providers could confirm that the farmer has a relative, employee, or organization that will help them on an ongoing basis. Alternatively, they could implement a plan to train the farmer on how to use this tool. Another possible solution could be to help the farmer set up a website or social media page that requires minimal updating (excluding prices and sales locations).
4. Given farmers' varied levels of knowledge, peer-to-peer learning opportunities where more knowledgeable farmers teach online technology skills to novice farmers can be very effective. For example, the Tech Hub has organized webinars and conference presentations in which farmers share their experiences with specific online tools (e.g., online sales platforms) and how they use them.
5. Technical assistance programs should consider expanding the availability of resources in languages in addition to English and hiring staff who are able to support farmers in different languages. In California, Spanish is especially important because, after English, it is the second most commonly spoken language among farmers of color and female farmers (California Department of Food and Agriculture, 2020). In addition, online sales platform companies should consider offering customer support services in languages other than English.

In closing, research-informed resources and programs that help DMFs utilize online tools can strengthen DMFs' resilience to future economic disruptions. Because California DMFs represent 10% of the total DMFs in the U.S., our findings and recommendations can guide programs working to strengthen the sustainability and resilience of regional food systems in California and beyond.

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Appendix A. Detailed Description of Survey Data Collection

We administered our online survey on the Qualtrics.com platform. Sampling for the survey focused on agricultural producers in California who sold at least some of their products through direct-to-consumer or direct-to-institution market channels. The questionnaire was available in both English and Spanish, and we offered a US$20 e-gift certificate incentive to participants. The survey collected responses from January through April 2021. We received a total of 364 complete responses that met the inclusion criteria.

The survey questions were focused on farmers' experiences of the COVID-19 pandemic and how they responded to its disruptions during the first 10 months (March–December 2020). The survey gathered data on farmer demographic characteristics (e.g., age, race and ethnicity, gender), farm operation characteristics (e.g., size, type of production, market channels used), responses to the impacts of the COVID-19 pandemic (e.g., changes in market channels and production), and factors that enabled and constrained their response to the pandemic (e.g., institutional or community support). A section of the survey focused on farmers' use of online sales and marketing, which is the focus of this paper's analysis. Analyses of other portions of the data have been discussed by Durant et al. (2023) and Pesci et al. (2023).

To reach prospective participants, we used email addresses obtained via three sources: the California Department of Food and Agriculture's (CDFA) list of Certified Farmers Market Producers; a list of direct-market farmers who are certified organic by the nonprofit California Certified Organic Farmers (CCOF); and California-based farmers with a profile on LocalHarvest, an online directory of direct-market farmers. We sent out an email to members of the CDFA and CCOF listservs with a direct link to our survey (1,693 contacts), and LocalHarvest disseminated our link internally via its listserv (1,700 contacts).

We had a total response rate of 16.1% (n = 364), out of which 360 responses were in English and 4 in Spanish. The ethnic-racial characteristics of survey respondents generally reflected the larger population of direct market farmers in California. Among direct market producers in California, 88.4% identify as White (non-Hispanic), 18.1% as Latino or Hispanic, 7.9% as Asian, 3.9% as American Indian and Alaska Native, 1.1% as Black or African American, and 0.9% as Native Hawaiian and Other Pacific Islander.

These percentages were calculated based on the proportion of the total number of California farmers by race and ethnicity who "sell directly to consumers" (USDA NASS, 2016). White (non-Hispanic) numbers were calculated from the overall California data (13,148 Latino and Hispanic producers identify as white racially; these were calculated as a proportion of the 113,717 white-identifying producers in California [11.6%]); 845 taken out of the original 7,308 = 6,463. Durant et al. (2023) and Pesci et al. (2023) provide detailed information about our sample's representativeness and demographic breakdown.

Appendix B. Demographic Breakdown of Survey Participants and Interview Participants (Farmers) in Relation to Their Use of Online Tools

Table B1. Breakdown of Direct Market Farmers who had an *Online Presence* in Each Demographic Group, Categorized by National Origin, Race/Ethnicity, Age, and Gender

Demographic group	Total (*n*)	Users (*n*)	*% Of group*	Non-users (*n*)	*% of group*
Total of sample	346[a]	225	65%	121	35%
U.S. national origin	303	203	67%	100	33%
Non-U.S. national origin	36	16	44%	20	56%
American Indian and Alaska Native	13	9	69%	4	31%
Asian	19	11	58%	8	42%
Black or African American	6	3	50%	3	50%
Latino or Hispanic	39	21	54%	18	46%
Native Hawaiian and Other Pacific Islander	1	1	100%	0	0%
White	263	177	67%	86	33%
Under 55 years old	185	126	68%	59	32%
Age 55 or older	149	90	60%	59	40%
Female	182	127	70%	55	30%
Male	157	92	59%	65	41%
Other gender (non-binary, trans, "other")	2	1	50%	1	50%

[a] The total sample was 364, but 346 participants responded to this question.

Table B2. Breakdown of *Online Sales Users and Non-Users* in Demographic Groups Categorized by National Origin, Race/Ethnicity, Age, and Gender

Demographic group	Total (n)	Users (n)	*% Of group*	Non-users (n)	*% of group*
Total of sample	358a	166	46%	192	54%
U.S. national origin	303	144	48%	159	52%
Non-U.S. national origin	36	13	36%	23	64%
American Indian and Alaska Native	13	8	62%	5	38%
Asian	19	7	37%	12	63%
Black or African American	6	2	33%	4	67%
Latino or Hispanic	39	18	46%	21	54%
Native Hawaiian and Other Pacific Islander	1	0	0%	1	100%
White	263	128	49%	135	51%
Under 55 years old	185	87	47%	98	53%
Age 55 or older	149	68	46%	81	54%
Female	182	89	49%	93	51%
Male	157	68	43%	89	57%
Other gender (non-binary, trans, "other")	2	0	0%	2	100%

[a] The total sample was 364, but 358 participants responded to this question.

Table B3. Farmer Interview Sample Descriptive Statistics

Farm and farmer characteristics	*n*	% of sample	Online sales	No online sales	Social media user	Website user
Total farmers	28		12	16	22	18
Age under 55	19	68%	9	10	17	14
Age over 55	9	32%	3	6	5	4
U.S.-origin	21	75%	10	11	16	14
Non-U.S. origin	7	25%	2	5	6	4
White (non-Hispanic)	17	61%	8	9	13	15
Non-white (BIPOC)	9	32%	4	5	8	3
Female	12	43%	4	8	8	7
Male	16	57%	8	8	14	11
Crop producer	25	89%	10	15	19	4
Livestock producer	5	18%	2	3	5	3
Acreage ≥ 6	13	46%	5	8	10	8
Acreage < 6	15	54%	7	8	12	10