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Authors
Diekmann, Lucy
Cortez, Summer
Marsh, Pauline
et al.

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RESEARCH ARTICLE

During COVID-19, Californians sought food security, connection and solace in their gardens

During COVID-19, many Californians gardened to bolster food security and relieve stress but struggled to access materials.

by Lucy Diekmann, Summer Cortez, Pauline Marsh, Jonathan Kingsley, Monika Egerer, Brenda Lin and Alessandro Ossola

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Abstract

Gardening offers a range of benefits, from food production to social connection to improved mental and physical health. When COVID-19 struck, interest in gardening soared, but it was unclear whether and how gardens would deliver these benefits in the midst of a global pandemic. We analyzed survey responses from 603 home and community gardeners across California, collected between June and August 2020, to assess trends in pandemic gardening. Gardeners highlighted the importance of gardens as therapeutic spaces where they could escape the stress of the pandemic, and as safe outdoor places for socializing. The study also revealed people's concerns about food supply, along with an accompanying interest in growing their own food to increase food security and self-sufficiency. The pandemic posed challenges for home gardeners, though, with 62% struggling to access gardening supplies. These findings suggest the importance of providing garden space, resources and support, especially to those populations with the least access to green space, so that gardens can serve as resources to improve community health, food security, and resiliency during future disasters.

In March 2020, the first wave of COVID-19 swept the globe, prompting full or partial lockdowns in more than 100 countries, including a statewide stay-at-home order in California. Meanwhile, another phenomenon was also garnering attention: a worldwide gardening boom (Lin et al. 2021). While the COVID-19 pandemic was widely considered unprecedented, turning to gardening during times of social, economic and environmental upheaval is not. For more than two centuries, individuals, social groups, and governments in the Global North (richer countries located primarily in North America, Europe and parts of Asia and Oceania) have used gardens for support during crises because of the multiple, overlapping benefits they provide (Cerda et al. 2022).

In the United States, "crisis gardening" traces its roots back at least as far as the depression of the 1890s, when cities such as Detroit, Philadelphia and Chicago promoted gardening vacant land as a form of economic relief for the unemployed (Bassett 1981). Globally,

Sacramento County Master Gardener volunteers harvest vegetables to donate to the local food bank. Participants in a survey of California gardeners reported that they were interested in addressing food insecurity in their communities during the COVID-19 pandemic. *Photo*: Judy McClure.

people have cultivated public and private plots of land in response to food shortages caused by wars and poverty (Milthorpe 2019). For example, during World Wars I and II, gardens were encouraged to alleviate domestic food shortages and served as important sources of resilience in both the United States and Europe (Barthel et al. 2015).

The emergence of the international community gardening movement, starting in the 1970s, coincided with growing environmental concerns, economic pressures such as rising food and gas prices, and challenges associated with migration (Lawson 2005; Malberg Dyg et al. 2020). In addition to acute and highly visible crises, people living in neighborhoods subject to disinvestment experience ongoing "crises of abandonment and discrimination" (Kato et al. 2014, 1834) and have utilized gardening to revitalize their communities and address inequities (Budowle et al. 2019; Gripper et al. 2022; White 2011). More recently, gardens have been sites for community recovery and resilience following extreme environmental events, such as Hurricanes Sandy and Maria (Chan et al. 2015; McIlvaine-Newsad et al. 2020) and the Christchurch earthquake in New Zealand (Shimpo et al. 2019).

The COVID-19 pandemic presented a new occasion to examine how gardens may contribute to resilience and recovery during crises. The pandemic provided many reasons for crisis gardening to emerge: a public health emergency, widespread unemployment, disrupted food supply chains, and soaring food insecurity. Californians experienced a massive reordering of daily life as they sheltered in place, non-essential work went remote, and schools moved online. Our research team assembled within a month of the pandemic declaration with the goal of understanding what role gardening played in people's lives during this unfolding crisis.

This paper examines the meaning Californians gave to gardening in the early months of the COVID-19 pandemic. The data presented here was gathered as part of a larger international study. However, this paper focuses solely on California; results from the full international data set appear elsewhere (Cortez et al. 2022; Egerer et al. 2022; Kingsley et al. 2022; Marsh et al. 2021). We draw on previous studies of crisis gardening to frame our research on the experience of and motivations for gardening in California during the early months of the pandemic.

The pandemic provided many reasons for crisis gardening to emerge: a public health emergency, widespread unemployment, disrupted food supply chains, and soaring food insecurity.

Crisis gardening

Studies of previous crisis gardens have identified different aspects of gardening that contribute to individual and community recovery and resilience (Chan et al. 2015; McIlvaine-Newsad et al. 2020; Milthorpe 2019; Okvat and Zautra 2014; Shimpo et al. 2019). While these garden features produce positive impacts outside of crises, gardeners can also draw on them to respond to the specific circumstances of a crisis. They include garden sites themselves and gardens' physical infrastructure; the practices involved in tending gardens; and gardens' outputs, especially food (table 1). For instance, McIlvaine-Newsad et al. (2020) found in the aftermath of Hurricane Maria that Puerto Rican families used communal gardens as a gathering place, where they shared news and information about the hurricane and could socialize and engage in healthy outdoor activities. For individuals, the practice of gardening and the associated connection to nature provide physiological and emotional benefits which can help counteract the negative impacts of a disaster or provide meaning and comfort in the midst of disaster (Okvat and Zautra 2014). Following Hurricane Sandy in New York City, gardens played important supportive roles by offering safe spaces and restorative practices that provided a sense of meaning (Chan et al. 2015).

Gardens are well known for bringing people together outside of disaster (Kingsley et al. 2020), and this feature of gardening is also thought to be

TABLE 1. Overview of garden features that contribute to individual and community resilience during crises

Garden feature	Pathways to resilience
Garden site and infrastructure	• Serve as gathering place, refuge, community hub • Distribution site for community assistance • Source of water, solar electricity, and tools • Green infrastructure can help mitigate and adapt to extreme environmental events (e.g., stormwater runoff during floods)
Food supply	• Provide food for self-sufficiency, food security, and health
Restorative practices	• Positive activities to alleviate stress, find satisfaction and meaning, provide a sense of normalcy
Community connections	• Strong social networks facilitate communication, aid and collaborative action • Social interaction • Social support • Creates capacity to act without waiting for outside assistance
Information exchange	• Maintaining and transmitting knowledge about how to produce food • Sharing news • Social learning to foster adaptive changes
Empowerment	• Gardeners cooperate to respond to community needs, organize, and participate in restoration/recovery activities

important for resilience. The process of bringing people together around gardening can help develop a sense of community and build social support (Okvat and Zautra 2014), both of which are important for taking action in response to a crisis. These communities of practice are also a means for creating, retaining and exchanging knowledge about how to produce food in a specific place, which has been called social-ecological memory (Barthel et al. 2015). This shared local environmental knowledge is important for those wishing to use gardening to avoid or mitigate crisis-induced food shortages. In Europe, urban gardening has led to enhanced social cohesion and collective action in times of need, helping to build the social and ecological capacity to avert collapses of the urban food supply (Barthel et al. 2015; Camps-Calvet et al. 2015). During disasters, gardens can also provide a place to share information about how a crisis is evolving and its local impact (Kingsley et al. 2022). Gardener social networks can be activated to support community members during a disaster, while fostering knowledge exchanges that can help people respond to post-disaster conditions.

Finally, in the wake of disasters, researchers have observed that gardening involves "multiple empowerment processes" (Okvat and Zautra 2014). It has the potential to inspire community organizing to gain access to public space, increase affordable food options, and address other community concerns (Calvet-Mir and March 2019; Chan et al. 2015; Kato et al. 2014). Researchers have called this "political gardening," which Calvet-Mir and March (2019, 107) define as "a wide variety of citizen-led practices pursuing social and urban transformation." By creating a space for community interactions, where people learn from one another and build attachment to place and each other, gardens can give rise to community-based recovery efforts as well as food-related and community-related activism (Kato et al. 2014).

When considering the role and meaning of gardens in the COVID-19 pandemic, it is important to remember that crises do not affect all people equally. The unevenness of pandemic impacts were very apparent in California and elsewhere in the United States: rates of infection, lack of access to medical care, and food insecurity were highest in low-income communities of color (van Dorn et al. 2020). Using "social recovery theory," Kato and Boules (2022) outline four key points in the trajectory of a disaster that affect how recovery unfolds differently for people and gardening projects. These are pre-disaster conditions, disaster impacts, immediate responses, and post-disaster conditions. Each of these points can magnify social inequities over the course of a disaster, "creating disparities in the extent of the long-term impact a community endures" (Kato and Boules 2022, 3). Prior to the pandemic, for instance, people living in apartments or condos may not have had space to garden, restricting their options to utilize gardening for relief or healing during the pandemic. People have different vulnerabilities to disasters, so that some groups were more exposed to the harmful effects of the pandemic and had less access to resources — including gardens — to mitigate pandemic risks and promote recovery.

Volunteers with the Master Gardener program in Santa Clara County work on growing and distributing seedlings. Researchers have found that the process of bringing people together around gardening can help develop a sense of community and build social support. *Photo*: Henry Morales.

Surveying gardeners

To measure gardening experiences and motivations during the COVID-19 pandemic, we used Qualtrics to conduct an online survey of gardeners in the Global North, primarily in the United States, Australia and Germany. The survey — which was available in English, German, Spanish and Vietnamese — was open from June to August 2020. We received 3,743 completed surveys, 603 (or 16%) of which were from California. The University of California, Davis, Institutional Review Board (Project ID: 1602882-1) and the Swinburne University of Technology Human Research Ethics Committee (Project ID: 3031) approved the study and all survey respondents gave their consent to participate. Gardeners were recruited through social media (e.g., Twitter, Instagram and Facebook) and targeted emails to community garden managers and garden groups.

In California, the primary mode of survey distribution was through UC Master Gardener Program communication channels. The UC Master Gardener Program trains community volunteers to provide the public with research-based information about home horticulture. Some of the ways Master Gardeners educate the public are by teaching workshops and classes, creating and managing demonstration gardens, online and written communications, and responding to garden questions. Historically, Master Gardener Program volunteers have been older, well-educated, white women, but programs around the United States are striving to diversify their membership and outreach. A limitation of this study is that our results are more likely to reflect the experiences of members of the UC Master Gardener network than all California gardeners. Given the timeframe for the survey, our findings represent gardeners' initial responses to the pandemic.

The survey included both open-ended and closed-ended questions about people's gardens, the value they placed on their gardens, gardening needs and challenges, and sources of support that could be helpful. In multiple-choice questions about challenges and support, participants could select more than one response option. Demographic questions included the gardener's age, gender, educational attainment, household size, and cultural or ethnic background. Because this survey was designed for an international audience, we did not use standard U.S. Census race and ethnicity categories. Instead, we asked people to self-identify and coded their responses to match U.S. Census categories where possible. In addition to racial and ethnic identity, participants also wrote in their religious, political and national identities; 19% of participants left this question blank. The survey did not include a question about garden network membership, so we cannot say how many respondents belong to the UC Master Gardener or other gardening programs.

Open-ended survey responses were analyzed qualitatively using reflexive thematic analysis techniques (Braun and Clarke 2019). To generate themes, three of the authors coded the full international data individually, shared and discussed codes, and then revisited the raw data. This iterative process was repeated until a final set of themes was confirmed. This paper presents only the California gardeners' responses to both closed-ended and open-ended questions. Closed-ended survey responses were summarized in Excel. Quotations used in the paper include a unique identifying number for each survey respondent and the location of their garden.

TABLE 2. Demographic characteristics of survey respondents

	Survey respondents	California*
Gender		
Female % (*n*)	85% (484)	50%
Mean age (range)	56.9 years (23–87 years)	
Education % (*n*)		
Bachelor's degree or higher	82% (489)	35.3%
Mean household size (range)	2.59 (1–9)	2.92
Race and ethnicity % (*n*)		
Asian	14% (63)	15.9%
Black or African-American	1% (3)	6.5%
Hispanic or Latino	11% (51)	40%
White	70% (315)	35.2%
More than one race	5% (24)	4.2%
Gardening experience in years		
First time gardening	7% (44)	
1–5 years	16% (95)	
5–10 years	11% (65)	
10+ years	60% (363)	

* Statewide data from US Census Bureau (n.d.).

Profile of gardeners

Of the 603 California gardeners who responded to our survey, most were female (82%), white (70%), held a bachelor's degree or higher (83%), and had an average age of 57 (table 2). Sixty percent of participants had gardened for more than 10 years. This demographic profile is more typical of Master Gardener programs (Takle et al. 2017) than it is of the state of California. One of the most diverse states in the United States, California is majority minority, and 44% of households speak a language other than English at home (U.S. Census n.d). However, just 1% of our surveys were completed in Spanish. While many California gardeners are low-income, immigrants or people of color (Valle 2022), their experiences of the pandemic may not be well represented by our survey results. The vast majority of responses were clustered around the state's major metropolitan areas: the Bay Area, Los Angeles, San Diego, Sacramento and Central Valley cities such as Stockton (fig. 1).

Survey respondents grew a mix of vegetables (94%), herbs (84%), fruit (71%) and ornamentals (69%). When respondents elaborated on the non-food plants they were growing, many mentioned California native plants, plants to attract pollinators and create wildlife habitat, and low-water-use plants such as succulents. A first-time gardener from San Diego (#626) mentioned she was "directly inspired by COVID" to plant "[m]edicinal herbs in my backyard garden," an interest that was shared by several others.

Most survey respondents gardened at home — either in their yard (84%) or on a balcony/patio (8%). Roughly a quarter of respondents gardened in a community garden. Nearly one-third of respondents gardened at more than one type of garden site. Other sites included UC Master Gardener demonstration gardens, school gardens, nonprofit farms, and gardens at work, hospitals and churches. Individuals' gardens ranged in size from a few containers to several acres. Among community gardeners in the study, 88% reported some change in garden rules or operating procedures as a result of the pandemic. The most frequently reported changes at community gardens were requirements for social distancing, protective gear, and more handwashing. Between June and August 2020, 16% of community garden respondents said their garden had either closed or was only open for essential maintenance.

Challenges during COVID

The most common COVID-related challenges that participating gardeners reported were feeling isolated, anxious and/or depressed (55%); difficulty getting personal protective equipment (55%); school closures and loss of child care (22%); and difficulty obtaining food (21%). While 20% of respondents wrote that their hours or wages had been reduced, more severe economic hardship such as losing one's job (7%) or struggling

to pay the rent, mortgage and utilities (3%) were less common, suggesting that our survey respondents were largely insulated from the worst economic impacts of the early pandemic. Many survey respondents reported having more time to garden (Kingsley et al. 2022), a situation which could be more common for people who are retired or are able to work from home. Service sector employees, people in the health field, and food and agricultural workers were more likely to continue to work in person, facing greater risk of exposure and potentially allowing less time for gardening. As one survey respondent explained, "Working in a dental office with half staff is taking up all my spare time so I get home too late to get in my garden" (#322, San Bernardino County).

The biggest challenge in relation to gardens was obtaining materials (e.g., seeds and compost), according to 62% of survey respondents. A loss or reduction in socializing with other gardeners was also an issue, with 28% identifying "too little interaction" as a challenge. When asked what would support gardening during the pandemic, survey respondents requested help obtaining seeds and seedlings (38%) and other materials (32%). Information on improving productivity (34%) and increasing self-sufficiency (33%) were the second and third most common requests for support. However, some respondents did not report any changes in their gardening experiences because of COVID; 23% said they had no new gardening challenges and 32% indicated they did not need additional support. The written responses of participants reporting little change in their gardening behaviors, attitudes or needs revealed that they had long valued gardens and had well-established gardening routines. This trend may be indicative of the proportion of highly experienced gardeners in the survey population. A case study of community gardeners in Edmonton, Canada, similarly found variable garden experiences during the pandemic; while the experiences were largely positive, for some they were negative and for others there was no change (Joshi and Wende 2022).

Enhancing food security

Food production was an emphasis for many gardeners in the study. Two-thirds indicated that they had planted more and were hoping to produce more in 2020. When explaining their interest in growing more of their own food, two issues came up most frequently in open-ended survey responses: (1) concern about the reliability of the food supply chain, and (2) exposure to the virus at the store. As these two themes suggest, food security is a concept with multiple dimensions (table 3). In addition to adequate food supply to meet people's needs, it also encompasses access to food, adequacy (which includes both food safety and the nutritional quality of foods), acceptability of food, and agency to make changes to the food system (Chappell 2018; Diekmann et al. 2020).

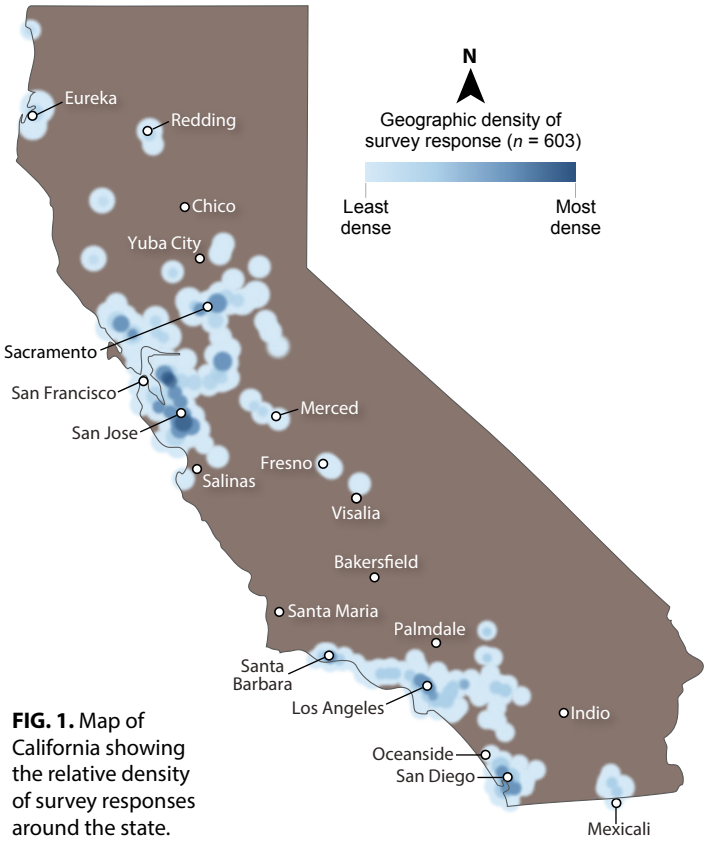

FIG. 1. Map of California showing the relative density of survey responses around the state.

In spring 2020, Californians were especially aware of the possibility of food supply chain disruptions and food shortages, having observed changes at grocery stores and a spike in food insecurity. Fifty-five percent of respondents reported limited selection at the store and 49% had encountered empty grocery store shelves. Typical comments included, "When the lockdown resulted in supply shocks in the grocery stores, the urgency of getting my garden going went way up" (#470, San Diego County). In response to their dependence on supply chains that were perceived as both fragile and outside of their control, many gardeners expressed interest in taking action to become more self-sufficient. As one gardener said, "I think COVID-19 has shed light on our dependence on grocery stores and has heightened the importance of self-grown food" (#560, Camarillo).

Another theme was concern about health risks at the grocery store. Seventy percent said they feared exposure to the virus while shopping, and 56% were concerned about worker safety. In a representative comment, one gardener wrote, "I have always looked to [my garden] for fresh produce, but COVID made me want to grow more to avoid stores" (#185, San Jose). Another gardener from San Jose explained, "I feel safer eating food I have grown at home" (#169). A nationwide survey of gardeners in Canada during the pandemic revealed a similar feeling that home-grown food was safer than store-bought (Mullins et al. 2021). While past studies have shown that gardeners are motivated

TABLE 3. Interview themes having to do with food security in pandemic gardens

Theme	Has COVID-19 changed how you think about the value of gardens for you and your community? Representative responses
Availability Supply chain concerns*	"It might provide us with food if they run short in the grocery stores." (#279, San Diego) "Absolutely the prices are skyrocketing and seeing people go without has been devastating." (#612, Stockton) "Yes. I have seen the supply chain problems and dug up more lawn to put in vegetables." (#330, Oakland)
Availability Increased food production	"I am an experienced gardener but had not grown veggies at home on this scale before." (#45, San Mateo) "There have been shortages of bagged salad mix in certain varieties. Growing micro greens fills in the gaps." (#125, Rancho Cucamonga)
Access Affordable food access	"Yes, with COVID-19 there is the need to produce food that may become scarce in the market. And with less money the value of gardens is priceless." (#93, Napa County) "My husband lost his job, so we are trying to buy less, drive less, and make our food at home." (#130, San Jose)
Adequacy Health and food safety	"For a while there it was scary to go to the grocery store. We were glad to have lettuce!" (#523, San Jose) "Because it is better for our health to have more veggies." (#616, San Jose)
Acceptability Food quality	"I am more motivated to spend time in the garden because I do find it to stress reliever also it's nice to know where my vegetables are coming from and how they were cared for." (#547, Carpinteria) "Helps reduce groceries needed, less exposure, higher nutrition, tastier, save money." (#108, San Mateo County)
Agency Self-sufficiency, empowerment	"I have tried growing more staples like dry beans because there was a shortage. I also preserved more foods this year. I feel a need to be self-sufficient in case the food supply chain is disrupted." (#456, Woodland) "Absolutely. It brought to the forefront how fragile our food supply chain is, and how important it is to be more self-sufficient (for ourselves and for mutual aid)." (#505, Oakland) "It has reminded me to be self-sufficient as much as possible and to empower others with the knowledge and opportunity to be the same." (#626, San Diego)

* While just one aspect of resilience in crisis gardens, food supply emerged as an important theme in our survey results.

by the quality (e.g., freshness and flavor) of home-grown food (Diekmann et al. 2020), this emphasis on food safety appears to be a unique feature of the early stage of the pandemic, when it was not yet clear how much risk grocery shopping posed.

Some survey respondents valued access to affordable food, either because they hoped to supplement their food budget or to have the ability to obtain fresh produce if stores closed. Few of the people who responded to our survey reported issues related to food insecurity, such as an inability to pay for food (2%, $n = 12$) or not having enough food at home (1.4%, $n = 8$). Over the same period, food insecurity rates statewide were much higher, rising to more than 25% of California households (CAFB 2021). Among the 23 respondents who indicated that they struggled with food insecurity, more were first-time gardeners (17%) and people of color (47%) than survey respondents as a whole (table 2). Otherwise, their gardening and demographic characteristics were similar to the larger survey population. While some expressed a strong motivation to increase their access to food as a direct response to pandemic hardship, food-insecure gardeners' interest in pandemic gardening was not one-dimensional. Gardeners in this group also described enjoying reconnecting with nature and the pleasure of time spent in the garden. A few other gardeners cautioned that goals of producing more food were not always attainable. As one wrote, "my garden isn't really a good value. I think it costs me more for the water and garden supplies versus the small amount of veggies I get" (#61, San Diego).

Gardening for well-being

Gardening also functioned as a restorative and therapeutic activity (Egerer et al. 2022; Marsh et al. 2021). When asked to rate the importance of various reasons for gardening, motivations associated with personal well-being scored highest. Reasons for gardening that were most often ranked as very or extremely important were connecting to nature (87%), stress relief (83%) and outdoor physical activity (76%). Describing the therapeutic aspect of gardening, a gardener (#88) from Stanislaus County wrote,

> *Being outside in my garden has been instrumental in providing me a measure of peace and happiness. Being stuck in the house makes me sad and I start to feel a sense of loss of being close to my grandchildren and to my friends. Active, sweat-producing hard work in the garden has been very therapeutic.*

Gardens also provided a space where people could spend time outdoors and feel connected to nature (Egerer et al. 2022; Marsh et al. 2021). A gardener

(#613) from Redwood City commented, "I think they're even more valuable than before, because we need ways to connect with nature in our own homes."

Connecting communities

In a time of social isolation, when most indoor activities were unavailable or considered unsafe, gardens took on new significance as a safe space for people to gather (Kingsley et al. 2022). One commenter explained, "Yes, it's increased my awareness of how important gardens are to a community and how they are a connecting factor for diverse groups. Also the value of having a safe, peaceful and healthy space to connect in" (#81, Sunnyvale). Survey respondents enjoyed supporting one another and deepening connections with others through gardening, especially by sharing seeds, seedlings and food. As a gardener (#201) from Manteca wrote, "Glad that I can give a little bit away to my neighbors and maintain connections from a distance." Similarly, a gardener (#320) from San Rafael wrote, "In addition to gardening for myself, the opportunity to share work, learning and produce with others during a time of relative isolation has been very important to me."

Exchanging information

With many people giving more time and attention to gardening, the demand for information increased. Long-term gardeners reported that their knowledge was in high demand from others who were just starting out. As one gardener (#143, Newark) wrote, "so many of my friends have counted on me to help them with first-time gardens." The Master Gardener and other garden programs reported an increased demand for information and responded early in the pandemic with a variety of online content. Both informal and formal networks appeared to be important sources of information. As one gardener from Oakland (#505) explained:

> *I am attending many virtual gardening classes that I otherwise wouldn't have had access to in person, and have connected with neighbors and other communities around food production and seed saving practices. It's been a very grounding and humbling experience; I wish I had learned more about how to produce my own food a long time ago.*

The widespread engagement with a variety of social and gardening groups to access gardening information reinforces the important role that communities of practice can play in maintaining and transmitting horticultural and ecological knowledge (Barthel et al. 2015).

Sharing fruits of their labor

To affect change through their gardens, survey participants were primarily focused on addressing food security in their communities. One prominent response to the pandemic was to share the fruits of the garden, either by giving them to friends, family, and neighbors, or by donating them to local food banks. A gardener from Palo Alto (#280) wrote, "I have . . . more time to trade fruits/veggies with neighbors and I feel good donating to food banks because I know there are a lot of hungry people." People also anticipated needing to give more away during the pandemic. A gardener (#141) from Sonoma County wrote, "I have always found value in producing for my family and friends; this year I planted more to help the neighborhood in case food is an issue in the coming months." Gardeners also sought to support others by sharing seedlings. A gardener from Pasadena (#331) wrote, "When I saw that so many people were gardening for the first time, I set up a free nursery on my front lawn. I had so many extra seedlings to give away."

A staff member from Valley Verde, an urban agriculture organization in San Jose, works with a community member to start a vegetable garden in May 2020. By creating a space where people learn from one another, gardens can give rise to community-based recovery efforts. *Photo*: Valley Verde.

Finding space to garden

For those participants (13%) who were either first-time gardeners or were returning to gardening in 2020 after taking a break, access to a place to garden was often the determining factor in their ability to start gardening during the pandemic. Many in this group were able to start gardening because they had either secured a plot at a community garden or moved to a home that had space to garden. In describing previous barriers to gardening, they mentioned community garden waitlists and apartments or condos that did not have space to garden or had restrictions on gardening. Their experiences are an important reminder that motivation to garden is not enough on its own; prospective gardeners also need space to realize their gardening goals.

Several respondents recognized that not everyone has access to a place to garden and envisioned a future in which all communities had gardening spaces. As one gardener wrote, "it gives me pause and makes me concerned that there is a racial/financial divide between those who are privileged with outdoors space to have their own gardens versus those who have not" (#563, Carpinteria). Others who managed community gardens noted that they had to turn people away because there was no space available or because they were not

Master Gardener volunteers prepare to distribute seedlings during the pandemic. In California, gardeners displayed a heightened awareness of the fragility of the food supply chain, and gardens became a good place to experiment with diversifying local food sources. *Photo*: Henry Morales.

able to operate at full capacity during the pandemic. Recognizing these limitations on access, multiple gardeners expressed a desire for greater opportunities for all, leaving comments such as, "Wouldn't it be great if everyone had a community garden" (#343, Los Angeles County) and "I wish everyone had access to a garden, now more than ever" (#553, Campbell). Those who mentioned access were more likely to be newer gardeners (52% had gardened for 5 years or fewer), people of color (42%), and slightly younger (46 years on average) than the survey population as a whole (table 2).

Resilience in a crisis

In this study, gardening had multiple positive impacts which supported individual and community resilience during the early months of the COVID-19 pandemic. For the California gardeners who responded to the survey, gardening contributed to well-being, food security, social connection, and the exchange of local knowledge, each of which can be a pathway to resilience in the face of crisis (table 1). Facing concern about food availability, safety and affordability, California gardeners provided food for themselves and others. In times of enforced isolation, they built social connections by sharing supplies and knowledge about how to garden. Information about gardening was highly valued and people sought it out from trusted organizations, experienced gardeners within their social circles, and online communities. Amid the stress of the pandemic, they found solace and satisfaction by working in the garden and spending time outdoors.

These findings are consistent with other studies demonstrating the dynamic and multifaceted benefits of gardening, not only in times of crisis (Calvet-Mir and March 2019; Shimpo et al. 2019). In fact, gardening's positive impacts may be amplified in adverse circumstances (Joshi and Wende 2022). This can be seen in our study, where many gardeners expressed a heightened, although not necessarily new, appreciation for their gardens. Gardens and gardeners are influenced by changing social, economic, political and environmental circumstances (Calvet-Mir and March 2019). In response to crisis, garden features and practices can take on new significance and urgency or can be directed to new purposes. An interest in growing one's own food for flavor and freshness might shift to a desire to increase production at home to insulate oneself from supply chain shocks during a crisis. Relaxing through gardening could take on new significance as stresses in other areas of one's life mount because of cascading challenges caused by a disaster. As one California gardener wrote, "I will consider the garden part of my emergency supply kit" (#44, city not available).

Gardens' capacity to supply food has been a recurring motivation for gardening during crises; the COVID-19 pandemic was no exception. At least two pathways to greater food security appeared to be at work in the first months of the pandemic at the individual and community level (Pourias 2015). At the individual level, increasing food production was a priority for many gardeners in California and around the world (Cerda et al. 2022), as the food system was one of the places where the pandemic's initial impacts were most apparent. The desire to grow food was also positively related to hardships experienced during the pandemic (Egerer et al. 2022), suggesting that some perceived gardening as a safety net against food insecurity (Niles et al. 2021). The riskiness of shopping was another concern for many people. Against this background, the relative safety of garden-produced food and gardens took on heightened importance. Positive impacts of food production extended beyond individual gardeners as people built community connections, exchanged information and supplies, and provided food to a wider group through gifts and donations. Gardeners reported ramping up individual production, while participating in social networks that help maintain and exchange local food production knowledge (Barthel et al. 2015). These social networks also have the potential to collectively mobilize for changes that enhance communities or local food systems; in the case of the COVID-19 pandemic, this might include encouraging lawmakers to allow farmers' markets and nurseries to remain open as essential services.

However, there are limits to gardening's ability to provide a short-term food solution following a crisis (Mullins et al. 2021). These include the time it takes from planting to harvest and the supplies and financial investment needed to start a garden from scratch. Variability in gardening skill and external challenges (e.g., pests, environmental conditions) can also affect garden output. Pourias (2015) suggests that, rather than boosting food production and saving money, the primary motivation for crisis gardening may be a lack of confidence in the current food system. In California, gardeners displayed a heightened awareness of the fragility of the food supply chain, and gardens became a good place to experiment with diversifying local food

sources and envisioning alternatives that were more environmentally and socially desirable.

For low-income or food-insecure gardeners as well as others, food production is just one of many motivations for gardening (Diekmann et al. 2020; Kortwright and Wakefield 2011). One of the findings of the emerging literature on pandemic gardening has been that gardens played an especially important social role in the early response to the pandemic (Joshi and Wende 2022; Kato and Boules 2022; Mejia et al. 2020). The possibility for safe social contact in the garden was a benefit for many gardeners and an antidote to the isolation that many experienced in the first phase of the pandemic (Joshi and Wende 2022). While many previous studies have shown the social benefits of community gardens before and after a crisis, the majority of our survey respondents gardened at home but still reported finding community in the garden.

The ability to garden and the benefits of gardening were not equally shared during the pandemic. In a study of urban agriculture in Washington, D.C., gardening was a positive experience for many community gardeners, but some gardeners with increased personal and work commitments or health concerns became less involved during the early phase of the pandemic (Kato and Boules 2022). Kato and Boules (2022) found an unequal distribution of garden benefits, so that those most negatively impacted by the pandemic also had less access to the benefits of gardening. However, in other places, during the pandemic and in other crises, gardeners from marginalized communities have benefited from gardens, where they maintained social connections, found social and emotional support, and improved well-being during a stressful time (McIlvaine-Newsad et al. 2020; Mejia et al. 2020). Gardeners from socially disadvantaged groups are not well represented in our study, so it is not possible to characterize the role that gardening played in their pandemic experience from our dataset.

As people had more time to spend gardening or turned to gardening with increased interest, study participants reported an increased desire for garden information. Experienced gardeners were being called on to answer questions and help start gardens, Master Gardeners and other gardening groups provided a wide variety of information online, and gardeners sought out information from multiple sources. The large and rapid response to this survey (~600 responses in three months) after sharing with Master Gardener communication channels shows that the Master Gardener Program has the potential to be a valuable resource for gathering and disseminating information during a crisis. In the same vein, it is important to recognize the limitations of this network's outreach potential (table 2) and to utilize other networks to complement that of the Master Gardeners, as well as to continue efforts to expand the reach of the Master Gardener Program to those who are not currently well-represented.

Long-term investment needed

California gardeners in this study engaged in activities that increased community and food system resilience during the pandemic. However, if gardens are to benefit California residents equitably, it will require long-term investment, both in securing places for people to garden and in fostering social and information networks that encourage these systems to flourish. To maximize the benefits gardeners and communities get from gardens, it is key to invest in garden spaces, infrastructure, education and social networks prior to a disaster, so that the necessary physical and social resources will be in place when the next disaster occurs (Chan et al. 2105; McIlvaine-Newsad et al. 2020; Shimpo et al. 2019).

One of the downsides of crisis gardening is that the rhetoric surrounding it has been used to justify treating gardening as a temporary use of land, and then converting garden spaces back to other uses once a crisis has passed (Vitiello 2022). Yet, land access is one of the biggest barriers to gardening, especially in urban environments (Horst et al. 2017). Therefore, retaining existing gardens and also creating access to more gardening space is important to ensuring that gardens are available in a crisis, especially to those who are most negatively impacted. In addition to creating more space for home and community gardeners, investing in garden infrastructure could also encourage garden preparedness for future disasters by helping offset garden start-up costs (e.g., water, equipment), and by creating infrastructure (e.g., water storage, solar energy generation, bioswales) that can be a community resource in times of crisis.

In the United States, "crisis gardening" traces its roots back at least as far as the depression of the 1890s, when cities such as Detroit, Philadelphia and Chicago promoted gardening vacant land as a form of economic relief for the unemployed.

Support for the social infrastructure of gardens is important. This might include providing spaces and activities designed to facilitate social interaction and community building. It is also important to provide support for staff to coordinate garden activities and offer garden education. During the pandemic, volunteers, staff and community organizers around the country took on additional work to keep gardening initiatives running and to help them adapt to COVID-related needs. However, places with shortages in staffing, volunteers or resources found it more difficult to respond to community members' needs during COVID (Joshi and Wende 2022; Kato and Boules 2022).

Home and community gardens offered multiple pathways to increase individual and community resilience during the pandemic. To ensure that these benefits are available and more widespread in future

crises, it is important to expand access to gardens and strengthen the networks of gardeners who develop, maintain and transmit gardening knowledge. Local governments, funders and other garden champions can provide resources to build capacity and support the human capital needed for gardens to flourish during future crises. CA

L. Diekmann is Urban Agriculture and Food Systems Advisor, UC Cooperative Extension (UCCE) Santa Clara and San Mateo counties; S. Cortez is Staff Research Associate, UCCE Santa Clara County; P. Marsh is Senior Lecturer in Dementia Studies, University of Tasmania, Hobart, Australia; J. Kingsley is Senior Lecturer in Health Promotion, Swinburne University of Technology, Hawthorn, Australia; M. Egerer is Professor in Urban Productive Ecosystems, Technical University of Munich, Freising, Germany; B. Lin is Principal Research Scientist, Commonwealth Science and Industrial Research Organisation (CSIRO), Brisbane, Australia; A. Ossola is Professor in Urban Science, UC Davis.

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