Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Farmer perceptions of climate, adaptation, and management of farmworker risk in California

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Submitted June 23, 2021 / Revised September 13 and November 23, 2021 / Accepted November 24, 2021 / Published online March 10, 2022

Citation: Wadsworth, G., Riden, H. E., & Pinkerton, K. E. (2022). Farmer perceptions of climate, adaptation, and management of farmworker risk in California. *Journal of Agriculture, Food Systems, and Community Development, 11*(2), 179–198. https://doi.org/10.5304/jafscd.2022.112.015

Abstract

Adaptation across systems[1] in agriculture is essential for sustainability under ongoing climate change. Farmers and agricultural employers implement changes in their work (e.g., mechanization, changing crops, managing workspaces) in ways that may directly impact worker health. In this study, semi-structured interviews were conducted with farmers and farm labor contractors in three agriculturally productive regions of California. We investigated (1) how farmers view changing climate in terms of worker safety and health; (2) how they are currently adapting to long-term weather patterns; (3) how their choices of management practices might impact their workers; (4) how they view their responsibility for their workers; and (5) what their

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Funding Disclosure
This project was supported by grants from the Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (CDC-NIOSH) Cooperative Agreement number U54 OH010969 and grant number UO1 OH007550; Agriculture and Climate Change Impacts on Workers' Health and Safety grant number NIOSH U01 OH010969; and The Western Center for Agricultural Health and Safety, grant number U54 OH007550.

Declaration of Interest Statement
No potential conflict of interest to report.

[1] We use the term "agricultural system" to refer to any system that produces livestock and crops, including the social, political, and economic components of that system.

overall observations are concerning environmental changes. Many employers made a clear distinction between weather and climate but not all agreed on whether they were experiencing climate change. Heat was notably the biggest climate hazard farmers identified. Most of the employers interviewed were proud of their longevity and ability to adapt to changing conditions in the field; however, they did not have established emergency procedures. Despite regulations that put the onus on employers, most participants believed that workers needed to take individual responsibility to keep themselves safe in the workplace. This research is one step in an ongoing research process designed to address the impacts of health and safety for agricultural workers in the context of climate change.

Keywords
Agriculture, Climate Change, Farmworker Health, Extreme Weather

Introduction

Background

In 1938, the U.S. implemented the Fair Labor Standards Act. However, this act and the included labor standards exempted agricultural employers, resulting in "agricultural exceptionalism."[2] As a result of this exclusion of agricultural workers from labor standards, agricultural employers have greater freedom to manage their employees than employers in other industries (Irfan, 2020). This has contributed to generally lower wages, fewer workplace protections, and a high annual number of fatal and non-fatal injuries (American Public Health Association [APHA], 2011).

California, ranked first in the United States for agricultural production, generated over US$50 billion in cash receipts in 2018 (California Department of Food and Agriculture, 2019). California's agriculture focuses on specialty crops that rely heavily on hand labor. Historically, much of California's success could be attributed to the disadvantage of workers. Yet, in recent years, California has striven to bring state laws for farmworkers into accord with the broader Fair Labor Standards Act[3] against much industry opposition (Getz et al., 2008). The state has successfully passed laws protecting farmworkers from abusive employers and health and safety risks.

In 1975, California farmworkers were allowed to organize as a result of the grape strikes 10 years earlier (Garcia, 2013). This movement led by farmworker advocates eventually led to an overtime rule enacted to limit regular pay for farmworkers to 10 hours a day or 60 hours a week in 1976. In 2005, the first legislation on worker safety under high outdoor temperatures was passed. This policy was designed, along with an aggressive campaign, to target farmworkers in the state who were dying at high rates due to heat-related illness. In 2016, legislation was passed to raise the minimum wage to US$15, phase in overtime pay, and reduce the standard workday for farmworkers to comply with the state standard for all other workers (Agricultural Workers: Wages, Hours, and Working Conditions, 2015–2016). Alongside this legislation, additional laws were developed to protect vulnerable outdoor workers.

Extreme weather events caused by a warming climate will result in dramatic changes over the next 50 years, including increases in the number and intensity of heatwaves, longer wildfire seasons with more intense fires, and extreme weather conditions leading to flooding and drought (Tippett, 2018). Climate change has the potential to seriously affect agricultural workers in California; in fact, they may already be experiencing consequences. Increased risk to workers for heat-related illness is just one component of a changing climate. It is anticipated that rising temperatures may also increase exposure to hazardous chemicals in the field that have unfavorable impacts on farmworker health (Levy & Roelofs, 2019). As temperatures continue to increase and heatwaves persist longer, scientists predict that the distribution of weeds,

[2] Agricultural exceptionalism—a current term in the political science literature—holds that the farming industry is different from most economic sectors in modern societies, contributing to broader national interests and goals, and warranting extensive state intervention.

[3] https://www.dir.ca.gov/dlse/

insects, and plant diseases will change, potentially introducing new pathogens. These new pathogens could subsequently alter the levels and types of pesticides to which workers are exposed (Boxall et al., 2009). Each day farmworkers are exposed to conditions—for long durations and at high intensities—that most other workers do not experience. While farmworkers cannot avoid these conditions at work, they face the additional challenge of recovering from them due to their low socioeconomic status and substandard housing conditions (Ramos et al., 2016).

Since changing climate poses risks to workers, employers need to consider both adaptations to the changing climate and potential rescue measures in the case of extreme events. Conditions such as increasing wildfires will decrease air quality and directly risk workers in wildfire-prone areas (Bedsworth et al., 2018; Riden et al., 2020). Research is beginning to address how changing weather patterns will impact human health in general. Still, there is little information on how it will specifically affect the health and safety of farmers, farmworkers, and agricultural communities. California agricultural workers in field labor are exposed daily to the elements and experience firsthand the effects of a changing climate.

Objective

This research was designed to examine the perspectives of farm employers in three agriculturally diverse regions of California, with a focus on climate change and worker risk. The overall aim of the research project is to address possible impacts on the health and safety of workers by developing informational materials for both employers and workers on risks associated with climate change. Moreover, the objective of this work was to gain a more nuanced understanding of how farmers view changing climate and how climate change will impact their management practices, including labor.

Therefore, we gathered information on how employers view the effects of climate change on the health and safety of their workers, what employers are doing to address extreme weather events and respond to risks faced by their field crews, and how employers view their role in adapting to risk and mitigating it for their workers.

Our data show (1) what farmers' overall observations are concerning environmental changes, (2) how farmers view changing climate in terms of worker safety and health, (3) how they are currently adapting to long term weather patterns, (4) how their choices of management practices might impact their workers, and (5) how they view their responsibility for their workers. This research represents one of the first steps to address impacts for the health and safety of agricultural workers in the context of climate change.

Materials and Methods

Study Area and Selection of Interviewees

As part of a larger ongoing research project entitled "Agriculture and Climate Change Impacts on Workers' Health and Safety," interviews were conducted in 2018 in the Fresno, Salinas, Imperial, and Coachella regions of California, as described by Riden et al. (2020). (See Figure 1 for the location of the study areas and Table 1 for the workforce population in each region.) These regions were selected because they all have ample production of specialty products reliant on hand labor. For example, in Monterey County (including the Salinas Valley), it is estimated that 50–60% of the cost of strawberry production is labor (Martin, 2020). We also collected historical information from employers on recent weather-related experiences for our selected regions, focusing on heat and drought, poor air quality and wildfires, and extreme rain events and flooding. Institutional review board approval was received for this study.[4]

The California Institute for Rural Studies (CIRS) developed a list of over 50 potential interviewees based on more than 40 years of prior research and established connections in agricultural areas, as well as information gathered from farm-

[4] Approved July 28, 2017; IRB Registration Numbers IRB00008463, IRB00003657, IRB00004920, IRB00001035, and IRB00006075. IRB by IntegReview, 3815 S. Capital of Texas Hwy, Suite 320; Austin, TX 78704 USA; +1-512-326-3001; http://www.integreview.com

based organizations. Individuals on the list of potential interviewees were screened for eligibility as described by Riden et al. (2020). The list was culled to 30 potential participants, and 16 agreed to participate. Agricultural employers, including direct-hire growers and farm labor contractors, were eligible for interviews. Throughout this paper, we will refer to agricultural employers as growers (only farm owner-operators who hire crews directly) or employers (direct-hire and farm labor contractors).

Interviews

This study was completed through semi-structured interviews with farm employers—both owner-operators and farm labor contractors (Appendix A). There was a wide range of types and sizes of employers reflecting the diversity of California agricultural employers (see Figure 2). Based on employer responses, we predicted the issues that the agricultural workforce may or will face as employers work to mitigate and adapt to climate change.

In our interviews, we asked employers about their knowledge, experiences, and perceptions related to climate change. We also asked employers about their specific adaptations to changes in long-term weather patterns, including how these weather patterns affect their labor management.

Our interview guide (Appendix A) was organized by specific weather and climate topics. It consisted of open-ended but targeted questions on heat impacts and responses, air quality impacts and responses, and rain and flooding impacts and responses. The questions were designed to better understand which factors most impact employers' choices related to labor management and worker safety. With a comprehensive understanding of these factors, it is hoped that the collected data can develop future strategies and policies needed to protect the health and safety of agricultural workers in California.

Telephone interviews were conducted with 16 growers: six in Fresno County, four in the Imperial/Coachella Valleys, and six in the Salinas Valley. One primary interviewer was supported by two other experienced interviewers. Interviews ranged in length from 30 to 90 minutes, with most lasting no more than 45 minutes. Since participants preferred that interviews not be recorded, detailed notes were taken during interviews, read back to the interviewees for accuracy before closing the interviews, and reviewed by the CIRS project director as described in our previous publication (Riden et al., 2020).

Because the sample size is relatively small, there was some concern that respondents could potentially be identified. Therefore, the gender of growers is alternated between male and female to increase participants' confidentiality. In addition, all employers in the Imperial/Coachella Valleys are referred to as "Imperial" with regard to their quotations.

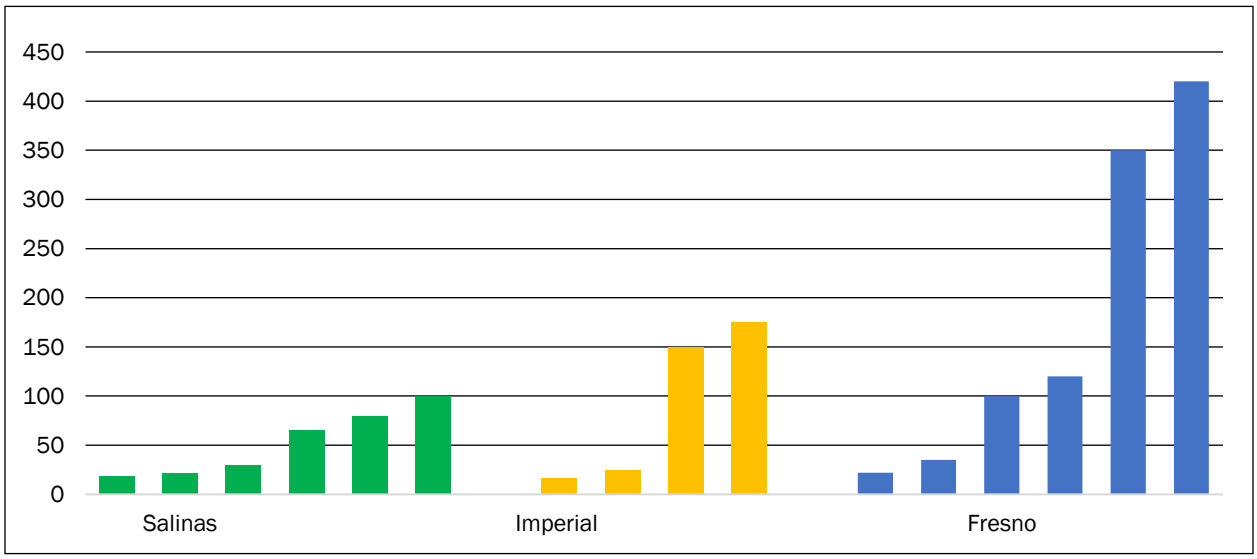
Figure 1. Map of the Study Area

Table 1. Farm Labor Workforce Estimates in Selected Counties, 2017

County	Farmworker population estimate
Riverside*	12,600
Imperial*	11,700
Monterey **	52,500
Fresno	46,500

* These counties include the Imperial and Coachella Valleys
** This county includes the Salinas Valley
Source: Employment estimates from California Employment Development Department (2018).

Figure 2. Crew Size by Region in This Study



Analyses

Prior to analysis, all personal identifying information was removed from the interviewer's notes, and participant codes were assigned. Analysis began with a method called "Qualitative Description." The researchers examined the interviews in a non-theoretical way, allowing for flexibility in creating a theory or framework (Neergard et al., 2009; Sandelowski, 2000; Sandelowski, 2009). The goal of using qualitative description is to provide a clear and straightforward account of responses without bias. It is not designed to develop dense descriptions, generate theories of behavior or decision-making, or interpret hidden meanings in interviews. While it allows for analysis of emerging themes, both the analytical process and data representation adhere to the data. The process of analysis is described below.

- All interview notes were first thoroughly analyzed for content. This type of analysis is dynamic and oriented to summarizing information in the qualitative data (Altheide, 1987; Morgan, 1993). Interview notes were open-coded and analyzed using Atlas.Ti qualitative analysis software, allowing for the identification of closely related codes and the development of networks of these related codes. Code categories were based on the structure of the interview guide and were grouped according to the topics investigated: heat, rain, and air quality.
- More in-depth coding was determined by trends that developed from the interview notes. Themes emerged from the initial broad coding categories, allowing for network development that led to conclusions about interactions among concepts introduced by the participants and coded by the analyst. Some of the themes that emerged were related to pride, adaptation, worker behavior, the future, and climate vs. weather.
- Atlas.Ti software allows the analyst to view related topics, codes, notes, and quotations and how they are related, developing networks of related themes. This enables the analyst to graphically see relationships among themes and helps the analyst delve into these relationships.[5]

Results

We have categorized our results into five broad categories: farmers' observations on environmental

[5] https://atlasti.com/2020/12/11/visualizingrelationshipswithnetworks/

changes, how farmers view the changing climate and its relationship to worker safety and health, how individual management practices may impact workers, how farmers are adapting to long-term weather patterns, and employer perception of worker responsibility and behavior. Each of these is presented below.

Farmer Observations on Environmental Changes

Climate vs. Weather

There was a clear distinction for many farmers between weather and climate. Most discussed long-term changes in weather patterns, yet only four specifically related these to climate change. One of these four stated that he had no concerns for his workers' health and safety due to extreme weather *"because God controls the weather and he's going to make it what it is, and I don't see change of climate making any significant changes in our weather."*

He further stated that a cooling climate trend was not related to human activity but God. Some of the farmers discussed records of weather and planting or harvest times that they had going back more than 50 years.

Still, when relating weather observations over time, farmers began by referencing their most recent year of experience. One interviewee shared that the previous winter was longer with more rain, while another stated that the winters recently had been drier and very hot. These observations were dependent on the region.

> We've had some very dry, hot winters. In table grapes, 20–30% lighter crops. This year was horrible, terrible, I want to cry. From 26,000 boxes down to 15,000 boxes. 90–100% of one crop I lost during the 112–114 degree heat-wave during the spring. That's never happened! (Fresno #5)

> Now the [drought] conversation is over all of a sudden, but the effects aren't. If it's happened once, it's going to happen again, probably multiple times. If I look forward, I have to look forward to [a new] commodity, one that is drought tolerant. For a grower, these heat waves coming in at all the wrong times—not the summer when you are expecting it. Three years ago, I was irrigating in December; I've never done that. Irrigating on a dormant plant! My vines were dying out in the winter. (Imperial #1)

The conversations around climate change itself were varied. As stated above, a few employers acknowledged that weather trends they perceived were related to climate change, but most stated that weather is always unpredictable. A few bemoaned the unpredictability of the weather from year to year but noted that their harvest window always happened about the same week every year. The difference in perspective is notable in the quotes below.

> Water is a big part of our system, we haven't experienced water shortages. A lot of what they're talking about [in the Central Valley] is climate change. Realistically, a coastal desert is being farmed. Now we're getting a lot less water with climate change. A lot is just not really accepting the reality. (Imperial #1)

> Let me preface my answer to your question about weather changes over time with the comment that the real meaning of changes in weather is you're asking about is climate change. Let me make sure to say that climate change is not happening as a result of man-produced CO_2. We are still recovering from a once global flood that happened about 4,000 years ago. (Imperial #2)

How Farmers View Changing Climate and Its Relationship to Worker Safety and Health

Heat

Heat was the most cited challenge for managing employees in the field. Employers notice an increasing frequency of heatwaves as well as overall higher temperatures. They stated that this impacts both their crops and their workers. Heat has caused some to lose crops and thus their workforce because if there is no work, workers go elsewhere. The perception of a labor shortage was not mentioned frequently. Still, employers did worry about

losing workers for reasons such as drops in immigration rates, fear of travel among workers due to immigration status, and an aging workforce.

In fact, when discussing heat, the aging workforce was mentioned more than once. The perception is that workers are getting older, and it is hard for them to work at a fast pace for long hours. When these aging, experienced workers are gone, there is no one to replace them. A few of the employers in the Fresno region stated that they are not sure if they will have a sustainable workforce in the future. They see the physical impact of the work on their long-term employees and are pinched by the reduction in immigration of new workers. One of these employers relies on H-2A visa[6] crews to supplement her established crews who live locally because she has been unable to recruit local workers.

The responses to questions about weather were coded to capture how employers alter their workdays as a result of the weather. The findings showed that most responses were related to heat. Many employers have adapted to rising heat and heatwaves by changing daily work schedules: start early, end early. One employer even stated that on really hot days, they start crews at 4 a.m. and end at 9 a.m. When asked about reasons for this extreme response, the employer stated first that the produce reacts poorly to being harvested in the heat and then secondarily stated that it helps his crews as well.

Employers are well educated about state regulations around employee management under hot conditions.[7] However, there is a tendency among employers to pass responsibility for heat protection on to workers themselves. So, while employers are conscious of the need to follow the rules and provide what is required (e.g., water, shade, rest, and training), there is still ambivalence around enforcing clothing standards and breaks.

During coding, networks among heat, water, worker behavior, and night work were revealed. Heat is closely linked with water and drought, and when discussing heat and its impacts on worker behavior, there are some interesting trends. Specifically, there is a tendency to place responsibility for self-care on the worker, as shown in previous research related to heat illness (Courville et al., 2013). In addition, there are clear indications that employers, while not always agreeing with workers' choices in clothes, believe the workers must take responsibility for how they dress and that workers themselves "know how to dress." None of the employers we spoke to had night crews, but one had tried out night harvesting of citrus with little success. Color is a determining characteristic of ripeness when hand-harvesting fruit, and the color under lights was not easy to discern. Furthermore, some comments may be considered racialist. For example, in several coded quotations, employers stated that workers "prefer the heat" and that "people who are used to it can withstand it."[8]

Regional differences concerning heat and worker management are notable. In the Imperial Valley, growers move workers to shaded fields at 108°F (42°C) and take them out of the fields at 115°F (46°C). In Fresno, growers stated that 100°F (38°C) and above was the problem temperature. In the Salinas Valley, growers talked about 80–90°F (27–32°C) days causing distress among workers. The Imperial and Coachella Valleys are in the Inland Desert Region in southern California, while the Salinas Valley is located on the northern coast. The Fresno region is in the San Joaquin Valley, inland but not as far south as the Imperial and Coachella Valleys. These differences in worker management correspond to the differences in the climatic regions where employers are located. Employers' decisions are clearly based on what is viewed as normal weather in these regions. However, all employers recognize the need to alter work patterns on hot days. No matter what the thermometer says, employers keep an eye on their crews, start them earlier and send them home earlier. Additionally, employers state that crews slow down on hot days, and the quotas employers set

[6] The H-2A visa program allows U.S. employers to bring foreign nationals to the United States to fill temporary on-farm jobs.
[7] https://www.dir.ca.gov/dosh/etools/08-006/EWP_shade.htm
[8] While acclimatization in outdoor work is important, the implication from this employer was more of an innate characteristic of the workforce.

for harvest are generally reduced, despite the increased need to quickly get crops out of the fields during hot weather.

Rain

Most responses about rain and wet weather were obtained from employers in the Imperial/ Coachella and Salinas Valleys. These regions have extremely different weather. In the Salinas Valley, rain is common but not usually intense. In the Imperial/ Coachella Valleys, rain is uncommon, but when it comes, it can be very intense.

Most interviewees in all three regions stated that they do not send crews out into muddy fields because wet soil creates difficult, dangerous, and costly work conditions. More than one employer mentioned the danger of getting vehicles stuck in the mud out in fields during intense rainstorms and preferred to avoid this situation. In addition, it is not conducive for crops to be harvested in the rain, and employers cannot require workers to wear appropriate footwear and rain gear. Employers in the Imperial and Coachella Valleys also mentioned the danger of lightning.

There were no clear recommendations from growers regarding responses to extreme rain conditions or flooding. One farmer stated that she provided rain gear to crews at one time; however, this was unsuccessful.

> We make sure our crews are safe under wet conditions. We don't have lightning issues. But if we do, we move people out of the field. We limit the work we do. It's too hazardous. Mainly we worry about slips, trips, and falls. Everyone has rain boots and whatnot. We provide those. Rain gear itself is provided by employees. In the past, we did provide it, but it was hard to keep track of and maintain, so we just asked them to provide it, and they take good care of it. (Salinas #3)

Pests

The discussion of rain also prompted some observations about pests that can be harmful to workers. One employer in the Coachella Valley noted that the previous season's increased rainfall led to standing pools of water in his fields that bred mosquitos carrying West Nile virus. As a result, he kept his crews out of the fields until he could drain the standing water. Another stated that with increased cool, wet weather on the coast, she noticed more black widow spiders under stacked pallets; she had decided to add training for her crews on dangerous environmental hazards at the edges of her fields where more wild vegetation was common.

> We have a couple [of] farms with poison oak. We try to avoid working there. The vegetation grows onto fences that could be a risk. We provide protective equipment. In some areas, we don't have ag-on-ag land. Our ranches abut natural areas, and there can be rattlesnakes, ticks, spiders. We do safety training to alert workers on those hazards. What to do. There are black widows in one field on the pallets. They love to nest there, but there have been no incidents. (Salinas #3)

Employers also noted the impacts of humid weather combined with higher temperatures on their crops (more mildew, spoilage, and insects) and their workers (the additive impact of heat and humidity).

Air Quality

Most growers had not thought about creating a formal response to poor air quality occurring when their workers were out in the field. However, some did have experience with crews exposed to smoke and/or dust. There are various responses to the risks workers face from dust and smoke.

One employer stated:

> We've never set up protocols for that, it's not like rain that hits or doesn't. You don't see it [coming]. Sometimes you see it, but it's more vague where you can measure it. We don't have [the] means for measuring air quality. This hasn't happened a lot until with the fires. This is new for us. We're just getting complaints now for the first time. It doesn't affect everyone the same. In general, it makes everyone feel somewhat bad. Like they're starting to get a cold—overall feeling bad. (Fresno #6)

Employers in the Imperial and Coachella valleys are more concerned with direct wind impacts rather than the effects of wind on air quality. For example, date workers (*palmeros*) cannot safely climb the trees when its windy. Additionally, there are wide expanses of desert landscape surrounding farm fields in the region, and wind moving across this desert picks up dust and sand and makes it impossible for crews to work. There is also real potential for haboobs (dust storms) to cover roads and crops. These are usually predicted, and workers do not go into the fields under these conditions.

However, there is almost always poor air quality in these southern inland valleys due to their proximity to Los Angeles smog and diesel trucks moving goods to Mexico along major highways. Farmers in this area state that they do not have knowledge of local air quality and when it is safe for workers to be out in the fields.

How Management Practices Might Affect Workers

Farmers interviewed in this project discussed their management practices freely. Many of them were proud of how they manage their crews and how this has resulted in a successful business. The theme of "pride and adaptation" was developed in analyzing employers' responses to multiple questions about labor management. Employers expressed pride differently but commonly in many of these interviews.

Pride and Adaptation

The importance of this specific theme relates to the willingness of employers to adapt their practices as conditions change and to identify business and personal priorities. Expressing pride in the longevity of one's farm and plans for the future are positive aspects with regard to adapting practices to change. Language interactions show up in coded networks that reveal statements of pride while referring to adaptation and pragmatism. Farmers expressed that if a farm has been in business for five generations, for example, that is a good indication of the ability of the owners to adapt to change. While some employers we spoke to are proud of how long their farm has been around or in the family, some are proud of the quality of their crops or how they treat their workers. Other participants were proud of their employees and how hard they work and respond to challenges.

> We're constantly moving crews around. If things just don't seem right, we move the crews to keep them happy and make sure they have a better work environment—so if we can move people to a cooler part of [the] valley, we do. (Imperial #3)

> At the heart of everything we do, we really put the crews first when we make decisions. If it's uncomfortable for crews to do, we scrutinize whether we should be doing it. We make individual accommodations when possible. There's always sun, wind, dust. But we try to make people as safe and comfortable as possible when working outside or in our greenhouses. (Salinas #3)

These employers are taking responsibility for real-time assessment of the conditions in the field and responding to them positively. Rather than handing responsibility over to the crews to stop when they are uncomfortable, employers take control by moving crews to cooler conditions when necessary. These are both safety and comfort issues and point to active management under harsh conditions.

> We have an agreement with our workers: hotter than 90 degrees, you go home. If you want to stay, you can, but you can only work 8 hours, not 10. That way they don't feel pressured, they aren't afraid to complain. You have to have this kind of climate in your workforce. You don't want them working under duress. I'm really conscious as an owner—and as a human being! All the heat illness laws make sense because not everybody is that naturally conscious. (Salinas #2)

This employer has clear standards for workers to assess and decide for themselves when they can continue working. He also limits their choice, so if they decide to stay when it's hot, they are forced to

work a shorter day. While this shifts some of the responsibility to the workers, it also provides choice without judgment. The statements above clearly point to helping workers build some power in their workplace.

> I do something called tip of the week. It's always related to what we're doing … and when I am being inspected, the inspector goes to talk to the workers, and the workers always say what I have said. So, they are listening. There's always going to be something that happens during the week. It gives you an opportunity to address some issues. If someone falls down, you have an opportunity to address that. To tell them to be careful and slow down in their work. It's not worth getting hurt. (Fresno #2)

This employer values workers for listening and taking training on board. In addition, she acknowledges that accidents happen and views them as an opportunity. She's proud of her innovation in creating a "tip of the week," specifically addressing some recent issues. She reinforces positive behaviors by addressing the need to slow down to avoid getting hurt.

The pride in worker management and trust in employees to work hard is a double-edged sword. While workers respond positively to respect in the workplace and higher wages, placing the responsibility on workers for deciding when to stop work relieves the employer of some responsibility. This was not a major trend in employer responses to hazards in the workplace, but it was evident.

Emergencies

While discussing extreme weather events, the topic of emergency procedures was explored. We were especially interested in how employers perceived emergencies and their thoughts about responding to fast-moving, extreme conditions that might exist during wildfires and intense rain and wind events. We asked employers how they respond to emergencies in the field, if they have established procedures, and what they think is necessary to safeguard their crews. Overall, employers stated that they did not have established emergency evacuation plans. This response reflected the overall lack of employer readiness for extreme weather risks like fast-moving wildfires or sudden, intense rainstorms.

While some employers stated they do not need an emergency evacuation protocol because they cannot imagine what would trigger such an episode, others said they keep such close watch on their crews that they can evacuate at a moment's notice. None of the interviewed employers had a formal emergency evacuation plan. However, most did have standard operating procedures for contacting crew leaders quickly, and all had established protocols for responding to accidents or illnesses in the field. The biggest issue with these procedures is the lack of complete cell service in many rural regions of California and the long distances between fields and resources.

How Farmers Are Adapting to Long-term Weather Patterns

Adaptation to change was one of the most frequent codes in these interview notes. Farmers often stated that one of their most valuable skills was adapting to changing conditions. This skill bodes well for future sustainability in the face of climate change.

> I think farming is all about adapting, so we have to keep on adapting. You can't predict [the] weather, so we need to implement protocols for dealing with conditions. So, we can follow specific protocols you have to keep up and stay ahead [and] be able to adapt and foresee upcoming issues… I think we just have to see what tech ideas develop. We are growing windbreaks to reduce wind and dust in our fields. Any kind of idea that can help reduce or cut back on extreme conditions can help. (Imperial #3)

When envisioning the future and what his farm would look like in five to 10 years, one farmer said:

> Probably not terribly different than it is right now. We seem to have come to a fairly stable position—[the] right number of people, [the] right amount of housing for the number of

> people we have. [The] right balance of crops. It might vary a little, but … (Salinas #1)

This is also clearly a statement of pride in having reached the optimum production level and management of resources, including workers.

Looking more deeply into the responses related to the future of their farms, most farmers expressed uncertainty about both the short and long term. This uncertainty is based on economics, competition, the labor market, and the climate. Below are examples of how employers are currently thinking about survival into the future.

> I think the ability to do what we're doing now will change. The crops we're growing will change. A hotter climate will limit people who want to work. The more extreme it gets, the shorter the days. All kinds of implications. They [workers] need the pay. A farm is going to have a much more difficult time attracting good workers … if conditions continue to get warmer and warmer, water is an issue. The labor situation is a mixed bag. I think that the likelihood of us doing what we are doing now in 20-30 years is not great. My kids will have to figure that out—ag-tourism, value-added. Clearly, the next generation will have to determine that but based on the past, I think the chances are low that the operation will keep going as it is now. (Fresno #3)

> If the temperatures continue to go up, and there is more frequent hot weather, we'll see more potential for heat-related problems. Not now, though. We might do more night or early morning activities. We may consider that to avoid working in the heat. But this also poses risks with visibility issues. If there is increased rain? I'm not thinking that will happen. The uncertainty of patterns is more [of] the challenge. The uncertainty will impact cropping schemes and cascade onto [the] staff. This causes delays in production work. (Salinas #3)

Overall, the differences in individual employers' visions for the future were based on the age and stage of the operation. While we did not collect age data, it was either known by the interviewers or employers voluntarily disclosed their age or indicated the stage of their experience in other responses. Older growers thought that their operations might not survive, and if they did, they would look very different. Younger growers were concerned with taking action now to adapt to perceived future changes so that they could continue in their occupation.

Employer Perception of Worker Responsibility and Behavior

We coded responses related to how employers perceived the behavior and responsibility of their workers. These are discussed below and focus on training efforts and requirements and how the workers responded.

Many farmers talked about workers' responses to training and how workers alter their work behavior under various weather conditions. There was the acknowledgment that the behavioral changes observed by employers may or may not be related to the training given by the employer. There was some discussion of what workers understand and whether they listen during training. One employer said he did not think the workers listened to him, but when he observed them in the field and quizzed them, there was ample evidence that they did listen.

> I think the most challenging thing is that sometimes our workers don't really want to follow our direction in respect to what happens to them. They may not report. May not feel comfortable reporting. Sometimes they don't. Sometimes you only know when it's too late. I wish that they would feel comfortable enough to report or stop work when they feel bad. (Fresno FLC)

Another stated that, regarding heat, she was more focused on crop damage than worker risk. In this instance, the employer also noted that training was a "drain on productivity."

> The direct supervisor on the specific ranch is the one that will deal with instances of heat-related illness; issues will be reported to that

> person. I am more focused on crop damage in the heat—the people are important, for sure, but there aren't that many issues with them.
>
> The training is more of a drain on productivity than the actual heat; it's not the training itself—it's the documentation. You do the training for 30-40 employees, that doesn't take too long, but then you have to do the documentation for all of them. On top of other "tailgate trainings," this takes up a lot of time. The worst is that the trainings often happen in the morning, which is precious productivity time. It's a drain. (Salinas #4)

There were also comments about the pace of work: a rapid pace benefits the grower and slows under hot conditions, impacting productivity and, in the long term, income. The productivity of crews declines under adverse conditions, whether it's heat, rain, or poor air quality.

> I think what farmers have to do is be aware of their crew. I had a field manager who wasn't the same [after he returned from a break]. He fell asleep twice, he was heavy set. I asked what was wrong. He denied any issues. But he admitted that since he got back from Mexico, he wasn't the same. He went to urgent care. He was admitted with an enlarged heart. So, it's important to know your workers and keep track of what the crews are doing and any weird time. And when you ask the workers, they say they're fine. They don't want to admit any weakness. [We] need to have workers who are comfortable talking about it. (Fresno #4)

One employer noted that workers on his farm commented last year about the smoke and poor air quality. This was the first time he had gotten complaints, and he has noticed an increase in cold or allergy-like symptoms on days with poor air quality. Despite these noted complaints, there is no evidence that any employer response followed. In fact, the employer stated that he is not sure what he can do under these circumstances.

> An interesting thing I heard on the radio the other day—most of the people who die from heat-related illness are from areas that don't typically experience extreme heat. They're not used to it. People who are used to it can withstand it. (Salinas #3)
>
> If they don't take precautions, workers can be dramatically affected. [I've seen] a couple of instances of people getting medical attention because of heat exhaustion recently. They got help and came back to work within a couple days. (Salinas #4)

Overall, many employers believe that workers need to take responsibility for themselves. This is in agreement with previous research, where there was a theme of workers assuming responsibility for regulating themselves when taking breaks and drinking water (Wadsworth et al., 2018). Employers state that crews want to take breaks at different times; therefore, the employers believe that they must allow crews to take breaks when they want and not mandate them. Several interviewees also mentioned throughout the interviews that workers slow their pace under both heat and poor air conditions. Most employers agree that workers know how to dress to protect themselves from heat and that this should not be mandated. Paralleling this perception is the contrasting perception that employers are actively caring for their crews and are responsive to their needs. The same employer often holds these contradicting observations.

Discussion

Federal legislation has led to poor working conditions for farmworkers in the United States, and these conditions are the direct result of agricultural exceptionalism. Historically, agriculture has been exempt from social, labor, and health and safety legislation. These exemptions highlight the current low status and high-risk conditions farmworkers face across the country. The status of farmworkers will inevitably affect their ability to respond to changes in the environment of their workplaces (Holdier, 2019; Rodman, 2016).

Through interviews with 16 agricultural employers in three regions of California, this research has provided preliminary information on address-

ing impacts to the health and safety of agricultural workers in the context of climate change. Employers are aware of the risks crews face while working under high temperatures. Our findings suggest that the employers we interviewed took the required and mandated steps to reduce risk. From these responses and other work completed over the past five years (Nelson, 2017), we can tentatively conclude that legislation to reduce heat-related illness on California farms has worked. Employers understand their responsibility in providing shade, water, breaks, and training as required by law in California (Mitchell & Langer, 2019). The campaigns to reduce heat-related illness and death in California have been successful (University of California, Berkeley, Labor Occupational Health Program, 2013). With regard to heat and climate change, employers expect the conditions to worsen, resulting in longer and more intense heatwaves. However, there remains a belief among employers that workers hold individual responsibility for taking breaks, resting in the shade, and drinking water.

Other environmental hazards that may worsen with climate change, such as rainfall, poor air quality, and fires, were not as carefully addressed by employers. This may be because of the stringent state regulations protecting outdoor workers under hot conditions and active statewide campaigns to mitigate worker risk. So, while employers talked about how they train their crews on heat regulations and symptoms, there was little discussion of training on other environmental hazards.

Under heavy rainfall conditions, adaptation protocols are informal; however, almost all employers interviewed had rainfall protocols. It is challenging for the crews to work when it rains and is detrimental to the crops; therefore, very few employers discussed risks to workers on rainy days. This is likely because crews will generally not be working under rainy conditions. However, the aftermath of a period of intense rain was discussed by one grower concerned with West Nile virus in standing pools on his fields.

Poor air quality on California farms can be due to pollution, dust, and wildfires. Some awareness exists around air quality issues, but this is not universal. While air quality is not a condition that farmers monitor, some are aware of dust and smoke and how these can affect employee productivity. However, they do not understand how to manage their crews under these conditions. Wildfires pose a dual hazard for agricultural workers of direct danger and poor air quality. One farmer had clear protocols in place when wildfires were nearby, likely because he was also a volunteer firefighter and kept up to date on local conditions.

Employers in the Fresno region noted that poor air quality is the norm. Last year, this resulted from wildfire smoke drifting into the valley from the north, but most of the time, particle pollution and ozone levels are high in the Central Valley. Farmers in Imperial/Riverside noted that their region is not attaining levels set by the EPA but are unsure about how to keep their workers safe under these ubiquitous conditions. There is clearly a divide between what are viewed as "normal" poor conditions and "emergency" poor conditions.

Similar to farmers in a Kentucky study (Hunt et al., 2018), there was very little consideration of emergency planning, particularly as it relates to environmental hazards. In conversations about emergency conditions, employers' responses were divergent. Some stated that they were only prepared for health or accident emergencies. The idea of an environmental emergency plan was of interest to most interviewees. But for some, it was beyond their ability to imagine an instance where emergency field evacuation would be necessary. There are many studies of this issue among farmers in developing countries, but fewer have been done in the U.S. (Budhathoki et al., 2020; Mishra et al., 2017; Yorose et al., 2021).

As shown in other studies (Courville et al., 2016; Wadsworth, 2018), there is a gap in understanding employer responsibility for worker welfare in California agriculture, even with strong health and safety policies and regulations in place. The history of agricultural exceptionalism in the U.S. has contributed to this gap.

> Ultimately, to the detriment of workers, two principal benefits resulting from farm worker exclusion aid the agricultural sector. First, agriculture benefits from the failure to examine the nature of employer/employee relations in the sector. The lack of study thereby disallows

> accountability and promotes the exclusion of workers. Second, the isolation of workers remains entrenched without opportunity for beneficial change in farm worker communities. Reversing the outsider standing of farm workers therefore requires examining agricultural law and policy from a race-based perspective. (Luna, 1998)

When moving forward with training and policies for farmers, language use must be sensitive because agricultural employers often feel that they are under more scrutiny than other employers and often fear increased regulations on their businesses. Most participants in this study believed that more regulation is inevitable as climate change progresses and environmental risks to employees become greater. Farmers as a rule, are against policies that regulate their work but are in favor of policies that assist them (Liu et al., 2018; Puglia, 2020). This group was no exception. The biggest challenge noted by farmers in this discussion was spending the time required to train their employees when they could be "working." Some also stated they have difficulty in keeping up with changes in rules. The fact that some employers do not see training workers as an essential part of their business is a challenging barrier to overcome.

Agriculture is one of the most dangerous jobs in the U.S. (Centers for Disease Control and Prevention, National Institute for Occupational Health and Safety, 2020). A safe working environment is a common expectation of employees in most industries. Agriculture should be no exception. While our work in the past focused on employee perceptions of workplace safety, this study focused solely on employer perceptions and their expectations are for the future (Courville et al., 2016; Wadsworth et al., 2018;). In this study, when asked if they expected the health and safety of their workers to be of greater concern in the future, there was a wide diversity of responses. Most employers stated that safety and health would be of greater concern, while several believed that labor would continue to get scarcer and employers would rely more on mechanization in the future. This has been an ongoing push in California agriculture since the 1970s (Martin & Olmstead, 1985; Sun, 1984) but has not materialized. Both employers and employees need to accept responsibility for safe working conditions in farm fields, but the onus lies with employers. According to the U.S. Occupational Safety and Health Administration, employers are responsible for providing a safe workplace (U.S. Department of Labor, Occupational Safety and Health Administration, n.d.) and California has passed laws to specifically protect farmworkers (California Department of Industrial Relations, 2020). With changes in climate, more laws can be expected. How agricultural employers adapt to these laws will determine which growers remain in business and which businesses are sustainable.

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Appendix A. Interview Guide

Key Informant Interview Protocol for Farm Employers

30–45 minutes semi-structured survey, with pre-screen for basic information that could be gathered before the full interview.

- Start off with a "rich" question, so the answer will not be short and too focused, which would set the wrong tone for the interview.
- Keep to only a few main topics or themes.
- Pilot on two farmers and see if the instrument yields good information, and modify as needed before the full set of interviews. As part of the pilot, get feedback on the questions from the farmers at the end of the interviews to strengthen the survey results.

Aim: To address possible impacts to the health and safety of workers with informational materials for both employer and worker on changing practices compounded by climate change. To get a more nuanced understanding of how farmers view changing climate in terms of worker safety and health, and how climate changes will affect their management practices, including crops and water supply, and therefore try and predict what issues will or may exist for their work force.

INTRODUCTION

Hi. My name is _____. I work for the California Institute for Rural Studies. We're working on a project with the University of California, Davis, Western Center for Agricultural Health and Safety.

INFORMED CONSENT:

This is part of a research study aimed at determining if farm employers are experiencing any changes in agricultural employment and HR management practices resulting from changing weather patterns. We are interested in hearing from you about any practices or experiences you have had with worker health and safety related to changing weather. The study is funded by the National Institute of Occupational Safety and Health.

I'm hoping you will participate in a (telephone or in-person) interview that will last up to 45 minutes. There are no right or wrong answers, and your participation is entirely voluntary. Our ultimate aim is to produce better health and safety training messages for those who work in farming as agricultural practices adapt to changing weather patterns in California.

All interviews will be kept confidential. I'll ask you to agree verbally and will not need your signature. Quotes from interviews will not be associated with names. Research documents will be kept confidential in accordance with the law and UC Davis policies. With your permission, this interview will be recorded using a digital recorder. We will use it only for report reference, and the audiotapes will be destroyed after the report is compiled.

You do not have to participate in this activity if you do not wish to, there will be no penalty if you do not participate, and you may discontinue at any time. We are not offering any compensation for your participation.

If you do not want to talk to the investigator or study staff, if you have concerns or complaints about the research, or to ask questions about your rights as a study subject, you may contact IntegReview. IntegReview's policy indicates that all concerns or complaints are to be submitted in writing for review at a convened IRB meeting to:

Mailing Address OR Email Address:	
Chairperson IntegReview IRB	integreview@integreview.com

3815 S. Capital of Texas Highway Suite 320 Austin, Texas 78704	

If you are unable to provide your concerns or complaints in writing or if this is an emergency situation regarding subject safety, contact our office at:

512-326-3001 or toll free at 1-877-562-1589

Do you agree to participate? (circle) Y N

LOCATION: Can be recorded by interviewer; does not need to be asked

NAME:

POSITION:

CROPS/COMMODITIES:

LENGTH OF TIME IN BUSINESS:

Do you expect to still be farming in 5 years? Y N

Number of employees: (15 MINIMUM):

1. Weather Observations

Just to start out, will you tell me about any changes in the weather over time that you've noticed?

Now, let's talk about how different weather conditions may affect you and your crews as you work outside:

I'd like to focus on three specific weather related conditions: heat, rain, and poor air quality, either from dust or smoke. I'd like to ask you a series of questions that I hope will allow us to understand how changing weather patterns affect the health and safety of you and your employees.

First, will you tell me if and how any of these listed weather related conditions presents (or has presented) a specific management challenge in your operation?

(If they prioritize one, move to that one first and focus on it.)

Rain and Flooding

1. Has your farm been impacted by high intensity rain or flooding?
2. What kind of plan do you have to manage your crews with rain and potential flooding while working?
3. What do you do to make sure you and your workers are safe while working under wet conditions?

Air Quality

There are multiple elements that impact air quality. I'd like to talk to you about two: dust and smoke. As you know, crews working in the field last year were impacted by smoke from wildfires.

1. What would you do if the air quality declined by either dust or smoke while you or your crews were working?
2. What kind of plan do you have in place to manage a possible evacuation?

3. How have dusty or smoky days impacted your scheduling of crews and/or tasks? (time of day, season, actual methods, crew size, work day length)
4. What do you think can be done to protect workers from the risks posed by poor air quality?

Heat

1. How do you manage your workers on hot days?
2. Tell me if you've had to do anything different as temperatures or lengths of heat waves increased in recent years?
3. How do you think high temperatures affect your workers? Have you noticed anything changing on hot days?

Now I'd like you to think about your crews at work. Is there any other situation related to the weather that represents a health risk for outdoor workers that we haven't touched on? (Animals, insects, wildfire smoke, working hours, etc.)

2. HR Management Practices

1. Will you describe to me, if you can, how changes in weather conditions as we discussed above might have led you to change how you manage your workers?
   [PROBE: For example, do you ever have to start work early or end early? Are there seasons when previously you didn't have crews working that you do now? Have you changed how you pay workers because of weather—like hiring larger crews or paying by the piece during harvest when crops are ready and temperatures are high?]
2. How do these conditions impact your scheduling of crews and/or tasks? (time of day, season, actual methods, crew size, work day length)
   [Probe on health and safety challenges or expected challenges. With both of these questions if this does not come up]

3. Future Changes

1. What kinds of health and safety issues do you expect your workers will face if weather continues to change and there are more droughts, heat waves, extreme rain events, etc.?
2. If the weather continues to change, and challenges you've mentioned intensify, how do you think you will adapt? [PROBE: Will you continue to farm? Will you move away from hired labor?]
3. *Do you expect the health and safety of your workers will be a greater concern going forward, specifically because of weather changes?*

   ☐ *Y*
   ☐ *N*
   a. *Why or why not?*

4. Describe any regulatory and policy changes you imagine resulting from more extreme weather events, like heat waves, high winds/dust, wildfires or flooding?

4. Closing

1. Is there anything you'd like to mention to us regarding worker safety and health that we didn't talk about?

2. Are your crews direct hire or contract?
   a. If contract, ask for the name and contact information for FLC.
3. When you look for educational and training materials for your crews, where do you get it and what format do you prefer?
4. Where do find the most useful information on health and safety?
5. If trainings or materials were available, what types of materials—and on which topics—would be most useful to you? There are currently materials available at no cost from UC Davis.

IN CLOSING:

Can we follow up with you in case we have additional questions?
Would you like us to provide you with a copy of the final report?