frontiers | Frontiers in Sustainable Food Systems

ORIGINAL RESEARCH
published: 16 June 2022
doi: 10.3389/fsufs.2022.887707

# Diversified Farming Systems: Impacts and Adaptive Responses to the COVID-19 Pandemic in the United States, Norway and China

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The COVID-19 pandemic fully exposed the vulnerability of the global agri-food system to shocks and stresses, highlighting the need for transformation and action to make it more resilient and inclusive. This paper offers a unique insight into the global nature of the COVID-19 pandemic by examining impacts and responses in the agri-food sector within three very distinct contexts, namely the United States, Norway, and China. Focusing on small, diversified farms, the study builds on prior research with the same farmers and support organizations from an on-going collaboration. Firstly, we conducted a short review of policy adaptations to understand how governments, the private sector, non-profit organizations, and communities "stepped up" to provide emergency relief, specialized training, and recovery support for farmers, support that was instrumental in preventing more devastating impacts in all three countries. Secondly, drawing from in-depth interviews with farmers (23) and government and non-governmental support organizations (19), we mapped the vulnerability and resiliency of selected farmers to shocks that severely disrupted traditional supply chains during the COVID-19 pandemic. Data were collected on both the negative and positive impacts of the pandemic to farmer inputs, including labor, operations, and markets, how these changed from the initial lockdowns in early 2020 and through 2021, and on farmer adaptive responses to these impacts. In some contexts, innovation and adaptive responses counteracted negative impacts. We saw diversifying markets, catering to consumer safety concerns, switching to direct and e-markets, hiring in more labor or relying on family labor, and switching to high demand crops and products as the most prominent adaptive responses. Farmers who lacked access to information and government programs, in large part because of language, technology and institutional barriers, missed out on pandemic related opportunities and suffered the most. As we enter the post-pandemic new normal it is important to take stock of lessons learned, and to continue to support those initiatives and innovations that were pivotal not only for weathering the storm, but for building a more inclusive and resilient agri-food system in the long-run.

**Keywords: community-supported agriculture, e-commerce, farmer impacts, policy adaptations, post-disaster resilience, small-scale farmers, sustainable food systems, agri-food systems**

OPEN ACCESS

***Edited by:***
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***Specialty section:***
*This article was submitted to Social Movements, Institutions and Governance, a section of the journal Frontiers in Sustainable Food Systems*

***Received:*** *02 March 2022*
***Accepted:*** *25 May 2022*
***Published:*** *16 June 2022*

***Citation:***
*Måren IE, Wiig H, McNeal K, Wang S, Zu S, Cao R, Fürst K and Marsh R (2022) Diversified Farming Systems: Impacts and Adaptive Responses to the COVID-19 Pandemic in the United States, Norway and China. Front. Sustain. Food Syst. 6:887707. doi: 10.3389/fsufs.2022.887707*

## INTRODUCTION

> "*Historically, pandemics have forced humans to break with the past and imagine their world anew. This one is no different. It is a portal, a gateway between one world and the next.*" (Arundhati Roy, The Financial Times, 2020).

Massive agri-food system disruptions have been commonplace throughout history. Disaster events, such as the COVID-19 pandemic (hereafter called "the pandemic"), can radically change agricultural landscapes (Eklund et al., 2016; Epstein et al., 2018; Lopez-Ridaura et al., 2021) and influence the adoption of new farming practices, crop choices and distribution mechanisms (Lin, 2011; Altieri et al., 2015; DiCarlo et al., 2018; Barrett et al., 2021), indeed, disasters can become critical moments of transformation (Folke, 2006; Bacon et al., 2012; Scheffer et al., 2012; Lioutas and Charatsari, 2021). This research builds on the important and burgeoning canon of literature that looks at rural livelihoods (Du et al., 2005; Valdés and Foster, 2010; Carreras et al., 2020; Gatto and Islam, 2021; Rasul et al., 2021), livelihood diversification (Gautam and Andersen, 2016), and smallholder farming (Hazell et al., 2010; Jayne et al., 2010), in the context of shocks. Given the pervasiveness and increasing frequency of human-environmental induced disasters, especially related to climate and health, there is widespread interest in understanding their impacts on agricultural systems broadly, as well as in the capacity of farmers to recover and adapt (Scheffer and Carpenter, 2001; Adger et al., 2005; Bacon et al., 2012; Kremen et al., 2013; Marín et al., 2014; Tendall et al., 2015; Folke et al., 2016; Kremen and Merenlender, 2018). Recovery in this context refers to a process of "bouncing back" to, or close to, a pre-disaster state (Klein et al., 2003; Cutter et al., 2008), whereas adaptation refers to the potential to be transformed into stable new states (Folke, 2006; Cutter et al., 2008).

Beginning February of 2020, the COVID-19 virus spread rapidly across the world with serious environmental, social and economic consequences (IPBES, 2020). The pandemic underscores how novel shocks to agri-food systems compound the already dire global impacts of climate change, biodiversity loss, and food insecurity (Carlisle et al., 2019; IPBES, 2019; IPCC, 2019; Petersen-Rockney et al., 2021). During the pandemic, farmers in all corners of the globe were challenged in unprecedented ways to adapt their production, marketing, sales, and food and labor safety practices to abide by COVID-restrictions in health and society in general. Under these circumstances, building resilience and adaptive capacity in the food system takes on new urgency with important experiences for sharing across nations and for planning a more secure global post-pandemic food system.

Our work builds on previous examinations of small-scale farming, disasters and agricultural change (Holt-Giménez, 2002; Shivakumar et al., 2005; Lin, 2011; Steffen et al., 2011; Epstein et al., 2017, 2018; DiCarlo et al., 2018) by examining how disasters or crises converge with ongoing agricultural transitions and may act as a catalyst for change. Using a qualitative and case-based approach, we examine the health pandemic in three globally important socio-political and food system contexts; the United States, Europe and China, to shed light on the impacts and adaptive responses of small-scale farmers in these distinct contexts. In general terms, in California, United States, small-scale farmers rely on the "free market" for economic survival, while in Vestland, Norway, the Norwegian "social contract" is a model case of government-supported family farm agriculture, and in Kunshan, Southeast China, as throughout China, the central government plays a dominant role in agriculture development.

Combining new empirical data derived from in-depth interviews with small-scale farmers and governmental and non-governmental organizations serving farmers, with a comprehensive mapping of relevant pandemic-related policies in these three countries, we find both commonalities and differences that provide fertile ground for cross-country learning and future planning. We aim to answer the following questions: (1) How have small-scale farmers been impacted by the severe challenges of the pandemic, and how have they responded to this crisis? (2) Which institutions are most effective in supporting small-scale farmers to weather the crisis? Who benefitted? Who lost out? (3) What can we learn from each other for building a more just, resilient and sustainable agri-food system post-pandemic?

## MATERIALS AND METHODS

This study used in-depth interviews and case studies combined with policy response mapping to explore the research questions. A geographically diverse case-study approach was used to generate a multi-faceted understanding of the complex issues of the pandemic in distinct real-life contexts (Crowe et al., 2011) where in-depth interviews with farmers and support organizations elicited experiences and explanations from multiple perspectives. The inclusion of support organizations provides insight into the pandemic-related impacts experienced by a larger number of farmers that they represent or serve. Farmers and support organizations interviewed were chosen based on meeting at least two of three criteria; (1) already part of established research collaboration, (2) snowball recommendations from key informants, and (3) locally recognized and appreciated as sustainable small-scale farmers or support organizations. Hence, some of the interview candidates were part of prior research relationships, building on trust already established with the research team, and expanded on to ensure a diversity of farm types and support organizations. We also conducted desktop research on the policy responses to the global pandemic in the agri-food sector for a "birds eye" view of the situation in three distinct socio-political contexts. An important component of this research was to capture the initial and on-going array of governmental and non-governmental responses to the pandemic. This involved consultation of government websites and policy documents available to the public, news articles, NGO websites, blogs and reports that continue to document pandemic related events, impacts and responses in real time as the pandemic enters its third year. Journal articles presenting research from the early stages of

the pandemic were obtained through literature searches and referenced if relevant.

## Study Regions

We chose three geographical locations for our policy and case-study investigation: United States/north-central California, European Union/western Norway and China/southeastern China, building on a previous comparative collaboration on sustainability perspectives in agriculture (Elias and Marsh, 2019). This study, therefore, presents a unique opportunity to explore and compare the impacts of a global pandemic on farmers and agri-food supply chains, and to assess and compare both farmer and policy responses, in three very distinct regions.

1. California, United States

California is characterized by a Mediterranean type climate with hot and dry summers, mild winters, and most agriculture depends on some type of irrigation system. It is a well-known center of agricultural technological and institutional innovation to support sustainable landscapes and food systems (Kremen et al., 2013; Iles et al., 2016; Carlisle et al., 2019; Elias and Marsh, 2019) and therefore a good candidate for studying self-driven diversified farming systems and small-scale farming. California horticulture farmers do not receive crop subsidies, relying on "free market" sales for economic survival and smaller farmers are often outcompeted by large operations (Iles and Marsh, 2012; Scheitrum, 2020). Those that do survive and thrive tend to have strong direct marketing strategies that respond to growing consumer demands for local, fresh and healthy produce. For this study, we selected eight farmers for in-depth interviews, and ensuring a diversity of sizes, crops, practices and markets. The farms, located in seven different counties of northern and central California, range from 7 to 270 acres—small to mid-size, with one outlier at 1,500 acres of orchards. Half of the farms grow tree crops—fruits, almonds and walnuts, three grow row crops, mainly vegetables, and one is a mix of tree and row crops. Five of the eight farms are 100 percent organic, while three are a mix of organic and conventional crops. Approximately 80 percent of hired labor on these farms, and in California generally, are immigrants from Mexico.

2. Vestland, Norway

Western Norway is characterized by a Northern Atlantic climate with cool summers, relatively mild winters and high precipitation year around. In Norway cultivated land accounts for only 3% of the country's total area. Meat (beef, pork, sheep and poultry/eggs) and dairy (cow and goat) production take place in rural areas all over the country, while the production of grains, vegetables, fruits and berries mainly takes place in central parts of Norway. The farm structure is characterized by relatively small family farms. Norway's agricultural and rural policies have historically been related to food security, farm incomes, maintaining population in rural areas and regional distribution of production and employment objectives (Bjørkhaug and Richards, 2008; Forbord et al., 2014; OECD, 2021c). We selected 10 farmers from the Nordhordland region on the west coast of Norway. This area was designated in 2019 as a UNESCO Biosphere Reserve as part of UNESCO's Man and the Biosphere (MAB) Programme (UNESCO, 2017; Kaland et al., 2018). Biosphere Reserves are model areas for sustainable development, where agricultural activities play an important role. The farms included in this study range from 22 to 461 acres (mean of 181 acres), where a large proportion of land on each farm constitutes uncultivated rangeland or woodlots (outfields). Farms combine fodder production (hay) with livestock rearing, mostly sheep, cattle, pigs, goats and chicken, and/or vegetable and fruit and berry growing. Most farms are run as family operations where members of the workforce have part-time jobs elsewhere, and labor is only hired in for the summer months.

3. Kunshan, China

Southeastern China is characterized by hot and rainy summers and cold and dry winters, and large areas are dominated by agricultural activities. This project continues past research in Kunshan County, located in the highly urbanized and affluent Yangtze River Delta adjacent to Shanghai. Alternative Food Networks (AFNs) have become popular here because of a demand-driven civic movement for greater access to healthy and safe food (Shi et al., 2011; Schumilas and Scott, 2015). AFNs appeal particularly to educated and conscious urban consumers who are willing to pay for the price premium of organically grown food. A number of sustainability farms have emerged in Kunshan, one of them being the Yue Feng Dao Organic Farm (YFD). YFD, established in 2010, is a hybrid business and state-owned enterprise consisting of 83 acres of organically grown rice, vegetables and poultry. YFD caters to the Shanghai market by selling directly to consumers through a Consumer-Supported Agriculture (CSA) model. As with California and Norway, the choice of YFD as the China site builds on relationships formed in prior research. However, due to severe lockdown conditions during the pandemic for YFD and the China-based research team, and the inability to conduct interviews by phone, only five interviews were possible. Furthermore, four of these farmers differ as they are farm labor-employees of YFD, having their own small farms in the nearby village of Chuodun (绰墩), while the fifth is a YFD marketing supervisor living in Shanghai. Therefore, their perspectives on pandemic impacts, and ability to respond, will be different than the other two cases.

## Interviews

The same questionnaire was used for conducting interviews in the United States, Norway and China. It was translated into the local languages with minor adaptations to improve clarity, allowing for comparability in impacts, responses and perspectives across the three countries. The research protocol was reviewed and approved by the Office for the Protection of Human Subjects, UC Berkeley and Duke Kunshan University, and by the Norwegian Center for Research Data (NSD) for the Vestland case. Data were anonymized before data entry and all audio files will be deleted by the end of the project period. In California and Kunshan, the study teams comprised lead faculty and students (University of California, Berkeley, Duke Kunshan University, respectively), conducting and analyzing interviews and policy research, while in Norway the study team comprised

lead faculty and a technical assistant (University of Bergen). The questionnaire started with a section where respondents were asked to rank various categories of pandemic-related impacts on a scale from 1 (no impact) to 6 (very highly impacted), for both negative and positive impacts. This was followed by a qualitative section on specific impacts with a set of ten open-ended questions. Interviews were audio-recorded (except in one case with a Chinese organization that did not consent), and in most cases were fully transcribed, coded and text analyzed, while in others key themes and quotes were excerpted and directly transferred to the data analysis excel sheets. Data on ranked negative and positive impacts were converted to percentage distributions of the six ranked options and presented as bar charts for easy cross-country comparison.

In total, 23 farmers were interviewed: 8, 10, and 5 from California, Vestland and Kunshan, respectively (**Supplementary A**). Interviews with farmers were conducted in person, over a digital meeting platform like Zoom or Teams or *via* cell phone due to lockdowns and pandemic restrictions and lasted one to two hours. In addition, 19 staff from 17 farmer support organizations; 6, 7 and 6 from California, Vestland and Kunshan, respectively, were interviewed with interviews lasting from 30 to 90 minutes (**Supplementary A**). Interviews with organizations were held virtually *via* cell phone, Teams or Zoom, except two in-person interviews in Beijing and Shanghai, China. These governmental and non-governmental organizations (NGOs) or agencies provide farmers with technical advice on agriculture and marketing practices, policy advocacy on behalf of farmers and sub-sectors of small, organic and socially disadvantaged farmers, as well as networking connections with programs and financing provided by government at different levels, in addition to their own emergency fundraising for impacted farmers. Interviews captured both the impacts on the organization's functioning as well as negative and positive impacts on the farmers they serve or represent.

# RESULTS

## Impacts and Adaptive Responses—Policy Measures

1. The United States/California

Beginning in March 2020, there were severe pandemic-related supply chain disruptions with coolers, packers, and food distributors across the United States (Congressional Research Service, 2020). Many farmers who sold directly to restaurants or through wholesalers to school and corporate cafeterias lost income as the demand from these sources dramatically reduced at the onset of the pandemic (California Farm Bureau Federation, 2020). Larger farms and ranches entirely reliant on major wholesalers fared worse. At the same time, supply chain and processing limitations hampered farmer responsiveness to increased consumer demand from supermarkets (ERA Economics, 2020). Farmers faced lost markets, health and safety issues, supply chain disruptions, and labor shortages. Farmers markets initially shut down, disproportionately hurting smallholder farmers, many organic, but later reopened with strict health protocols when designated as "essential services" after concerted lobbying (Woods and Zare, 2021) by such California-based organizations as Community Alliance with Family Farms (CAFF). *"While the state has declared that farmers markets are essential services just like grocery stores or pharmacies . . . a number of jurisdictions have decided to ban them anyway. And so we spent the past four weeks advocating. . . talking to local policymakers, city councils, to say no, this is an essential service. They're not special events. They're not luxury items. These are essential services, where people, including low-income families, using SNAP [Supplemental Nutrition Assistance Program] and other market match programs actually get their healthiest groceries"* (CAFF staff member).

Numerous non-governmental organizations (NGOs), state, and federal institutions played pivotal roles in the pandemic response. While wholesale markets decreased significantly, opportunities for farmers who were able to deftly pivot to direct and on-line marketing increased as demand for low touch, locally grown produce skyrocketed. Organizations such as CAFF and Kitchen Table Advisors (KTA) implemented on-line training to help family farmers adapt to the demands of switching to digital platforms with required safety measures. The United States Department of Agriculture (USDA) supported a program from May 2020 to May 2021 called "Farmers to Families" that provided funding for farms to produce food boxes for local communities, especially schools, food banks, and farmers markets (USDA, 2020a; USDA-AMS, 2020). During the first round, with the business, marketing and networking assistance of California-based NGOs such as Fresh Approach and KTA, many smaller farms participated in USDA programs, including previously excluded socially disadvantaged farmers (Fresh Approach, 2020). The USDA defines a socially disadvantaged farmer or rancher as "a farmer or rancher who has been subjected to racial or ethnic prejudices because of their identity as a member of a group without regard to their individual qualities. Those groups include African Americans, American Indians or Alaskan natives, Hispanics, and Asians or Pacific Islanders" (USDA, 2020b). During the second round, however, many organic farmers became ineligible for USDA programs that required Good Agricultural Practices (GAP) certification, which prohibits common practices of organic farming such as wildlife conservation and on-farm composting, and further lacked the expertise and capital to fund the GAP verification process (Bitker, 2020; interviews).

The USDA also implemented three rounds of the Coronavirus Food Assistance Program (CFAP) to provide pandemic assistance for producers in 2020 who faced market disruptions (USDA, 2020b). The Paycheck Protection Program (PPP) was an important US Small Business Administration (SBA) loan that helped farms keep their workforce employed during the pandemic (NSAC, 2020). The American Rescue Plan Act of 2021, signed into law by President Biden on March 11, 2021, allocates $1.9 trillion to COVID-19 relief measures, with an estimated $10.4 billion designated to strengthen the agricultural and food supply chain (see **Supplementary B** for more detail). A designated $4 billion will be used to provide debt forgiveness for socially disadvantaged farmers.

ARPA provided funding for the extension of federal programs such as Pandemic-EBT, PPP, and CFAP. Enrollment in CalFresh (food stamps) increased by 25% between January 2020 and June 2020 with 2.6 million households (CalFresh Data Dashboard). In California, Governor Gavin Newsom distributed $75 million in state funds, with an additional philanthropic effort to raise $50 million in private donations, providing cash relief assistance for undocumented individuals, many who are farmworkers. Socially disadvantaged/non-English speaking farmers experienced greater losses when their traditional markets closed (wholesales, farm stands). Many organizations made it their goal to close the information and linguistic gap, such as CAFF, Kitchen Table Advisors, and Fresh Approach, as well as the CDFA Farmer Equity Program by translating easy to understand information into Spanish, and offering webinars with simultaneous translation (CDFA, 2020; Bacon, 2021; CAFF, 2021). A large study by the California Institute for Rural Studies (CIRS) showed disproportionate economic burdens and household and community-level suffering and stress as compared to the overall population. It also revealed poor access to adequate healthcare, partially mitigated by local clinics, highlighting severe social and economic inequalities within the California food system leading to heightened food insecurity and health risks for farmworkers and their families during the pandemic (CIRS, 2021; Committee on Agriculture, 2021).

2. Europe/Norway

In the European Union (EU), three main types of policies were implemented in the agricultural sector in response to the pandemic (OECD, 2021a,b,c): (i) flexibility extended to implementation of Common Agricultural Policy (CAP) regulations, (ii) exceptional market measures, and (iii) direct support to farmers and rural areas. Policy packages directed toward the most affected sectors were made by each individual Member State based on their own specific circumstances, as long as they complied with the EU's state aid rules and did not distort competition within the EU (OECD, 2017). Various measures directed to the functioning of the food supply chains were implemented in the different Member States as they were recognized as essential services, e.g., trade in food products was facilitated through green corridors and restrictions on people's movement were alleviated. Further, to secure recruitment of agricultural labor, different measures were put in place in Member States, e.g., through schemes encouraging workers laid off in other sectors or students to temporarily work in the agri-food sector. For instance, the Czech Republic set up platforms to connect the supply and demand of seasonal workers, and eased processing of seasonal visas for the sectors (OECD, 2021c). The reduced availability of imported food gave a growth in sales primarily serviced by small (or mid-size) farms, food, and beverage companies. This has left local food producers uniquely affected, and perhaps, well-positioned to reinforce or grow their place in the portfolio of food offerings and markets (Lusk and Anderson, 2020). Pandemic response policies directed toward consumers also had an impact on producers of agri-food products. Income losses and economic uncertainties, together with restrictions for restaurants and other away-from-home food suppliers, generated changes in food demand among consumers which the industry needed to cope with. Many customers turned to delivery services and e-commerce, putting a pressure on farmers and producers to adapt to these services and change their value-chains (OECD, 2021c).

Norway is not a member of the EU but is largely influenced by EU policy through the EEA agreement between the EU Member States and the EFTA countries Norway, Iceland and Liechtenstein. Norway has implemented several measures in response to the pandemic, many of which are relevant to the agricultural sector which was designated as a critical sector early on (see **Supplementary C** for an overview of schemes). Most of the measures that were implemented are general and apply both to full-time and part-time farmers. Among these are government provided economic stimulus packages to businesses in general to mitigate the long-term effects of the pandemic, the so-called "corona package" [(Ministry of Finance, Norway, 2020)]. Here, one element is aimed at producers who experienced substantial cost increases related to labor, infection control regulations, and other factors. A second element is aimed at livestock farmers who experienced a sharp increase in the price of feed over a short period of time. Support was given to those farmers who were unable to carry out their activities due to the lack of seasonal workers, for example, a temporary scheme provided incentives for laid-off workers to take up jobs in agriculture; Norwegian workers would keep 50% of their unemployment benefits if they took up work in the sector. As such, the agriculture sector was the only sector that had a rise in employment so far in this pandemic (Holgersen et al., 2020). Further, farmers who were unable to harvest in 2020 due to the lack of workers were eligible for payments under the crop insurance compensation scheme. Farmers producing local and high-end products for restaurants struggled to make ends meet. Farmers and farm workers with small children initially had reduced capacity to run their farms when they also had to take care of their children due to lock-downs of schools. However, early in the pandemic farmers were classified as critical workers, and kindergartens and schools for their children under the age of 12 were reopened during periods of full lock-down.

3. China/Kunshan

China was the first country in the world to battle the pandemic, with person-to-person transmission of the coronavirus nationwide in January 2020 (Wu and McGoogan, 2020). During the early stages China faced a rapidly developing food supply shortage as transportation disruption resulted in a large amount of overstocked perishable products, especially poultry, meat, and vegetables (Pu and Zhong, 2020). In February 2020, when virus containment measures were in effect across most provinces in China, food prices had grown by 22% compared to February 2019, especially for perishable produce (Reuters News, 2020). In rural China, where the food system consists of mostly subsistence farms, farmers encountered less disruption from the lockdowns because they mostly produce for home consumption and are not directly involved in the food

supply chain. However, many subsistence farmers temporarily lost their main source of income, as they work as migrant workers in urban areas outside of seeding and harvest seasons. Most severely affected were the low-income migrant farm workers, who juggled the risk of failing to be self-sufficient at their home farms, and the reduction in income and inadequate governmental support.

Before the pandemic, the Government of China (GoC) had already created a series of national level risk-management strategies for its food system in preparation for natural disasters (Pu and Zhong, 2020), and these strategies have helped China to define the responsibilities of different levels of governments and coordinate efforts across the multi-level governance during the pandemic. Existing programs include the Cereal Bag Provincial Governor Responsibility Mechanism and the Food Basket Major Responsibility Mechanism that facilitate provincial governments to proactively intervene in food production and circulation during emergencies and require municipal governments to regulate food prices in their cities, respectively (Pu and Zhong, 2020). These preventive measures have helped China to quickly adapt to a food crisis mode during the pandemic in terms of resource allocation and responsibility distribution. The major additional policy responses of the GoC and private sector to the pandemic outbreak started immediately after the on-set at the end of Jan/beginning of Feb 2020 (see **Supplementary D** for more details). The top priority of the government's policy response was to resume agricultural production and ensure farmers' work by providing transportation and financial support and guiding local governments to prioritize essential small and medium-size enterprises. Special attention was given to agricultural enterprises that focused on inputs production, distribution, slaughtering, and products processing (Pan et al., 2020).

In response to overstocking issues and in order to protect rural households from falling into poverty (again), the GoC focused on improving the logistical and marketing channels for perishable agricultural products (Luo et al., 2020), as a means to ensure a steady flow of agricultural products to consumers, and as a way to prevent price increase and discontent within the general population as a result of lack of access to affordable foods. For instance, the Ministry of Transportation offered a "green channel" pass for truck drivers to help transport fresh produce and waived all toll fees. Logistics companies, farmer cooperatives, as well as e-commerce companies were organized to market agricultural products through the internet. For migrant workers, a "point-to-point" policy was implemented; "Notice on Doing a Good Job of "Point-to-Point" Service Guarantee for Returning to Work for Migrant Workers". Before trains and planes resumed operation, workers from other counties were transported together and directly to their working place in buses organized by the government. This increased the efficiency of work resumption and reduced the probability of cross infection, and as of March 6, 2020, 2.63 million migrant workers benefited through this policy (Pan et al., 2020).

To address labor shortages in farm production, the GoC differentiated the travel restrictions placed on municipalities based on the transmissibility of the virus and number of active cases. In areas deemed as low risk, enterprises and farms could fully resume production. At the same time, the agri-food system chain was targeted to provide more job opportunities and secure greater food supply at a local level where migrant workers faced travel restrictions. Local businesses, cooperatives, and family farms were encouraged to employ local workers. Counties were asked to encourage local enterprises to provide temporary and flexible job opportunities, build a communications platform between workers and businesses, and if necessary, create public service job opportunities to ensure local workers' employment (Pan et al., 2020). Migrant workers from the villages also had the opportunity to sell their farm products through new online sales platforms. For example, Pinduoduo, the largest agriculture-focused technology platform in mainland China, provided 500 million Yuan of special subsidies to purchase agricultural products at a price higher than the average market price (Luo et al., 2020; Zhan and Chen, 2021). E-commerce played a crucial role in helping the agricultural market to adjust to pandemic conditions and reform. Data from the Ministry of Commerce show that there was a 40% increase in total transactions online of agricultural products in the first half of 2020 (Jingdong Big Data Research Institute, 2020). Supported by national social media platforms with participation from government officials, celebrities, e-commerce promoters, and local farmers, various e-commerce platforms helped greatly in selling those agricultural products that had excess supply due to transportation restrictions. Furthermore, as lockdown measures led to a huge spike in demand for fresh groceries, e-commerce companies expanded the coverage of contactless delivery and pick-up options, similar to those observed in other countries (Zhan and Chen, 2021). The most popular e-commerce platform in China, Taobao, in coordination with Alibaba, set up a 1-billion-Yuan fund on February 12th, 2020, to help farmers throughout the supply chain: production, transportation, and marketing, referred to as the "Love and Help for Farmers Program", where farmers from eight provinces were able to sign up. In less than 40 days, 118,000 tons of fruits and vegetables were sold to consumers across China (Fei and Ni, 2020).

## Impacts and Adaptive Responses of Farmers and Farm Organizations

1. The United States/California

In the United States, farms were considered "essential services" from the beginning of the pandemic so they were not subject to lockdowns. Most continued operating throughout the pandemic. For California the median age of the eight interviewed farmers was 54 years, ranging from 31 years to 83 years, with a 50/50 gender distribution of three men, three women, and two female-male pairs. Six were full-time and two were part-time farmers. The main negative impacts interviewed farmers reported were lost markets, lost income, and supply chain disruptions (**Figure 1**). Organization staff, referring to the larger number of farmers that they support, reported more widespread and severe impacts as compared to the sample

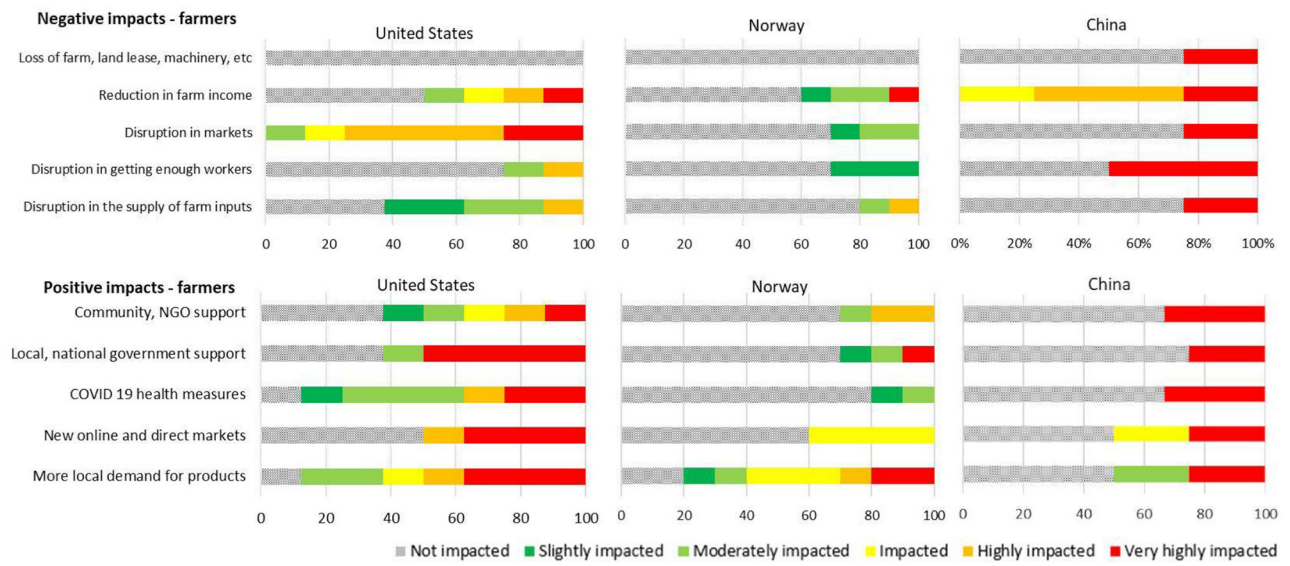


**FIGURE 1 |** Negative (top pains) and positive (bottom pains) impacts of the COVID-19 pandemic as perceived by the interviewed small-scale farmers and their farm operations, shown as percentage distributions over the six different impact categories (gray = not impacted, green = slightly impacted, light green = moderately impacted, yellow = impacted, orange = highly impacted, red = very highly impacted), in the United States, Norway and China ($n$ = 23).

farmers, especially in lost income and market disruptions, as well as reduced labor due to sickness or fear of sickness (**Figure 2**). "*I've seen farmers making different decisions about what to grow, the timing, the size of their operations to be more efficient, dealing with having less labor and sales, those are things to manage risk*" (California government advisor). "*Missing a few markets for a small business is enough to put people into financial straits. These are incredibly small farms operating on razor thin profit margins, if they even have profit margins*" (NGO small farm advisor).

On lost markets we quote an advisor stating: "*...changing your entire business model takes time, takes effort, takes labor. Yes, they were able to pivot and pick up on the CSA boom, but at the same time to sell the same amount of produce they had to put in a lot more work and time*" (CAFF advisor). Concerning supply chain disruptions, a farmer reports: "*Product was delayed, materials were delayed because factories weren't up and running fully. We struggled a lot, especially early on when everyone got really scared*" (Mid-size vegetable farmer). Further, a support organization representative states: "*I think it's important to distinguish between what the market was doing and what income was doing, and where the fault lay…demand may be spiking but their income is not changing, and it's beyond their control due to limitations in supply chain and processing to respond to increased demand in grocery stores*" (UC Extension). On labor (deficit) a farmer responds: "*Labor was a problem in vegetables. It's a problem because we couldn't count on the people who used to help out*" (Small vegetable farmer). And on labor surplus a farmer reports: "*A lot of people were out of work, a lot of field guys, guys that worked in construction lost their jobs, so they came back to pick fruit because I have always left the door open…*" (Mid-size fruit farmer).

Many fruit and vegetable farmers, including those in the study sample, adapted their production, labor and marketing strategies quickly to mitigate pandemic-related closures and fluctuations and take advantage of a surge in direct and on-line consumer demand (**Figure 1**). Several NGOs (e.g., CAFF, KTA, Fresh Approach—see policy section above) were key for linking farmers with government programs aimed at supplying emergency food relief during the pandemic, partially compensating for the loss of other markets. A mid-size fruit farmer stated that: "*With COVID-19 people wanted low interaction shopping, direct market/delivery. We have a CSA program and e-commerce, and huge demand rose for those programs. 1500 CSA members compared to 600 last winter (maybe lower).*" With the help of Fresh Approach, this farm received a first-round grant from the USDA to participate in the 'Farmers to Families' program, supplying top quality organic produce to nearby schools and food banks. Several also applied and received payroll protection grants and funding from other support programs. As a result, only half of the study farmers experienced lost income, and only for a relatively short time (**Figure 1**). The nut farmers lost income from declining prices due to export market disruptions, especially to India and China, but partially made up the difference with their organic nuts that continued to sell well in the domestic market. A cannabis farmer interviewed remarked on how the price of his commodity increased by 10% and he was able to easily sell the whole crop at a high price, resulting in a good income year. Both the farmers and the organizations reported unprecedented cooperation among farmers, consumers, government and NGOs to help farmers weather the storm. "*It's been very rewarding to be a part of this very broad 'all hands on deck' effort to help the agriculture community weather this crisis.… and to see how many farms and ranches have navigated the waters on their own … Just a tremendous amount*

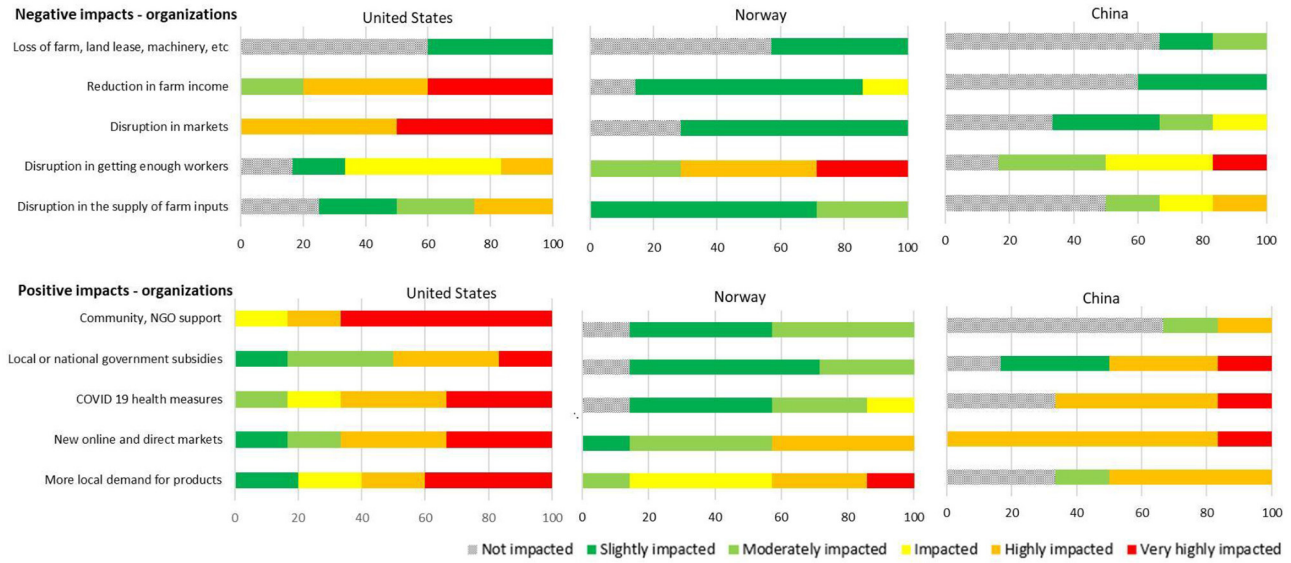


**FIGURE 2 |** Negative (top pains) and positive (bottom pains) impacts of the COVID-19 pandemic as perceived by interviewed support organizations on the farmers they serve or represent, shown as percentage distributions over the six different impact categories (gray = not impacted, green = slightly impacted, light green = moderately impacted, yellow = impacted, orange = highly impacted, red = very highly impacted), in the United States, Norway and China ($n$ = 19).

*of energy has been poured into the crisis response. I hope we can be a part of institutionalizing what good has come out of this so that it doesn't just sink back into the ground, like water after a short rain.*" (UC County Extension Officer). "*I don't know, but to the degree that there hasn't been more negative impacts on farmers to the point of having to sell their farms, is a combination between their own nimbleness and adaptation and government programs. Both were required.*" (CAFF staff member).

Not all farmers, however, had the same access to support: "*... for socially disadvantaged farmers and ranchers I'd say particularly for those who do not speak English as a first language, they had an extreme level of disruption earlier on primarily because they market mostly to either a wholesaler or an institutional market or farmers markets and they did not have the same access to information and resources about how to pivot or change those markets in a pandemic*". As an example, an indigenous woman small-scale farmer reports: "*Regarding the coronavirus, the real truth is that I don't look for help, someone like me, I only read a little Spanish, no English, I've heard about programs...but no, nothing, still I feel fortunate.*" In her case, the owner of the land she leases took an interest in her well-being at the outset of the pandemic and together they designed a website to offer excess produce through a Bay Area-based CSA. An emergency relief fund was created and funded by six support organizations to help fill this gap, distributing nearly one million $ in funds to 80 Black, Indigenous and People of Color (BIPOC) farmers during 2020 (BIPOC Steward of Land Relief Fund).

The post-pandemic future of e-commerce and direct marketing to consumers and needy families as a continued positive impact for small, medium and organic farmers is very much in question, as government programs terminate or shift to the advantage of large corporate farms (Bitker, 2020), and consumers decide to continue, reduce or halt their CSA subscriptions. Highly efficient corporations like Safeway, Amazon Fresh and Walmart will likely continue to dominate the e-commerce space, while the participation of small and medium farmers producing local foods for consumers of all income levels will depend upon continued lobbying by advocates, government support, farmer nimbleness, and consumer loyalty. "*At the beginning, yes, unfortunately it didn't last through the whole year. It only was at the beginning when there was nobody else open, and there was no produce in Safeway. It was very good. Unfortunately, it didn't sustain.*" (Small vegetable and fruit farmer). "*It's a very political, and unfortunate, reason for why it ended. ....we had a strong application—I mean we distributed so much local organic produce to our community. ...but when the USDA announced who they chose for their second round it was very clear they awarded the next contract round to huge distribution companies, like Cisco...They wanted to prioritize boxes that had meat and dairy in them. So yeah, for the second round of the grant, there were no small farmers*" (Mid-size fruit farmer).

2. Norway/Vestland

For Norway the median age of the 10 interviewed farmers was 53 years, with a 50/50 gender distribution. Seven of them were full-time farmers and three part-time farmers (30-50%). Most of interviewed the farmers, 60%, reported no impact or only slight impact on their farm operations over the course of the pandemic, and none had been severely impacted, as one of the farmers noted; "*I have experienced mostly positive impacts,*

*as negative impacts are not noticeable on such a small-scale and diversified farm operation as mine*" (Farmer 1). Negative impacts were very limited; 70% of the farmers experienced no negative impacts or only slight negative impacts (**Figure 1**). None experienced loss of their farm, farmland, land lease, machinery or other property, and only one farmer was severely impacted by a reduction in farm income. Disruptions in the supply chain were also very limited. Lost markets were noted by several of the respondents. "*The farm restaurant has been negatively impacted, especially during the 2020 summer with max. 20 guests allowed, compared to the usual 50-60. The constant search for solutions and improvements has had a psychological impact. Cancellations, uncertainty, disappointment*." (Farmer 6). Most of the farmers commented on the uncertainty; *"There has been more uncertainty, poor predictability and difficulties related to planning, and the psychological aspect is most prominent, not knowing if the customer base disappears. For example, the slaughterhouse was uncertain about delivery for a short period during the lockdown. Farming costs are high anyways, hence also my product prices, but can struggling restaurants afford to pay? To me this is an ethical dilemma as I have a sense of solidarity with my customers".* (Farmer 1).

In contrast, there were more positive impacts of the pandemic reported by the farmers. For example, 80% of the respondents saw an increase in the demand for locally produced foods, and 40% saw an increase in the use of new online and/or direct markets. Only 30% received government support. "*I noticed societal change in attitudes and interest in food origins, self-sufficiency, and other food matters. More people were helping each other in the community too, and there was a societal change in attitudes—the status of Norwegian agriculture has improved*" (Farmer 2). "*Private customers have become more interested in local food, and I have more direct inquiries (without active marketing), increased demand, and increased sales*" (Farmer 1). "*We experienced more sales through other channels than usual. We saw an increase in dairy demand and sales and a higher demand for Norwegian vs imported produce in general. We increased our direct sales and got compensated by increased overall demand through the cooperative.*" (Farmer 6). Many reported on impacts on work life due to lockdowns and restrictions; "*I have less vacation, but more time working from home (other jobs), and this is an advantage when you have livestock*" (Farmer 2). "*The pandemic has given me more time at home, and I get more work done. Fewer visitors mean less time 'wasted' on visits. I have increased sales, so I see only positive impacts*" (Farmer 4). However, some farmers did not notice much difference; "*Not much has changed; I have mostly worked like before. Only a bit more washing etc.*" (Farmer 7).

Most of the farmers had made only minor adaptations as they were not very impacted. One farmer reports; *"We have experienced slightly lower production due to the uncertainty in the restaurant market but we have high flexibility because of multiple income sources, so not very vulnerable. We are awaiting the situation and seeing how it develops. The waiting strategy is only possible due to other income sources*" (Farmer 1). Another farmer reports: "*We've not had to adapt much—we're used to fixing things ourselves. Small-scale farming and self-sufficiency are an advantage in a pandemic because it makes you much less vulnerable than the rest of the society*" (Farmer 2). Several farmers used social media more extensively in promoting their farm operation; "*From early in the pandemic (March 2020), I made a change in my professional social media activity—from occasional to daily updates (Instagram), focused on storytelling and sharing everyday life—marketing and entertainment value for others, as well as positive social value for us*" (Farmer 1).

Forty percent of the farmers had not received any form of support while the rest had received various types of limited support, like online courses and workshops arranged by various organizations, networks and labor unions, to develop professionally or provide professional support. The Farmers Union ("Norges Bondelag"), with 62 000 members and 500 local branches around Norway, helped with competence development and social needs. Norwegian Agricultural Counseling ("Norsk landbruksrådgivning"), with 24,000 members and 330 employees, provided courses, webinars, and professional development online. Cooperatives like "Prior" and the Norwegian Food Safety Authority provided professional support. Networks, such as Food Arena ("MatArena"), a network to inspire, develop and connect actors in sustainable local food production, played an important motivational role. The government was identified by 70% of the farmers to be most important in supporting farmers, along with NGOs, the local community and other farmers, and agricultural corporations. However, farmers noted "*The Norwegian compensation model is suitable for large operations; small farms don't 'fit' in the system. You also need an accountant to write applications, and this is not economically sustainable for small operations.*" (Farmer 6). "*Large-scale operations are more affected economically by the pandemic but can get more governmental financial support.*" (Farmer 2). Many commented on positive experiences with community support, "*Other farmers helped with labor during intense and critical parts of the season. The municipality also helped to some extent—as a conversation partner and bureaucratic support.*" (Farmer 2). "*Neighbors helped both socially and economically—we helped each other like back in the old days. You step across the fence and help your neighbor. That's why we have a different experience with the pandemic in rural areas than in urban areas—people are less psychologically affected in the countryside.*" (Farmer 10). "*The cooperatives ('Samvirkelagene') are important—their commitment to receive agricultural products anywhere in the country (in contrast to private enterprises) has proven robust during the pandemic* (Farmer 2).

In Norway, farmer organizations reported on slightly more negative impacts to the farming community than reflected in the responses from the interviewed farmers. Here, as in Kunshan and California, disruption of getting enough farm workers was reported as the biggest negative impact, with disruption in the supply of farm inputs to a lesser extent (**Figure 2**). There have been major challenges related to labor supply in the spring and summer of 2021 for vegetable and fruit growers and a good yield year resulted in a lot of waste. On the positive side, there were also more positive impacts than reported by the farmers themselves (**Figure 2**). Foremost, increased local demand for agricultural produce was noted. In particular, there has been an increased demand for locally produced meats in

new marketplaces, but also increased production costs for these products. The dairy farmers increased their returns in 2021. Also, a boost in online and direct marketplaces, like home- or local delivery points, like the "REKO-ring", were registered. 'REKO' stands for 'REttferdig KOnsum' (fair consumption) and was founded in Finland by Thomas Snellman in 2013. The first REKO ring in Norway was established in 2017 and as of Oct 2020, there were 120 rings scattered around the country serving about 500,000 customers and 500 producers, supported by the Norwegian Farmers' and Smallholders' Association ('Bonde og Småbrukarlaget'). The REKO-ring offers producers direct contact with potential customers *via* a digital meeting place. Customers pre-order and pre-pay items *via* the ring's Facebook page which are then delivered by the producer at the ring's announced delivery location, date and time, for example the IKEA parking lot on Thursday nights in Bergen.

3. China/Kunshan

For China, the median age of the four interviewed farmworkers at Yue Feng Dao Farm (YFD) was 67 years, with a 50/50 gender distribution. They are all from the nearby village and grow food and raise animals for home consumption in addition to their employment at YFD. A fifth interview was carried out with the YFD marketing manager who lives in Shanghai. The interview information gathered at YFD overlaps with the pandemic- related disruptions seen throughout China in commercial farms. The major negative impacts were disruption in markets and/or supply chains, disruption in getting enough workers, and reduction or loss in farm income (**Figure 1**). "*In the early stage of the pandemic, farm workers were not permitted to come back out of concerns of pandemic prevention. To stop the crops and vegetables from completely rotting away, all employers and managers who remained in Kunshan were assigned to harvest.*" (YFD Marketing Supervisor). Due to the lockdowns, lost work and income were also the major impacts for YFD workers (**Figure 1**). All of the YFD employees/farm workers interviewed work at the farm primarily for additional income. YFD did not experience more severe impacts as it had an inventory of inputs and the agricultural technology bureau also offered supplies made scarce by the pandemic.

Farmworkers and the YFD marketing supervisor also spoke about the farm's sustainable farming philosophy and transmission of healthy farming ideas and practices to employees. Although organic products are very expensive for farm workers to afford, some have adopted practices such as less use of chemicals back in their own kitchen gardens. The pandemic set back the positive changes the farm workers were adopting. "*I experienced lockdowns in the early stages, so I didn't have my monthly income. But I have to feed my family. How can I afford sustainable agricultural products from YFD? And how can the sustainable planting mode supply the amount of food my family needs?*" (YFD farmworker). This quote points out the farm worker's perceived drawbacks of organic vegetable, rice and poultry production during crisis. On lost income, a representative of the Farmers Seed Network further explained: "*. . . remote communities that we have helped are mostly based on subsistence farming and remittances from migrant workers. Therefore, these communities are the source of migrant workers. When the pandemic started, the workers were unable to travel back to work after the Spring festival, so they lost some income at the beginning*". When asked what governmental support farm workers received during the worst period of the pandemic, whether national or local, they all replied in similar ways, commenting that they only got face masks and sanitary products rather than financial support: "*We don't know how the local government is compensating the loss of YFD, but we did not receive much support other than asking us to stay at home.*" (YFD farmworker).

There were also positive developments as farmers and managers adopted measures to reduce the losses under the pandemic (**Figures 1**, **2**). The new and expanded e-commerce and online platforms used by local farms showcased how local agricultural products might be the safest and most available option for residents under pandemic restrictions. Specifically, the pandemic opened up opportunities for YFD to invent new strategies to recoup its losses. According to the farm manager interviewed, "*YFD seized this opportunity to extend their market chain and unite three kinds of industries."* In addition to sustainable farming, YFD diversified its agricultural products and value-added processing for e-commerce sales: "*We started to rely on social media platforms to do promotions. We use "wechat" mini programs to sell our organic products and use "wechat" public accounts to spread our sustainable farming philosophy.*" "wechat", an application that merges socializing and commerce functions, is now the most widely used app in China. Further, pandemic-related overseas travel restrictions gave rise to a surge of domestic traveling so YFD began to develop activities to attract tourists and offered educational immersive programs on sustainable agriculture. For example, "*We encouraged customers to learn how to prepare for, plant and harvest rice. By offering such an experience, customers will get to know the connotation of sustainable agriculture. It is a process of learning by doing.*" In this way, YFD successfully merged its long-term goal of educating the next generation to embrace sustainable agriculture with an income-generating opportunity associated with the rise in domestic travel and demand for extracurricular activities. With regards to direct markets, these quotes are illustrative: "*The Covid is actually a good thing for these small ecological farmers because everyone is cooking at home. For farmers that have a direct connection to their consumers, it's actually a good thing for them*" (Beijing Farmer's Market representative), and: "*. . . a turning point for family farms as people are willing to spend more money on vegetables during a crisis, thus starting to appreciate the quality of sustainable agriculture.*"

(Liangshumin Rural Reconstruction Center representative).

According to interviews with farmer support organizations, the largest negative impact was the disruption in getting enough workers (**Figure 2**). This was due to the block of transportation. When COVID-19 first spread massively in Feb 2020, it coincided with China's spring festival and many migrant workers went back to their hometowns in this period, hence migrant workers were not able to return to their workplaces after the holidays as they were asked to quarantine. However, this impact was

relatively short-lived. For governmental-affiliated organizations like the YFD Farm and the Liangshumin Rural Reconstruction Centre, the local governments were able to respond quickly and opened up emergency channels to transport workers and farm products. For non-governmental organizations like Beijing Farmer's Market, they were able to find ways to get in touch with the farmers during lockdowns, for example driving to their village and getting the products themselves over the village gates. It was somewhat surprising that most of the respondents of the organizations indicated that the pandemic actually brought more positive than negative impacts, most importantly represented by the introduction of new online and direct marketing channels. Organizations like Beijing Farmer's Market and YFD Farm put their available products on online platforms like Wechat's mini program so that consumers could browse through and purchase directly. The products were either delivered to the consumer's house *via* logistics companies or were placed in a set location for consumers to pick up at a certain time. These methods were the safest and the most convenient ways for consumers to acquire their fruits and vegetables, thus boosting the total sales and income of the organizations.

Interviewed non-profit organizations did not receive any financial support from the government during the pandemic. Subsidies would mostly go to larger enterprises and governmental-affiliated organizations, according to the director of the Beijing Farmer's Market. Some individual farmers who are not government affiliated nor cooperate with bigger enterprises, were able to benefit from programs like Alibaba's 'One billion-Yuan fund' but were not direct beneficiaries of central government programs. According to China's Third National Agricultural Census, there are around 310 million people who work in China's agricultural sector, a majority of them 'scattered farmers' ("*Bulletin on Main…Census (No. 5)")*. The organizations suggested that the government could pay more attention to these farmers and release more targeted policies at a local level, as said by the director of Beijing Farmer's Market: "*You need to have a supporting market mechanism so that this farmer can connect with it when doing ecological agriculture. It's difficult now*".

# DISCUSSION

Here we present a unique comparative and empirical based study, reflecting on pandemic-related impacts and responses on and by diversified farm operations, governments and non-governmental entities in three very different contexts, revealing fewer devastating impacts than anticipated in large part because of the breadth and depth of multi-level responses across sites. We are, however, aware that this represents just part of the global picture and that many other farms and communities (see e.g., Barrett et al., 2021; Lioutas and Charatsari, 2021; Lopez-Ridaura et al., 2021), especially in the global south (see e.g., Carreras et al., 2020; Morton, 2020; Gatto and Islam, 2021; Rasul et al., 2021), saw more severe impacts and fared worse, as evidenced by a growing literature (Abiral and Atalan-Helicke, 2020; Jámbor et al., 2020; Meuwissen et al., 2021). Our study is an important contribution for understanding both the vulnerabilities and resilience of different actors within the agri-food system during the global COVID-19 crisis, with clear policy recommendations toward a more inclusive, resilient and sustainable food system for the future.

## Commonalities and Differences Across Countries; United States, Norway and China

We anticipated that—given the differences in socio-political systems, the pandemic impacts, and, especially, the policy responses, would mirror these differences, with impacts greatest in market-dominated US, and government playing a smaller role to mitigate negative impacts especially among smaller scale farmers, as compared to Norway and China where it was expected that government would step in to shore up the agri-food system. These expectations were largely met in Norway and China, where government policies to deal with curtailed transport, labor availability, lost markets, and input supply disruptions were quickly put into place to help agriculture, especially larger-scale farm enterprises and cooperatives. Surprising, however, was the extent to which the United States federal government also responded to the pandemic, albeit belatedly, with major infusions of money to support agriculture, early on making the decision to include all farms that employ workers in its signature Payroll Protection Plan, and under the Coronavirus Food Assistance Program, to fund farmers of all sizes to participate in USDA boxes (Bitker, 2020; USDA, 2020b). Thus, government policies were enormously important in all three cases in preventing more severe or long-lasting impacts on farmers, such as loss of land and equipment.

Nevertheless, the combined farmer and policy data reveal that in the three cases not all farmers benefited from the wide-ranging government programs, and that, benefits were hard to access for socially disadvantaged/non-English speaking farmers (Beatty et al., 2020; Committee on Agriculture, 2021; the US), small, diversified family farmers (Norway), and "scattered farmers" unassociated with government-backed enterprises (China). In their large survey study, the California Institute for Rural Studies revealed the disproportionate burden of COVID-19 illness and economic hardship on farmworkers of color in California (CIRS, 2021). For these farmers and farmworkers, to a significant extent the local community, non-governmental organizations, the private sector and concerned consumers stepped in to make up the difference. As such, a major finding is that across sites a constellation of actors worked in concert to help farmers and the agri-food sector weather the pandemic storm (see also Barrett et al., 2021; Meuwissen et al., 2021). In China, the major role of Alibaba's digital platform linking thousands of "scattered" farmers with excess produce to buyers throughout the country, facilitating marketing, transport and distribution was important. In Norway, direct markets and the Norwegian Farmers and Smallholders Association have been the driving force behind the fast growth of REKO-rings, digitally connecting small, diversified farmers with individual customers to make up for lost markets with restaurants and farmers markets. And in California,

non- governmental organizations such as Fresh Approach, Community Alliance for Family Farmers, and Kitchen Table Advisors have focused on supporting socially disadvantaged farmers to gain access to the information and skills needed to participate in new opportunities (e.g., e-commerce, Farmers to Families), and generating emergency funds to tide them over periods of health and economic crises (Fresh Approach, 2020; Kitchen Table Advisors, 2021).

The strong policy response to the pandemic reinforced actions taken by farmers themselves to quickly adapt to an unprecedented situation, particularly regarding access to labor. As food providers they were considered "essential", however, the freedom to work as farmer-owners did not extend to foreign or migrant farmworkers in Norway and China, respectively, and the US, was also impacted, though less so, by closures at the Mexico border. Norway adopted policies to encourage Norwegian unemployed and laid-off workers to take the place of foreign labor barred from entering the country, while in China on-site managers and other personnel went into the fields to harvest until "point to point" policies provided emergency transport for migrant workers. In California, farmers reported adopting public health measures to prevent contagion (least successful in large, compact operations such as chicken and meat processing) and relying more on trusted long-term employees. Very small farms in all three countries relied intensely on non-paid family members and neighbors during the early months of the pandemic. This was an "all hands on deck" response to prevent more illness and keep food flowing to distribution points, near and far.

Also, strongly evident across the three sites, and somewhat surprising, across the three sites was the positive impact of the pandemic in expanding consumer demand and appreciation for healthy and locally grown food. Fruit and vegetable farmers, especially in California, quickly pivoted markets for their produce from closed restaurants and wholesalers to CSA boxes, farmers markets, and on-site stores, often pulling in a variety of products from other sources to add diversity and value to the boxes. As a result of initial support from USDA subsidies through Farmers to Families and intermediary organizations such as Fresh Approach and Kitchen Table Advisors, the benefits were more widely spread to include small and organic farmers, and needy families accessing boxes through their schools, food banks and churches. In Norway, although both pandemic-related negative and positive impacts were less frequent and dramatic, farmers had similar experiences with consumer interest in "food origins" and appreciation for Norwegian products above imports, where increased demand from cooperatives and direct markets more than made up for losses in sales. Both the policy data from China and the experience of YFD Farm show how farmers, consumers, government and the private sector cooperated *via* e-commerce platforms to ensure food distribution to urban centers across the country. In the case of YFD, the farm diversified its fresh and value-added products to meet increased Kunshan County/Shanghai demand for locally grown, high quality food, even at high prices, using the ubiquitous "wechat" social media platform to sell their organic products and promote their "sustainable farming philosophy".

## Lessons Learned and Suggestions

Diversified, small and mid-size farms were able to survive and even prosper during the pandemic because of their "nimbleness" in quickly pivoting to direct marketing as demand increased. Organic farmers did especially well as healthy food during a health pandemic was at a premium in all three countries, as did cannabis and wine producers in the United States. In China, subsistence farmers linked to local seed supplies were able to plant where farmers reliant on purchased seed delayed their spring planting, linking seed access to resilience. Villages able to store their own seeds using traditional knowledge suffered less from supply chain disruptions.

The necessity of community solidarity together with institutional support for surviving a health crisis affecting the entire planet became apparent. In the United States, hard lessons were learned from the lack of solidarity at the federal level during 2020, to a significant extent made up for at local levels and by NGOs until federal policies kicked in. Institutional support in the EU and Norway was stable from the start because of the long-term social contract with a high degree of trust among citizens with their governments. In addition, active Farmers Unions, cooperatives and member organizations and networks mobilized to break farmer isolation and uncertainty during the pandemic. In China, the government pressured the private sector to mobilize its assets to support farmers and distribute food, and local governments helped smooth supply and labor disruptions, while consumer-driven food e-commerce exploded around urban centers as a result of the lockdowns. Non-governmental organizations played a minor role in China, however, groups like the Farmers Seed Network and Beijing Farmers Market had been working for a long time on behalf of sustainable small farms and this support proved crucial for some of these unorganized or "scattered" farmers during the early months of the pandemic.

The big question remains as to whether these positive lessons will endure after the pandemic is over. Below we summarize the main categories of suggestions for building a more socially, ecologically and economically resilient agri-food system post-pandemic, bringing together responses from the three sites.

### Diversify Markets

Nearly all farmers and support organizations concur that diversified crops and markets are essential for coping with shocks like the global health pandemic, and similarly with the weather shocks they face with increasing frequency. With the pandemic, markets were hit directly, so farmers able to pivot quickly to direct marketing did relatively well, and farmers with a diversity of fresh and processed products to offer sheltering-at-home consumers did even better. In addition, several farmers benefited from a break in perceived unfair competition with imported food, especially from Mexico in the case of California, and other EU countries in the case of Norway. Even YFD Farm benefited from closed regional borders adding a new source of local tourism income. Finally, farmers noted that in times of crisis, and reduced demand, more markets are needed for second quality produce. Several of the policies sustained during the pandemic address these marketing issues and could be kept in place as stable support for small and mid-size farms, especially organic farmers

that typically incur higher costs of production: (1) on-going government funding for fresh produce farmers to supply local foods to needy families year-round, with a sizeable proportion of contracts going to small and organic farmers; (2) public support for organizations, such as Fresh Approach, Norwegian Farmers' and Smallholders' Association ('Bonde og Småbrukar-laget'), and Beijing Farmers Market, among many others, as partners for connecting and aggregating produce from smaller farmers to supply a range of customers; (3) place tariffs on imported foods from countries with lower environmental, labor and food safety standards to bring up prices to cover the costs of sustainably grown foods; and (4) fund research and training through such organizations as Farmers Seed Network and CAFF to build a more diversified agri-food system.

### Retain Positive Changes in Social Norms

This global pandemic put a spotlight on peoples' essential connections to food and food providers while lockdown restrictions increased demand for locally produced foods that were perceived as safer and more readily available. Further, in all three contexts, although less so in China where e-commerce of processed foods is highly popular in urban areas, sheltering-in-place led to renewed interest in home cooking and family mealtime, particularly among affluent households. Farmers involved in direct marketing perceive this as a positive change in social norms that they hope will continue post-pandemic. In Norway, most farmers identified the need for continued food knowledge promotion amongst consumers. In California, farmers are cautiously optimistic that consumers will continue to appreciate locally grown food. Similarly, farmers and organizations referred to a positive cultural shift from the individual to the collective. One example was the partnering among farmers to add products to boxes to add more variety and value for consumers. Another was the wide sharing of information through webinars and social media on accessing personal protection equipment, new markets, and government and emergency funding in a spirit of solidarity more than competition. In Norway, communities re-kindled some of the traditional social structures of helping each other, and society supported farmers as essential workers by keeping their schools and kindergartens open during lockdown.

### Prioritize Socially Disadvantaged and Small to Midsize Farmers

Whereas this study has highlighted the resilience of many small and mid-size farmers in a global health pandemic, supported by multiple levels of institutions, the findings also indicate inequities in impacts, leaning more negative than positive for immigrant farmers (California) and "scattered" subsistence farmers (China) lacking adequate access to information, funding and alternative markets. In Norway, however, even small semi-subsistence farmers did not fare badly because of government subsidies and other sources of income. Negative impacts were minimized where NGOs and selected government programs actively targeted socially disadvantaged farmers, but only to an extent. Furthermore, farmworkers across the three sites faced serious negative impacts. As a result, one of the key recommendations for "building back better" post-pandemic is to prioritize socially disadvantaged farmers and farmworker conditions, however these may be defined locally. Specifically, in California, respondents are eager for programs to continue that included small, organic and immigrant farmers, such as Farmers to Families Round 1, and for NGOs operating on a shoestring to be recognized for their immense importance during the pandemic with more sustainable financial support. They urge provisions in the 2023 Farm Bill that prioritize new, beginning and historically disadvantaged farmers, building their capacities to weather future crises. In both California and Norway, farmers recommend relaxation of regulatory barriers, such as the Good Agricultural Practices (GAP) certification requirement on USDA boxes, which discriminate against organic practices. Further, the pandemic revealed major breakdowns in large food processing capacity, highlighting the need for more local processing, especially in meat and dairy, currently stymied by regulatory and capital requirements (Altieri and Nicholls, 2020; Hobbs, 2020; Lioutas and Charatsari, 2021).

In Norway, the progressive social contract between citizens and their government is nonetheless focused on large operations, and consumers rely heavily on cheaper imported food. Also in China, pandemic policies favored larger private and government-affiliated enterprises, with millions of "scattered" subsistence farmers and migrant workers left to fend for themselves during lockdowns. Several organizations recommended that in the future more attention be paid to these farmers with targeted policies on a local level. Village farmers that did better during the pandemic were those who lived in self-reliant communities, sharing seeds and other inputs, and marketing products among themselves, a long-term resilience strategy supported by the Farmers Seed Network.

### "Hybrid" Agri-Food System?

In addition to the country-specific lessons learned from the pandemic, this study has enabled an examination of what we can learn from each other in terms of effective responses to a major crisis. For instance, whereas the European Union/Norway and China had a unified rapid response to the pandemic to prevent its spread and worsening health and economic impacts, the United States' federal response was delayed leaving much of the heavy lifting to individual states with heavy costs in lives and economic harm. China was able to quickly mobilize its government apparatus, private sector and citizens to distribute food to urban areas throughout the country, and to favor farm products from badly hit localities such as Hubei Province, minimizing food insecurity. In the United States, high unemployment and delays in getting cash and food stamps to needy families resulted in huge lines at food banks, continuing at a more modest level into the third year of the pandemic. Norwegians prevented such impacts through continued employment guarantees and support to handle lost workers and output in the farm sector, combined with community solidarity, farmers' unions and well-functioning cooperatives. In the United States, and California in particular, despite and partially because of the federal delays, there was a spectacular non-governmental response to the

market and supply disruptions—both by farmers and support organizations, reducing harm to small commercial farms and socially disadvantaged farmers and farmworkers. These crisis-driven innovations were less apparent in Europe and China. In the end, the United States government did not let market-driven forces go unchecked, providing significant relief by the second year of the pandemic. Given these major strengths and weaknesses across three very different societies, it is interesting to contemplate building a "hybrid" crisis response structure that takes the best from each system. Indeed, this comparative study suggests a strong need for such an exercise by policymakers, NGOs and citizens across the world in their deliberations and planning for the next global crisis.

## CONCLUSIONS

This paper presents a novel assessment of impacts and adaptive responses to the COVID-19 pandemic in diversified farming systems in the United States/California, EU/Norway and China. We show commonalities for several of the adaptive responses despite very distinct socio-political systems, most importantly:

- Sharp rise in e-commerce;
- Increased direct and diversified markets to consumers;
- Changes in social norms toward collaboration and re-kindling of community traditions;
- Crucial designation of farmers and farmworkers as "essential";
- Crucial government emergency and recovery support; and
- Complementary training and logistics support by NGOs and/or the private sector to farmers where government support was lacking.

Overall, different actors responded in manifold new ways, which in concert resulted in the resilience reported above. Examples include the use of new sources of labor, new sanitary measures, innovative adaptations to shifts in consumer demand, and the expansion of food deliveries at home (Lusk and Anderson, 2020; Wieck et al., 2021), just to mention a few. How to leverage Internet-enabled food supply and distribution for enhanced food system resilience deserves further attention. A key question is how online grocery-shopping will evolve after the pandemic. Will this have ramifications on the infrastructure of the supply chain, food safety and public health? Will the large corporate e-commerce platforms and food distribution networks dominate the market and squeeze out individual farmers, or will there be a continued demand for locally and sustainably produced foods? Scaling up this study to include more farmers and support organizations spanning the whole spectrum of the food system would allow for a wider scope as well as more in-depth analysis and knowledge generation on the evolution of mechanisms and adaptive responses in the wake of disaster.

## DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Office for the Protection of Human Subjects at UC Berkeley and Duke Kunshan University, and by the Norwegian Center for Research Data (NSD). The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

IM and RM designed the overall project, wrote the grant proposal for funding, provided guidance on methods, analysis, and our collaborative process. IM, RM, KM, SW, SZ, and RC collected, analyzed, and summarized qualitative data. HW, RM, KM, SW, SZ, RC, and KF contributed to policy mapping. IM and RM led writing and revision. HW and KF contributed to writing and editing. All authors contributed to the article and approved the submitted version.

## FUNDING

RM and IM acknowledge the Peder Sather Center Research Grant 2019-2020 and the Research Council of Norway (TradMod: Grant No. 280299) for funding this work.

## ACKNOWLEDGMENTS

We thank all farmers and representatives of organizations that were willing to share their experiences and insights throughout the interview process. We thank to Linn Voldstad for conducting and transcribing interviews with Norwegian farmers and Ji Zhang, Chuhan Jiang, and Danyang Shi from Duke Kunshan University for conducting interviews at YFD Farm. We thank Alastair Iles for his constructive discussions on diversified food systems under crisis and Alicia Barraclough for helping compile the figures.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2022.887707/full#supplementary-material

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