

# Farming and Ranching through Wildfire:

## Producers' Critical Role in Fire Risk Management and Emergency Response

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### **Abstract:**

Wildfires increasingly threaten California's agricultural sector, posing serious risks to farming, ranching, and food systems. We conducted a survey of 505 California farmers and ranchers affected by wildfires between 2017 and 2023. Main findings show that wildfires' impacts on producers are extensive and range from mild to catastrophic, with both short and long-term repercussions, regardless of their exposure level. Producers play a central role in community emergency wildfire risk response and management by reducing fuel loads, creating defensible space, and leveraging their fire management expertise for themselves and their neighbors. Many producers lack a robust financial safety net, particularly among vulnerable populations, pointing to the need to increase access to recovery resources including insurance and disaster assistance programs. We find an urgent need for policy reforms, improved support, targeted extension programs, and integrated coordination mechanisms. Producers are our overlooked allies in building widespread wildfire resilience. Enhanced collaborative efforts among producers, fire professionals, and agricultural support organizations are thus imperative to co-create and implement strategies that ensure the long-term sustainability and economic viability of California's agricultural communities.

### **Keywords:**

Wildfire Impacts, Wildfire Risk Management, Disaster Recovery, Farm and Ranch Resilience, Community-based fire management, California Wildfires

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## Introduction

Wildfires are one of the most significant threats to California's food and farming systems. That threat is far-reaching- California's agricultural production is critical not only to the state's economy, it's also fundamental in providing a great diversity of crops and livestock to our national and global food supply. Increased drought conditions coupled with over a century of fire suppression and land-use change have led to more extensive and frequent wildfires (Goss et al., 2020). The size, longevity, and intensity of wildfires is rapidly increasing, putting local and global food systems, and the California agricultural producers that steward them, at unprecedented risk.

Wildfires threaten the quality of life, safety, and livelihoods of producers. They threaten infrastructure, crops (Dillis et al., 2022; Zakowski et al., 2023), and livestock (O'Hara et al., 2021). Additionally, wildfires lead to closed markets during evacuations, power outages, smoke-related illnesses, and post-traumatic stress. In 2020, ash and toxic smoke engulfed millions of acres of farmland and rangelands across the Western United States impacting farmworkers and agricultural operations, even in regions typically considered well outside traditional wildfire danger zones. The threat of wildfires is potentially catastrophic to agricultural communities, especially those already struggling economically.

Given the immediate danger wildfires present to agricultural communities and our food system, understanding effective mitigation and recovery strategies is crucial. Our study aimed to assess: 1) The impact of wildfires on agricultural producers; 2) Producers' role in community wildfire preparedness, risk management, and response; and 3) Challenges and strategies for wildfire

recovery. By focusing on these three objectives, our study aims to provide a comprehensive understanding of the challenges faced by producers and solutions for confronting wildfires.

## **Producers Surveyed**

We administered a 34-question, cross-sectional survey to California agricultural producers impacted by wildfires between 2017 and 2023. Participants had to be owners, operators, or decision-makers of farms or ranches. To be impacted by wildfires, respondents had to have experienced: fire on or near their operations' property; a wildfire evacuation order; wildfire-induced power outages; and/or smoke, ash, or poor air quality due to wildfires. The survey had three sections: wildfire exposure and impacts, wildfire disaster response and recovery, and operation background and producer demographics (see appendix). After the survey was developed, the face and content validity was established by a panel of experts. Before distribution, the survey was pilot-tested with 18 producers selected randomly from the sampling frame.

The survey was developed on Qualtrics and distributed to a sampling frame of 19,518 producers compiled from three sources. First, we obtained contacts from DTN's FarmMarketID (FMID), as recommended by Ulrich-Schad et al. (2022). However, in California, FMID generally underrepresents ranchers and diversified, organic, and beginning producers (Joe Lopp, DTN, personal communication). To address these gaps, we thus added CCOF's list of organic farmers, Community Alliance with Family Farmers, and Farmer Campus lists of producers who participated in wildfire programs. We also distributed the survey via the California Cattlemen's Association e-newsletter and through UC Cooperative Extension county advisors.

To incentivize participation, respondents were offered a \$20 gift card and the opportunity to enter a lottery for eight \$200 prizes. The survey was open from April to August 2023. To ensure the data integrity, a rigorous cleaning process was implemented (anonymized, 2023) including removing incomplete, non-consenting, and disqualified responses; a total of 505 valid responses were retained for analysis. Since the number of producers impacted by wildfires in California has not been documented, we aimed for a sample size of over 384 survey responses to achieve a representative sample size for California's 63,134 operations (NASS, 2024), producing a 95% confidence level with a 5% margin of error (Ary et al., 2019).

Results were analyzed using descriptive statistics on Google Sheets (anonymized, 2024). Comparisons between groups were conducted using chi-square tests, with  $p$ -values calculated to determine statistical significance at a predetermined level of  $p < 0.05$ . The technical appendix includes sample size and  $p$ -values for all comparison groups. All subsequent comparisons reported are statistically significant.

### **Producer Profiles**

Of the 505 respondents across California (FIG. 1), 70% produced only crops, 13% produced only livestock and 17% produced a mix of both. In total, 440 had crops and 153 had livestock. Primary crops grown included tree fruits and nuts (41%), grapes (38%), vegetables (25%), animal feed crops (15%), and flowers (13%). Primary livestock raised included beef cattle (non-dairy) (59%), small ruminant grazers (sheep and goats) (31%), poultry (28%), and bees (12%). In total, there were 116 ranchers, or producers with cattle, sheep, or goats. A majority of producers had at least 20 years of experience (52%), and on average, sold less than \$250,000 per year (66%). Forty-three percent considered their practices to be organic or ecological, 42% were

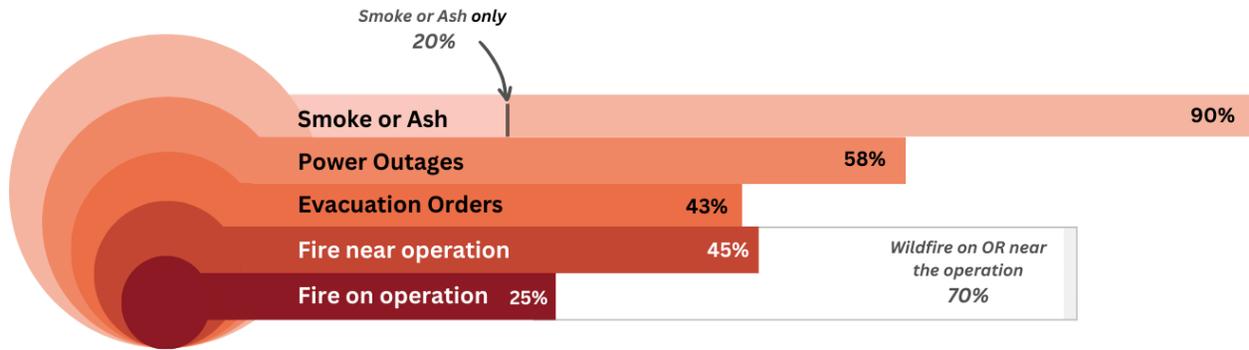
over 64 years old, 12% self-identified as limited-resource based on the USDA definition, and 10% identified as belonging to a group that has been historically subject to prejudice, henceforth referred to as socially disadvantaged.



**FIG. 1.** Map of 505 Survey respondents’ operations that were impacted by wildfires in California

### The Impacts of Wildfire Exposure

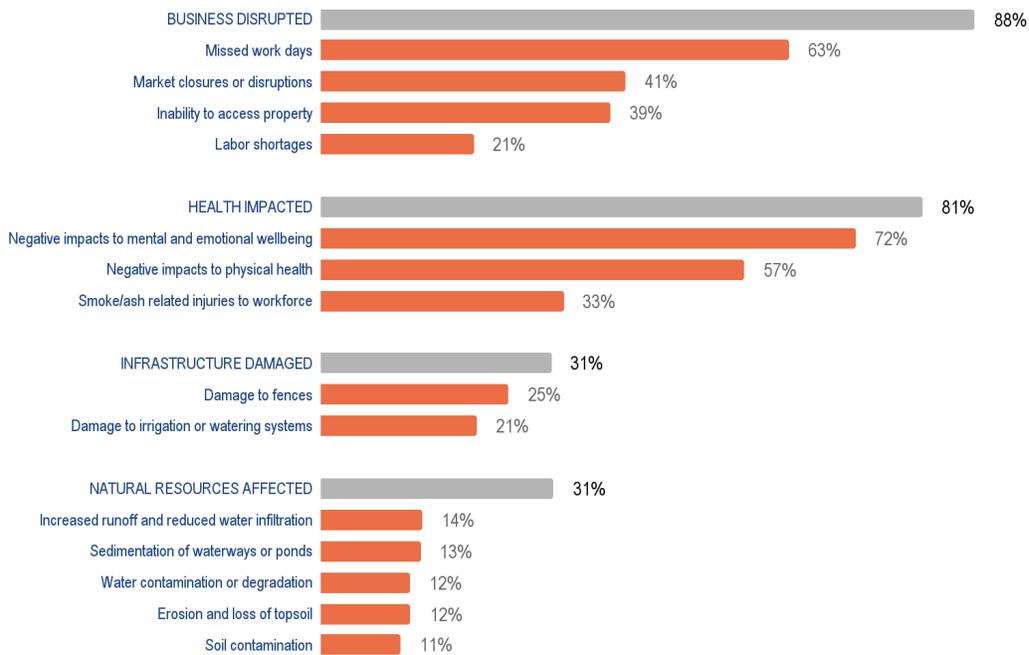
Producers faced a range of threat exposures from wildfire, each with varying degrees of severity in potential impacts (FIG. 2). Those with fire directly on or near their operation (70%) experienced the most severe impacts (FIG. 2), while those further away may only deal with less severe impacts like exposure to smoke and ash (20%). Producers experienced wildfires an average of two out of the last six years. Twenty-six percent had also experienced wildfires before 2017 and 17% before 2000.



*Note:* Darker red denotes increased severity and potential impacts

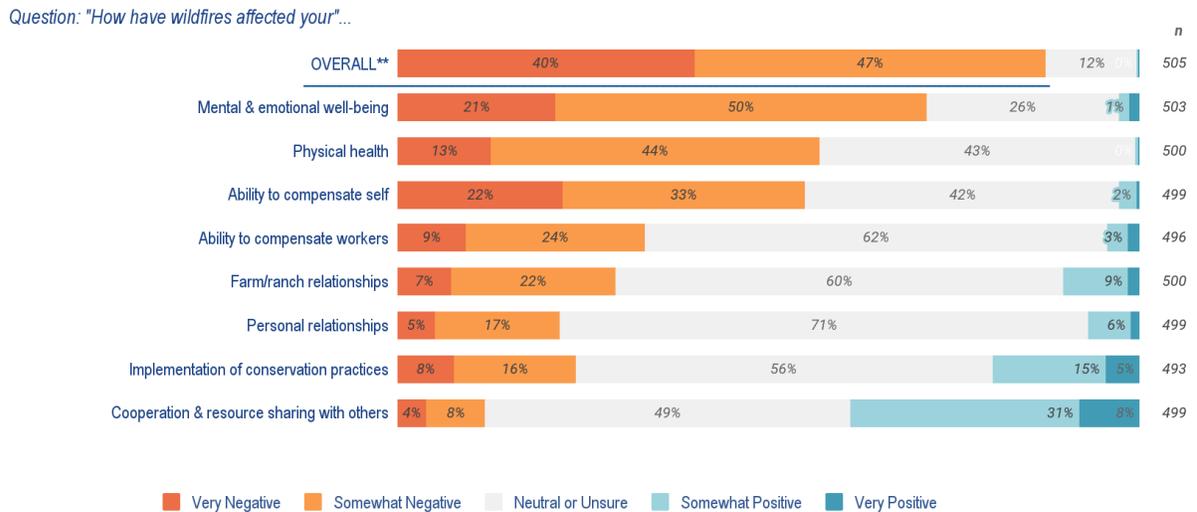
**FIG. 2.** Types of wildfire exposures faced by producers. Each type has differing levels of severity and potential impacts ( $n=505$ ).

Wildfires disrupted operations and impacted producers, regardless of exposure type. The majority of producers reported business disruptions (>88%) and human health impacts (>81%) (FIG. 3). In comparison, those with wildfire on their operation, reported greater impacts, including infrastructure damage (85%) and the inability to access their property from over a week (55%), to over a month (10%).



**FIG. 3.** Reported wildfire impacts on operations and producers, including business, health, infrastructure, and the environment ( $n=439$ ).

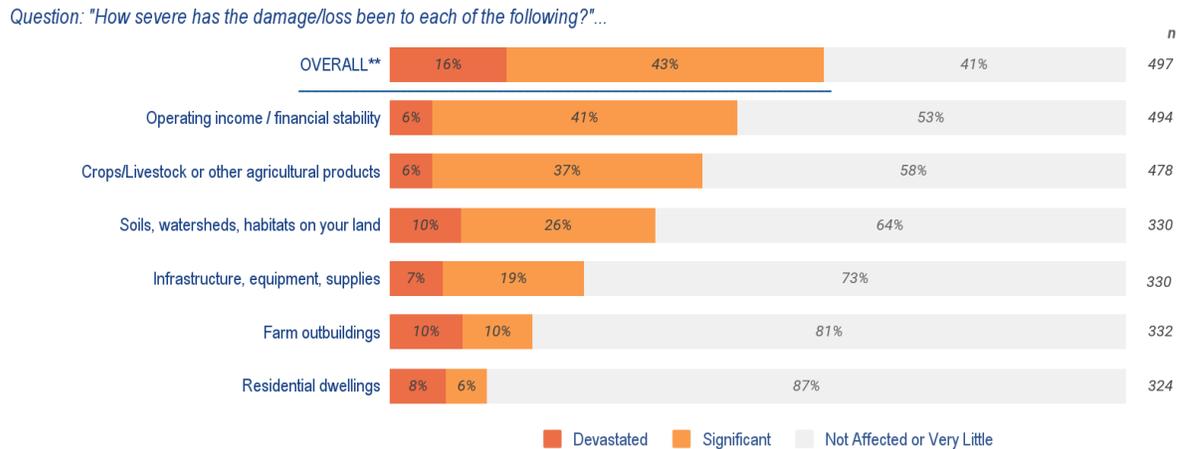
Overall, wildfires had significant negative impacts on producers (FIG. 4). Most producers (71%) reported negative impacts on their mental and emotional well-being, and a majority (57%) reported negative impacts on their physical health. Most indicated that wildfires negatively impacted their ability to compensate themselves. This was evident as 64% of producers with labor shortages ( $n=287$ ) reported they needed to work extra hours to compensate for the shortfall. Some producers endured months of relentless work, leading to exhaustion as documented by open-ended responses. One beneficial outcome of the wildfires was an increase in cooperation and resource sharing in over one-third of producers (39%), suggesting a possible rise in community solidarity and mutual aid.



\*\*Overall was determined by the proportion of respondents who selected “somewhat negative” or “very negative” in at least one of the eight respective categories in response to the question “How have wildfires affected your”..

**FIG. 4.** How wildfires affected producers’ health, relationships, cooperation, and practices

The survey revealed that 59% of producers (n = 497) experienced significant damage or losses in at least one of six categories (FIG. 5), while 16% reported devastating damage in at least one category. The extent of devastation varied depending on the type of wildfire exposure. Among those with wildfire spreading onto their operation, 87% reported significant losses, with 43% experiencing devastation. However, significant losses were still reported among those with less severe exposure types: 33% of producers who experienced power outages or smoke and 30% of those who experienced smoke or ash only noted significant losses in at least one category. Notably, two producers reported devastation by smoke and ash alone and two by power outages, with one noting they shut down and left farming due to a power outage.



\*\*Overall was determined by the number that selected “significant” or “devastated” in at least one of the six respective categories in response to the question “How severe has the damage/loss been to each of the following”..

**FIG. 5.** Severity of damages and losses due to wildfires

### Impacts on Crops and Livestock

Wildfires severely impact crops and livestock. Of the 268 farmers who reported crop losses, most were due to ash damage (46%), inability to work (35%), to harvest (34%), or to irrigate (18%). Direct fire exposure scorched, singed, and desiccated crops (17%), affecting long-term productivity, and contamination led to a loss of marketable crops (20%). Farmers specifically reported decreased crop yields (56%), reduced growth or maturation (45%), and compromised flavor or taste quality (44%). Furthermore, 20% of crop losses continued for more than one season for farmers with fire on their operation. Producers also reported some positive effects, including increased pollinator activity (30%) and flowering or fruiting (26%), though recurrent fires can negate these potential benefits (Carbone et al., 2024).

Producers with livestock ( $n=146$ ) reported negative impacts on the health and production of their animals. Overall, they experienced prolonged smoke exposure to their animals (62%), reduced

quality or loss of pasture, rangeland, or feed (50%), and the need to evacuate livestock (32%). Wildfire reduces the number of livestock a rancher can support due to forage losses that last multiple years (Davy and Dykier 2017). While evacuations can safeguard animals during wildfire events, they can also contribute to animal stress and health issues (O'Hara et al., 2021). Thus, potentially as a result of smoke, feed loss, and additional movement, 42% saw a reduction in the productivity of their livestock including (but not limited to) reduced weight gain (30%) and lower conception rates (12%). Additionally, livestock health was impacted in 27% of operations including smoke-induced pneumonia (23%), deaths (16%), and injuries that recovered (5%). Lastly, beekeepers ( $n=18$ ) reported a loss of forage (21%), loss of hives (14%), and bee death or illness (12%). These findings highlight the wide-ranging impacts of wildfires on agricultural productivity, affecting livestock, crops, and the pollinators that sustain them. Given these impacts, understanding producers' wildfire response and risk management strategies is essential.

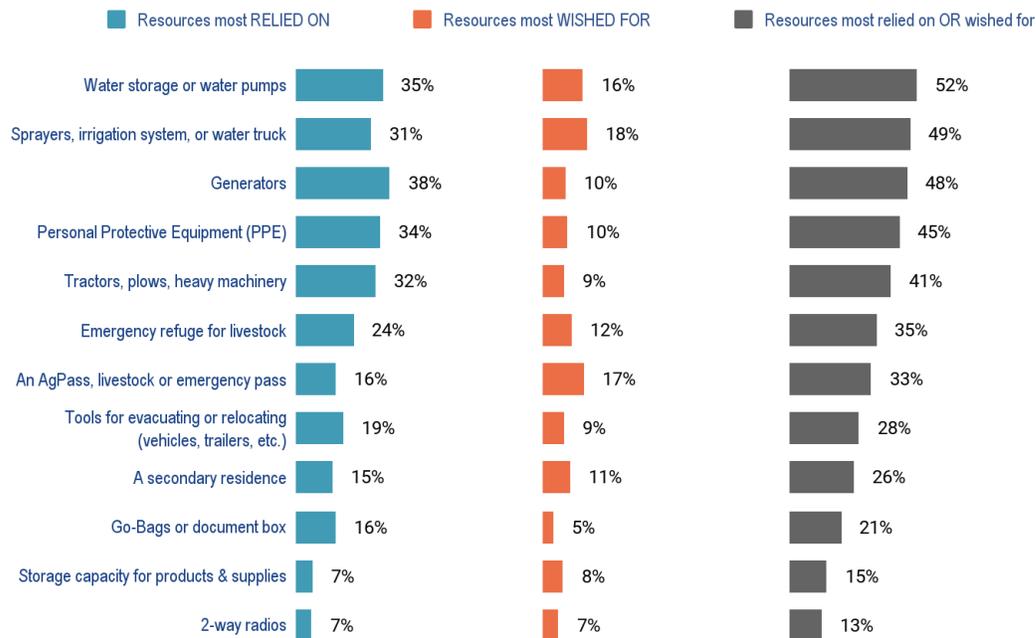
### **Frontline Response & Risk Management**

The survey highlighted that, beyond making their operations more resilient, producers play pivotal roles in supporting emergency responders and protecting their local communities. More than three-quarters of producers (77%) near wildfires provided direct support to their neighbors and emergency responders ( $n=303$ ), and this percentage was even higher (91%) for the subset of producers who experienced fire on their operation. This assistance included creating firebreaks and defending properties directly (47%); sharing local knowledge (38%) such as access routes and past fire behavior; providing water for firefighting (36%); providing evacuation support to people, animals, and crops (37%); and donating supplies (28%). Even those who only

experienced smoke and ash supported their community's emergency response efforts in large numbers (41%).

When faced with an approaching wildfire, most producers reported staying and protecting their property at least once. About two-thirds of producers (65%) sheltered-in-place or actively defended their property. Of those who evacuated their premises, 75% returned as soon as possible to assess and mitigate any damage. To minimize damage, 45% of producers had to harvest or distribute crops and relocate livestock or equipment as the fire was approaching.

Producers' resource needs and investments reflect the reality that they were responding to help their community in times of wildfire and providing support to prevent wildfires. They depend on essential resources to prepare and respond to wildfires (FIG. 6). However, significant unmet needs remain, with producers most desiring water systems (18%) and water storage (16%) as well as AgPasses or emergency passes (17%) to return to property under evacuation orders. Importantly, producers expressed the need for *more* of the resources they most relied on, especially generators, watering systems, water storage, and machinery. As a result, producers reported preparing for future wildfires by investing in off-grid systems such as generators and solar panels (48%), water storage (44%), evacuation planning (31%), crew training (19%), and community preparedness group participation (19%). These preparedness measures help ensure human safety and livestock care during wildfires and that operations can continue or quickly resume after a wildfire event.



**FIG. 6.** Resources producers most relied on and wished for during the wildfire ( $n=440$ )

### Fuel Load Managers

Beyond responding to the immediate threats of wildfires, producers used a range of strategies to mitigate wildfire risks on their own and neighboring properties. A major focus among surveyed producers was creating defensible space around buildings and infrastructure, an action taken by 72% of producers. This included enhancing building resistance to wildfires (24%) and establishing firebreaks (24%). Fuel load management was also a common strategy, with 68% of producers actively managing fuel loads through forest thinning (45%), grazing (29%), or prescribed burning (17%). Notably, many producers expressed concern about fuel loads on neighboring private properties, pointing to the collective action and cross-boundary cooperation needed among rural landowners to effectively reduce wildfire risks.

### Experienced Fire Managers

Further enhancing their ability to manage risks, fire management experience was common among producers. Seventy-two percent of 488 reported having some form of fire management experience, including practicing pile burning (61%) and prescribed burning (22%). Additionally, 21% had received fire suppression training, and 10% had experience working as firefighters. This experience can equip producers with valuable skills to effectively handle wildfire threats and contribute to community-wide response efforts. Livestock producers, in particular, are at the forefront of these efforts.

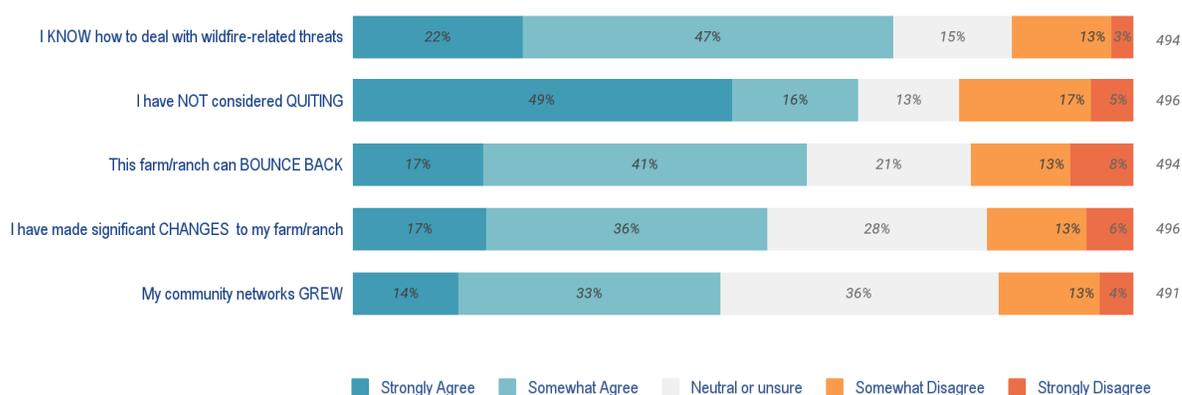
### **Ranchers Lead the Way**

Ranchers were statistically significantly more likely to participate in wildfire risk management and response than other producers. Small-ruminant ranchers of sheep and goats were particularly engaged in fuel load management, with 94% using methods such as grazing (77%), thinning (72%), or beneficial burning (34%). Historically, when regulations allowed in the 1950s, California ranchers burned more than 200,000 acres annually (Biswell, 1999). Today, we find that in our study 81% of all livestock producers and 95% of multispecies ranchers, in particular, have experience with fire management. Notably, cattle ranchers stood out, with 17% indicating that they are firefighters, more than any other type of producer. Moreover, producers with livestock were most likely to assist neighbors and emergency responders during wildfires, with ranchers providing the most assistance (89%), considerably higher than all other producers (65%). Nonetheless, the substantial role of all producers in wildfire risk management underlines the need to evaluate their sources of recovery and resilience.

## Bouncing Back: Recovery & Resilience

Producers are committed to recovering from wildfires despite significant challenges. Adaptation efforts are widespread, with 53% making significant changes to reduce wildfire risks (FIG. 7). Additionally, 47% reported strengthened community networks, echoing the importance of community support and cooperation in overcoming wildfire impacts. Despite the hurdles, many producers remain optimistic, with 69% confident about managing wildfire threats and only 21% believing they may not recover. However, over 35% of each group—socially disadvantaged, limited-resource, and immigrant producers—believed they might not recover, a statistically significant difference.

Question: "To what extent do you agree or disagree with the statements below? "



**FIG. 7.** Producers' confidence and adaptation levels in response to wildfire impacts.

For the most part, surveyed producers were dedicated to continuing; 65% have not contemplated quitting due to the wildfire impacts they experienced. However, producers who quit are underrepresented in our study and other studies have shown that wildfires can profoundly impact the continuity of farming operations (Petersen-Rockney, 2022). While more research is needed to quantify the number of agricultural operations lost to wildfires, our research shows that 65%

( $n=13$ ) of those who stopped farming/ranching did so at least in part due to wildfires.

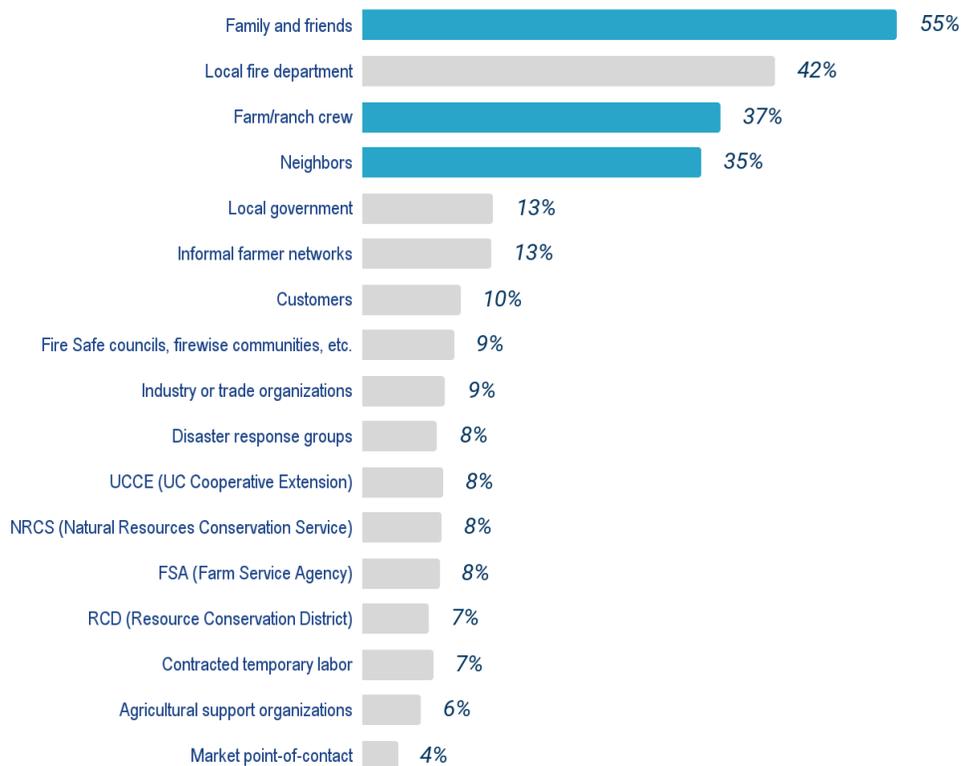
Additionally, 22% of those still active have considered quitting, and 34% knew someone who had quit due to wildfire. Limited-resource, first-generation, and beginning producers were up to three times more likely to consider quitting than their counterparts, a statistically significant difference. To aid continuity, strong relationships, and institutional support are critical.

### **Relationships: Base of Resilience**

Support from personal and institutional relationships was vital during and after the wildfire. Personal relationships, particularly with family, friends, farm and ranch crew, and neighbors, were most helpful to producers (FIG. 8). This reiterates the role of community and social networks in recovery efforts.

Institutional support also played a role in aiding producers during wildfire recovery. Local fire departments and Cal Fire were highly regarded for their assistance and nearly 20% of producers identified at least one agricultural support agency, such as Cooperative Extension (UCCE), USDA Natural Resources Conservation Service (NRCS), USDA Farm Service Agency (FSA), or Resource Conservation Districts (RCD), as most helpful. However, no single agency stood out as a significant source of wildfire assistance among producers. Those with wildfires on their operation were nearly twice as likely to use FSA, NRCS, or RCD support than other producers. Support from agricultural agencies was nearly twice as likely for experienced producers and 1.4 times more likely for multigenerational producers than for their beginner and first-generation counterparts, suggesting the importance of long-term relationships with agencies (Munden-Dixon et al., 2018). In contrast, direct market producers were more likely to depend on customers, informal farmer networks, and fire-safe councils and less likely to depend on the

FSA, which tended to support producers with intermediated markets. Similarly, limited resource producers were more likely to rely on friends and family. The reliance on these relationships for recovery points to gaps in institutional support and leads us to examine gaps in their financial safety net.

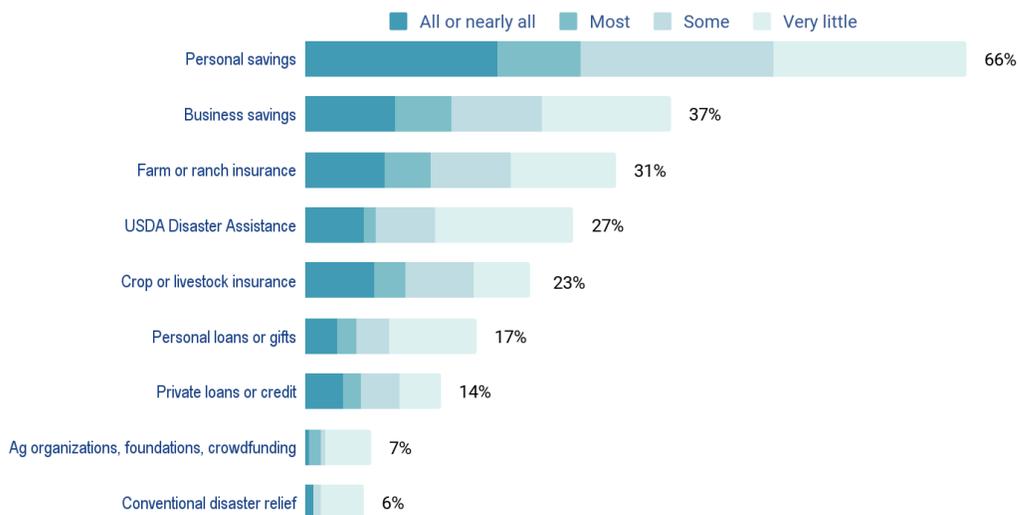


**FIG. 8.** Individuals and organizations identified by producers as most helpful to the farm or ranch during and after the wildfire. ( $n=470$ ).

### A Limited Safety Net

As a whole, producers relied on various financial recovery sources, mostly leaning on personal savings (FIG. 9). Among 252 producers with significant losses (FIG. 5), one-third relied on one source, another third on 2-4 sources, and the rest on more than five. No single source covered more than half the losses for most producers (Table 1). Despite overall low utilization (FIG 9), crop/livestock insurance often provided higher loss coverage than other non-savings sources.

Question: "How much of your total losses were covered by each financial source?"



**FIG. 9.** Financial recovery sources utilized by producers significantly impacted by wildfires ( $n=252$ ).

Financial Recovery Source	Coverage		n
	All or nearly all (80-100%)	More than half (50%-100%)	
Business savings	13%	31%	91
Crop or livestock insurance	9%	28%	54
Personal savings	13%	27%	158
Farm or ranch insurance	7%	26%	72
Ag organizations, foundations, crowdfunding	6%	24%	17
Private loans or credit	0%	18%	33
Personal loans or gifts	0%	14%	42
Conventional disaster relief	7%	7%	14
USDA Disaster Assistance	0%	6%	65

**Table 1.** Percentage of producers reporting coverage of significant losses by financial recovery source.

Reliance on insurance among producers was notably limited. Sixty percent of producers with significant losses did not use federal crop/livestock insurance or private farm/ranch insurance.

The reasons for limited insurance usage included not having federally subsidized crop/livestock insurance (62%) or private farm/ranch insurance (32%), decisions to not submit claims (29%), and types of damage not being covered (21%). Among those without crop/livestock insurance, 45% indicated high costs, 23% reported unavailability for their commodities, 15% indicated a lack of interest, and 15% lack of awareness.

Similarly, USDA disaster assistance programs, including those under FSA, NRCS, USDA Risk Management Agency (RMA), and USDA Rural Development (USDA RD), were less relied on, with 73% of producers with significant losses not utilizing these programs. The primary reasons cited for low utilization were lack of awareness (42%), ineligibility (40%), and cumbersome application processes (23%).

Several groups, including socially disadvantaged, beginning, limited-resource, direct market, and first-generation producers were statistically significantly less likely to use insurance or disaster assistance programs compared to all producers. A similar trend, though less pronounced, was observed among organic or ecological farmers, those with annual sales under \$250,000, or those managing less than 50 acres.

### **Assistance is Urgently Needed**

Agricultural producers play a critical role in wildfire risk management and response. Their efforts in reducing fuel loads, creating defensible space, and applying fire management expertise are essential for mitigating wildfire impacts on their operations, rural communities, and California as a whole. However, wildfires have extensive and potentially devastating effects on producers, both short and long-term. Immediate disruptions include crop and livestock losses, lack of property access, operational challenges, injuries, and stress. Long-term consequences involve trauma, infrastructure damage, loss of perennial crops and forage, and degradation of essential natural resources. These impacts are particularly severe for operations built over a lifetime or across generations, and shedding light on these hidden impacts reveals the true costs of farming and ranching through wildfire seasons and highlights where support is most needed. Producers often rely on personal savings and rely less upon agricultural support agencies, insurance, and disaster assistance programs to recover from wildfire impacts. This reliance raises sustainability concerns for all producers, and particularly for socially disadvantaged, limited-resource, and beginning producers. This situation is alarming given the central roles producers play in managing fuel loads, creating defensible space, and supporting disaster response efforts.

Our study's findings underscore the urgent need for policy reforms and initiatives to support all California producers and ensure equitable access to recovery resources amidst increasing wildfire threats. Government intervention is crucial to better integrate producers into emergency response efforts and distribute support resources throughout the community. Without such support, we risk losing producers vital to our local food systems. The agricultural community is often underrepresented in the state wildfire task force, and we must truly bring all players to the table to recognize and support producers' vital roles in fire management and response.

Policymakers must invest in local and regional wildfire resilience coordinators, support wildfire mitigation project planning, improve regulatory efficiency for resilience practices, and enhance cost-sharing for prescribed grazing (CalCAN, 2023). Effective wildfire risk management in agriculture demands a multifaceted approach, incorporating better outreach and education for existing recovery programs, enhanced flexibility and usability of insurance and assistance programs, and greater technical support for navigating these programs. Policymakers and fire professionals must recognize, support, and expand existing farmer-and-rancher-led wildfire solutions, agricultural community networks, and local support systems to strengthen wildfire resilience and recovery.

One thing is certain - California faces a future that includes fire. By understanding the myriad ways that producers are harmed and how they help neighbors recover, we can begin to tangibly value them as pivotal parts of the solution and as overlooked allies in building broadscale wildfire resilience. Policymakers, fire professionals, agricultural producers, and support organizations must work together to co-develop and implement wildfire mitigation strategies to safeguard the long-term sustainability and economic viability of agricultural communities throughout California and beyond.

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