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The Struggle for Environmental Justice in a Forgotten Community: Agricultural Hazards, Risk Perceptions, and the Use of Transdisciplinary and Community-Based Approaches for Policy Changes at the Local Level

By

ALFONSO ANTONIO ARANDA
DISSERTATION

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Para mis padres que trabajaron en el azadón, sortearon tomates, lloraron y lucharon para que mi hermana y yo fuéramos a la universidad.

ABSTRACT

Composed of three articles, this dissertation examines the development of a transdisciplinary and community-engaged research partnership developed to address longstanding and undocumented concerns about agricultural health hazards among residents of an unincorporated farmworker community. Article I connects the literature on risk studies and environmental justice by using participant-led focus groups to examine residential perceptions of risk among white and Mexican-origin residents. It finds that residents of the case study community are acutely aware of contamination at the local level through their knowledge about the sources, fate and transport, and consequences of human exposure to environmental and occupational hazards. My findings substantiate claims that disadvantaged communities are often exposed to so much pollution that any sense of uncertainty about being exposed is all but extinguished, leading to a collective sense of *toxic certainty*. Implications of this research demonstrate the importance of participatory research and qualitative methods for uncovering rich community insights that could help guide the creation of risk communication policies founded in the knowledge, understanding, and potential barriers faced by target audiences. Article II further connects risk studies and environmental justice scholarship through the use of participant observation and focus groups to explain why and how environmental inequality, in this case living near agricultural hazards, is maintained in a farmworker community. It demonstrates the ubiquity and necessity of agricultural hazards, which leads residents to perceive a need for science information and government support to navigate the path toward environmental justice. Results highlight how contextual (place-based) and institutional resources serve to produce an ambiguous climate for community responses to environmental inequality, thus relegating risk management to the household and individual levels. Article III critically examines the development of our transdisciplinary and community-based partnerships. It recommends that, to best support communities, transdisciplinary environmental justice research should (a) reflect residents' needs and concerns, (b) respect local ways of knowing and unknowing, and (c) produce notable outcomes for the community. This research addresses a significant gap in the environmental justice literature that has extensively interrogated agricultural hazards, which are predominantly experienced by Latinx farmworkers in the

United States. Lessons learned from this research provide environmental justice scholars with a framework from which to engage with scholars of diverse backgrounds and disciplines to examine complex environmental problems alongside disadvantaged and vulnerable communities. In turn, this work adds to the transdisciplinary research scholarship through an innovative approach to environmental inequality at the community level. Using community-based and transdisciplinary approaches to operationalize the concepts of environmental justice advances the field, whereas the bulk of scholarship has focused on single-discipline approaches.

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ARTICLE I

Residential perceptions of risk in an agriculturally-structured community: a qualitative assessment

INTRO

Agricultural pollution disproportionately affects minority and underserved communities in California's Central Valley (CalEPA, 2021). Particularly at risk are those living in rural, farmworker communities on unincorporated county land-- a geographic entity administered by the county (Harrison, 2011).

Agricultural activities that cause pollution include barnyard and feedlot operations, cropland management, agricultural processing, and the use of heavy machinery. These activities are known to produce excesses in livestock waste, grain particles, fertilizers, herbicides and insecticides, together with oils, grease and other toxic chemicals that passively enter the environment. In addition to the physical risk of toxic exposure, living near sources of industrial pollution may cause psychosocial and mental health problems to affected populations, especially in low-income areas with limited access to medical and social services (Elliott, 2010).

The case study community, located in Northern California, is an ideal place in which to conduct an environmental justice study on account of its demographic profile, proximity to agricultural hazards, and its long standing concerns about exposure. As an initial assessment, I employed participatory research and qualitative methods to examine local knowledge and perceptions about environmental health risks among white and Mexican-origin residents and the place-based factors shaping residential perspectives.

Understanding the communities' knowledge and perceptions of risk through qualitative methods such as focus groups could inform the creation of environmental health studies and risk communication practices that are grounded in the experiences and potential barriers faced by the target audience, and preventing future exposures. Further, participatory research enables the collection of qualitative data while engaging with local residents as equivalent actors in the research process (Gasior Altman et al., 2011; Montag, 2019).

This article first connects the literature on risk studies and environmental justice. It then describes our community-based participatory research process and participant-led focus group methodology. An initial assessment of residential perceptions about contamination in the air, water, and soils is followed by an analysis detailing residential knowledge on the fate and transport of suspected contaminants together with perceptions about the potential consequences of human exposure to environmental hazards. This article aims to examine more than just risk perceptions, but how certain social and place-based factors influence how risk is understood and experienced in farmworker communities. The analysis can also help highlight how risk perceptions contribute to the maintenance of environmental injustice in agriculturally-structured communities.

LITERATURE REVIEW

Risk studies emerged in conjunction with the mainstream US environmental movement of the 1960s-70s, forming new modalities of interpretation and conceptions of the relationship between the environment and human health (Tierney, 2014; Brulle, 2009). Given the myriad of theoretical and conceptual approaches that currently address risk, it follows that there are multiple definitions of the term and that the field of risk studies is highly contested (Burgess, Alemanno, & Zinn, 2016). Overall, risk studies is dominated by technical, psychological, and sociological perspectives. Technical perspectives define “risk” as the statistical probability of a known event occurring (e.g., the chances of landing *heads* in a coin toss or the likelihood of developing an illness). Key to this understanding rests on the idea that risks can be identified and measured through formal risk assessment tools and then integrated into various government practices (Gregory et. al, 2009; Fischhoff & Kadvany, 2011; Doron, 2016). Scholars also attempt to measure, predict, and understand how people perceive risk, with cognitive psychologists leading the way. Finally, sociologists like Ulrich Beck (1992) and other analysts theorize the place of risk and its management in contemporary society, viewing it as a core concern in what they term today’s “Risk Society.” From this more theoretical perspective, risk is now the dominant way of analyzing social

relations and conflicts given its scientific and technical legitimacy together with the complex political and discursive aspects that its management implies (Beamish, 2015).

Psychological and sociological perspectives

Research in psychology and sociology has long examined public perceptions of risk with an emphasis on environmental, health, and sociotechnological hazards (Burgess, Alemanno, & Zinn, 2016). These studies are useful for elaborating new theories about individual demographic and cognitive processes as well as the contextual factors shaping risk perceptions (Tierney, 2014; Burgess, Alemanno, & Zinn, 2016).

Psychological (or *psychometric*) perspectives generally portray risk perceptions as subjective experiences that can be measured and predicted via study, observation, and quantification (Szasz, 1994; Slovic, 2000; Fischhoff & Kadvany, 2011). One of the major assumptions of psychometric research is that probabilities are difficult to understand so non-experts must rely on often-inaccurate intuitions (or cognitive heuristics) to assess the likelihood and severity of adverse and uncertain events (Tierney, 2014). Of the many heuristics in judgment decisions that psychology offers, Tversky and Kahneman's (1974) classical cognitive heuristics-- *availability*, *anchoring*, and *representativeness*-- are heavily cited in the environmental risk perception literature of the past and present. Likewise, the heuristic of *fatalism* is commonly invoked by psychologists to explain perceptions of environmental risks and cancer risks (for a review see Cohen, 2022).

Further, sociological research demonstrates that individual and group perceptions are largely shaped by power relationships, community dynamics, and cultural conceptions about science and technology (Greenberg, 2019). Oftentimes these studies are theoretically situated within the broader sociological literature (i.e., Douglass, 1966; Giddens, 1999; Beck, 1992). Of note, Mary Douglas' (1966) social constructionist approach hypothesizes social responses to risk as expressions of deep-seated cultural knowledge used to maintain social cohesion in the face of adverse and uncertain events, conditions (Lupton, 2006; Beamish, 2015). (Lupton, 2006; Beamish, 2015). Adding to Douglas, Ulrich Beck's

(1992) seminal *Risk Society* thesis argues that society experienced a major qualitative change in the way it maintains social cohesion and that this change occurred in consequence of the atomic age (Lupton, 2006). For Beck, contemporary forms of social organization are shaped not so much by capital and labor as by the institutions that create risks and those institutions tasked with managing it. Under this view, natural hazards fundamentally differ from the new, post-WWII inventory of sociotechnological hazards because the former is considered knowable and manageable while the latter may not be calculable nor spatially and temporally constrained (Harrington & Elliott, 2015). As a result, it is argued that contemporary risk societies are overly-reliant on experts in scientific knowledge to define and interpret risks (Beck, 1992), leading to public confusion and mistrust in the institutions responsible for risk and its management (Auyero & Swistun, 2008; Cable, Shriver, & Mix, 2008). In this article, I use the risk society thesis as a framework for addressing gaps in the environmental justice literature-- namely, the ability of vulnerable and disadvantaged communities to overcome confusion and uncertainty about everyday forms of environmental health risks.

Risk perceptions and environmental justice research

In the aftermath of the 1960s-70s US environmental movement, new discursive communities emerged around the risks posed by sociotechnological hazards in the environment to human health (Brulle, 2009). Most notably, the environmental justice movement examines the uneven geographies of environmental health risks on the basis of race and class (Hollified et al., 2018). Many cases illustrate the role of socially constructed risk perceptions in determining community responses to acute contamination events such as the siting of landfills and toxic waste facilities, pesticides and lead poisonings, and industrial chemical accidents. While these events draw attention, relatively less is known about the knowledge and perceptions of communities experiencing everyday forms of environmental injustice such as living and working near chronic agricultural chemical applications. According to the literature, vulnerable and disadvantaged communities are particularly at risk of experiencing environmental forms of suffering together with the confusion and uncertainty about exposure that accompanies it (Auyero & Swistun,

2008; Cannon, 2021). In resource-dependent communities, for example, perceptions of risk can be impacted by a number of social and historical factors such as employment in the main extractive industry, social capital, and local interactive capacity (Greenberg, 2019). Drawing on Auyero & Swistun's concept of "toxic uncertainty"-- the normalization of risk and the uncertain exposure to toxic environments-- more recent environmental justice work examines the cognitive shift of individuals and groups towards "toxic certainty"-- the normalization of risk and the certainty of exposure to toxic environments (Cannon, 2021).

Adapting Cannon's original definition and integrating it with lessons learned through the practice of participatory research and qualitative methods, this article builds on the concept of 'toxic certainty'. While Cannon develops an understanding of toxic certainty through an analysis of political discourse in a post-disaster community, in this study generated a valuable and descriptive account of how community members employ awareness (Li et al., 2021), critical thinking (Gregory, 1991), and risk assessment (Stein, 2016) to know and perceive environmental health hazards. Specifically, I argue that living under everyday exposure to agricultural risks enables residents to overcome uncertainty through (1) an increased awareness about the requirements for producing and harvesting agricultural commodities in the region. As a consequence, I found that rural residents are uniquely situated to observe and to recognize the intensity and frequency of chronic agricultural emissions. (2) Second, residents overcome uncertainty by thinking critically about the widespread use of agricultural inputs in the environment. Practices of critical thinking have, for instance, positioned residents to adequately imagine and describe the fate and transport of suspected agricultural contaminants across different media. (3) Third, these practices enable rural residents to assess the risk of everyday exposure to agricultural hazards despite the absence of a successful risk communication program for residential exposures. Therefore, counter to research in vulnerable and disadvantaged communities, residential knowledge and perceptions about risk increasingly reflect clarity and certainty about environmental health exposures. In short, the imposition of toxic certainty represents tensions between the risk society's ability to restrict information to experts and the

community's ability to define and interpret risks (Cable, Shriver & Mix, 2008). I argue that residents' complex patterns of knowledge and perceptions of risk shine a critical light on the production of authoritative information about the environment and human health.

CONTEXT AND METHODOLOGY

Case Study Community

The case study community is an unincorporated farmworker community of approximately 1,000 residents situated along the Sacramento River in rural Yolo County. According to the latest demographic estimates, 80% of the population is Hispanic/Latino of Mexican origin while 13% is White alone (ACS, 2017; 2018). Of the total population, an estimated two-thirds work in nearby farms. Despite the wealth produced by the local agricultural industry, between 11-25% of families are thought to live below the Federal Poverty Level. Likewise, its proximity to the University of California, Davis (UCD) does not translate into a high number of bachelor's degrees earned by residents (ACS, 2011; 2017). The political economy of agriculture literature shows that these conditions are not instances of market failure but rather the normal functioning of commodity, real estate, and transnational labor markets in the quest for profits.

Furthermore, as observed in other US communities (London et al., 2021; King et al., 2009), the case study community's unincorporated status translates into chronic underfunding of physical, social, and economic infrastructure. Compared to nearby incorporated places, unincorporated residents depend on county-wide elected officials for the provision of municipal services like police, public transportation, public drinking water, and healthcare-- all of which are presently underserved. Due to the informal nature of community development and local employment trends, agriculturally-structured unincorporated communities remain segregated and unequal. Under these conditions, longstanding residential concerns about environmental health risks are warranted and reasonable. As an initial assessment, I used participatory research and qualitative methods to examine residential perceptions of environmental health risks and any perceived effects of these risks on community health status.

Community-based participatory research

Community-based participatory research emerged as the most appropriate approach for this study on account of residents' concerns over extractive research, whereby university personnel enter low-income communities and communities of color to collect data and then exit. Theoretically, community-based participatory research represents a departure from traditional research because of its focus on ameliorating the power asymmetries underlying the process of knowledge creation and transfer (de la Torre, 2014; Deeb-Sossa, 2019). In practice, community-based participatory research relies on partnership building and participatory research methods as means of promoting values-based questions and community action (Wilson et al., 2018). Additionally, community-based participatory research is thought to improve the rigor, relevance, and reach of empirical research (Balazs & Morello-Frosch, 2013). For vulnerable and disadvantaged communities, community-based participatory research holds the promise of empowerment through increased awareness about --and institutional support for-- local issues (Deeb-Sossa & Manzo, 2018).

Following these principles, a number of local leaders were recruited to formally serve on this project as *promotora-researchers*. Whereas the literature typically depicts *promotoras* as cultural and linguistic brokers between Spanish-speaking residents and research professionals (Johnson et al., 2013), here the role of *promotora* is extended to include the responsibility of project development, implementation, and evaluation. Most importantly, student researchers and *promotora-researchers* share the goal of improving community health status through the process and outcomes of research and collaboration. To prepare for qualitative data collection, the team conducted a series of *promotora-researcher* workshops for the benefit of *promotoras* (as *insiders*) and student researchers (as *outsiders*). At our workshops the team explored topics in community-based participatory research, environmental health and justice, and community resources in the region. *Promotora-researchers* subsequently reviewed, amended and approved our data collection strategies, and further completed CITI-Certification training to work as

participants and data collectors. *Promotora-researchers* were paid in gift cards at the rate of \$20/hour for any time spent on the project (i.e., meetings, workshops, participant recruitment, data collection, evaluation, and review, and community events).

Focus Groups

Qualitative data was collected in a structured form to explore residential perceptions of risk among white and Mexican-origin residents of the case study community. The focus group method was selected to gain an ‘insider’s view’ of the community granted the absence of published accounts about environmental health problems in disadvantaged and unincorporated rural areas like the case study community (King et al., 2009; Malen et al., 2016). To start, the principal investigator drafted a focus group interview guide based on the literature about environmental health in agricultural communities. During our workshops, *promotora-researchers* shifted attention away from questions about disease outcomes to questions about environmental exposures because of the perceived difficulties of exploring medical matters in a group setting. After several rounds of validation and reliability testing, a final interview guide was established in English and Spanish.

Participant recruitment was led by *promotora-researchers* as a result of the target population’s status as hard-to-reach (Goodman, 2011). Recruitment thus followed a non-probability form of snowball sampling beginning with a convenience sample of initial subjects who served as “seeds” through which successive “waves” of participants were included (Heckathorn, 2011). Although the team did not select by race, Spanish-dominant *promotora-researchers* enlisted Spanish-dominant study participants for sessions in Spanish while English-dominant *promotora-researchers* recruited participants for focus group sessions in English. Spanish language focus groups (n=3) were composed almost exclusively of Mexican-origin residents; English language focus groups (n=2) were overwhelmingly white with a small number of Mexican-origin residents.

All five focus groups were subsequently conducted in the span of a week during the fall of 2017. Depending on *promotoras-researcher's* recruitment strategy, the number of focus group participants ranged between four to nine residents per session. Each focus group met once for 1-1.5 hours at either the local family resource center or Methodist church. The sessions were facilitated in English (n=2) and Spanish (n=3) by *promotora-researcher* moderators trained in qualitative interviewing methodology. *Promotora-researchers* followed a list of semi-structured questions to guide the conversation. The sessions were tape-recorded to ensure accuracy of data collection and the tapes were later transcribed verbatim by undergraduate students trained in transcription. Student researchers in attendance kept detailed hand-written notes during each of the sessions. Food and drinks were provided. Upon completion, each focus group participant received a \$25 Walmart gift card. Undergraduate and graduate students provided childcare during the sessions.

DATA ANALYSIS

Using qualitative analysis methods, typed transcripts of each focus group were coded with NVivo11. To guide the analysis, I applied the key themes of (1) physical exposures, (2) pathways of exposure, (3) associated health outcomes, and (4) the contextual dimensions of the community as a place where everyday exposure occurs.

RESULTS

Perceptions of risk

Focus group participants in English and Spanish described regular contact with contaminated media to be a significant risk to the health of community members. Medias of concern included the community's air, groundwater, and soils. According to respondents, the principal source of contaminated media is agricultural nonpoint-source pollution either alone or in combination with other point-sources of pollutants. Participants also demonstrated working knowledge about the fate and transport of suspected

contaminants across different media, leading to perceptions about their potential impacts on community health status.

Perceptions of air

Promotora-researchers asked focus group participants to describe the community's air and their perceptions indicated a general sense of dissatisfaction. While some respondents described the community's supply of "fresh air" as a positive aspect of rural life, they and others similarly acknowledged the quality of the air as potentially dangerous. For example, participants in all focus groups spoke of the threat to local air posed by agricultural emissions in the form of fertilizers, herbicides, and insecticides applied by ground and air. Of these methods, aerial applications were particularly noted with participants suggesting that it was common for pilots to circle over residential areas to spray targeted crops. Similarly, Mercedes, a farmworker and resident of 3-years, pointed at county vector control efforts: "[We also breathe what they spray for mosquitoes]". In addition, participants suffering from respiratory problems emphasized the threat to human health posed by a local grain mill responsible for expelling plumes of fine "dust" into the community every autumn. ["Our cars are covered in dust every morning"], exclaimed Reina, a longtime resident and retired cannery worker who suffers from asthma. "Imagine our lungs!", she retorted.

Perceptions of water quality and soils

Focus group participants were asked by *promotora-researchers* to describe the quality of the water in the case study community. The responses across all focus groups were alarmingly similar. At every session, nearly all respondents perceived residential drinking water as summarily contaminated and of poor quality-- unfit for drinking and cooking. According to respondents, the community's water supply comes from a series of public wells located near the community and quality control problems are generally recognized and readily ascertainable to residents. "Everyone knows that the water is bad for you," exclaimed Dan, a longtime resident and participant of our English-language focus groups, "I have been

told that since I was little.” Participants typically described the community’s water as “dirty,” implying that it may contain trace amounts of soils and sediments. “[Sometimes you’re washing white clothes and it’s left completely dirty],” explained Marina, a 3-year resident and participant of our Spanish-language focus groups. In response, Pamela --a longtime community leader--, suggested that recent groundwater problems were due to the persistence of drought conditions in California, which caused one of the community’s public wells to fail. “[Since the [remaining] well is shallow, it pulls everything including dirt]”, asserted Pamela. Nevertheless, respondents assured us that “everybody” regularly purchases bottled water irrespective of well status.

When asked by *promotora-researchers* to describe the soils and sediments in the case study community, participants expressed a sense of unease. While many reported experiencing “dirt” in their faucets (see above), others expressed concerns over the condition and quality of the dirt itself. According to respondents, the soils and sediments around the community are landing grounds for chemicals such as pesticides, which leads to groundwater contamination. For example, at our English-language focus groups, Johnny, a handyman and resident of seven years, speculated on the depth of local soil barriers to groundwater: “Two of the large farmers told me that the water table is only a few feet. So I’m just putting the math together [...] and there’s not much room for [chemicals] to break up”. Johnny’s assessment was quickly acknowledged and supported by participants despite a lack of conclusive information about the matter (e.g., soil studies and monitoring research). Similarly, during our Spanish-language sessions, Dario, a longtime resident and construction worker, expressed concerns about groundwater contamination through permeable soils: “[All of the orchards and crops are irrigated by hose and everything goes into the ground to be filtered [...] I often wonder if our well water passes through the same grounds]”. Compared to contamination in the community’s air and water, which was more sensible to participants, perceptions of soil contamination were largely inferred based on working knowledge about the fate and transport of suspected contaminants.

Fate and Transport

The scientific study of fate and transport examines how chemicals transform, degrade, and move across surface waters, soil and groundwater (the subsurface), and the atmosphere (Hemond & Fechner, 2014).

Fate and transport models are foundational to comprehensive understandings about the human and ecological effects of historical, current, and future exposures. In practice, human health and ecological risk assessment is a multidisciplinary task that requires insight into aerodynamics, hydrology, geology, chemistry, microbiology, toxicology, epidemiology, statistics, etc. (Troldborg, 2010). During our focus groups, participants demonstrated a working knowledge about the fate and transport of suspected contaminants while providing concrete examples of how the process unfolds theoretically and in their everyday lives as residents of an agriculturally-structured community.

At our Spanish-language focus groups, for example, respondents discussed the pathways by which agricultural pollution impacts human beings through contact with contaminated media. As expressed by Juan, a 20-year resident and construction worker: “[The same chemicals sprayed around town are the ones that affect our water. With all those chemicals, when it rains, they go into the town [...] since we use water for everything, it all comes in and affects you]”. In Juan’s conceptual model of risk (see Figure 1), which participants agreed upon, five specific pathways are considered:

1. Source(s) of contamination
2. Downward vertical transport of contaminants to groundwater table
3. Horizontal transport of contaminants from groundwater aquifer to public wells
4. Upward vertical transport of contaminants from public wells to residential homes
5. Human contact with contaminated media, resulting in pathology

These pathways involve fate and transport of suspected contaminants in air, soil and water, and the effects of human exposure to contaminated media. “[Even if we don’t drink the water, during a shower we absorb it]”, underscored Josefina, a 20-year resident and homemaker.

Likewise, during our English-language focus groups, participants formulated a similar model of risk for the movement of contaminants in the air. As explained by Mary, a longtime resident now retired: “All these chemicals they’re putting on the ground, it’s in the dirt [...] wind comes in, it flies out, and gets into the bodies of adults and children”. Compared to Juan’s conceptual model of risk, Mary’s model emphasized human exposure resulting from the horizontal transport of contaminants from agricultural lands. In both models, participants adequately described a complete pathway between diffuse sources of pollution, a transport media, and an exposure route at the receptor contact point. Counter to prevalent research on environmental risk perceptions in disadvantaged populations, these findings demonstrate a working knowledge and understanding about the fate and transport of suspected contaminants at the community level. Residential perceptions further include insights about the effects of everyday contamination on community health status.

Community Health Status

Focus group participants agreed that, in theory, constant exposure to contaminated media increases people’s risk of developing chronic illnesses. In the community, respondents reported a high prevalence of allergies, asthmas, and cancers that were attributed to both environmental and lifestyle/genetic factors. For environmental factors, participants considered it logical and reasonable to expect community health status to be negatively affected by the chronic presence of agricultural pollution in the environment.

For example, respondents in our English- and Spanish-language focus groups described a number of chronic respiratory conditions they perceived to be aggravated by agricultural pollution. Lourdes, a 10-year resident and homemaker, alleged that her daughter’s allergies and asthma worsened after arriving in the case study community from a rural town located only 10-miles away. Similarly, Marina and Mayra, residents of 3- and 23-years, respectively, reported seasonal summer and winter allergies in their children. “[I think it’s because we live here with all the pesticides and all],” remarked Marina. Elsewhere, in our English-language focus groups, a recently-arrived resident shared initial perceptions about lung health: “it

seems like everyone is sick with this horrible respiratory thing that's just lingering and everyone needs inhalers now." Respondents further agreed that the elderly and those with pre-existing health conditions are particularly at risk for respiratory problems as a result of constant exposure to agricultural hazards.

Place-based factors shaping perceptions

According to John Agnew (2005), the geographical constructs of space and place are inherently related: space is location and place is the occupation of that location. From this perspective, the case study community can be described as the site where everyday exposure occurs. This location is defined by powerful structures and institutions imposing their control and narratives upon the community, thereby influencing how risk is understood and experienced in place (Ibid; Harrington & Elliott, 2015). What, then, are the place-based factors shaping residential perceptions about environmental health risks in the case study community?

Living next to the fields

Residents of the case study community possess acute perceptions and working knowledge of risk due to years of living and working in agriculture. Compared to nearby communities that are similarly surrounded by agriculture, virtually all residential homes in the case study community are located within 3 blocks of active cropland. This dynamic offers residents a front-row opportunity to further awareness about the requirements for producing and harvesting agricultural commodities in the region. During our English- and Spanish-language focus groups, participants demonstrated familiarity with the physical aspects and seasonality of agriculture and so took readily to the idea that residents are constantly exposed to agricultural pollution.

Johnny, a 7-year resident, argued that it is reasonable to expect residents to be exposed to agricultural pollution. "Well, it seems like the more amount of time you reside here and, if you occupy most of your time here and you were doing work in the same area here, then it seems that you never really get any

retreat from being contaminated." For Johnny, living in the case study community implies constant exposure to dangerous chemicals, including those used for local vector control. "If you have ground assaults and aerial assaults combined with a low water table, well now you have no protection so you might as well just start spraying straight poison!" Mabel, a longtime resident, emphasized that pollution is a prominent feature of both rural and urban communities: "[Here we have bad water and in Los Angeles they have bad air.]" Furthermore, Mabel asserted that for residents of the case study community there is a tradeoff between agricultural production and community health status: "[I suspect living close to the fields but the fields are also what brings food to our tables.]"

Working in the fields

Agricultural employment on the part of residents of the case study community appears to sharpen perceptions of risk associated with agricultural pollution. According to a 2018 Census Bureau ACS 5-year Estimate, the case study community demonstrates a higher than expected number of residents working in Farming, Fishing, & Forestry (approximately 21.3 times higher compared to other places). As a farmworker community, it follows that local knowledge of agriculture is well conserved and practiced by farmers and farm employees. This includes firsthand knowledge and perceptions about technological inputs such as pesticides and fertilizers together with their movements in the environment and any potential effects on community health status. During our English- and Spanish-language focus groups, participants shared some of the knowledge gained as a result of agricultural employment.

Dan-- formerly employed by a local crop dusting company--, described quitting his job after learning about the toxic properties of the pesticides he was tasked with handling. According to Dan, the requirement of pesticide handlers to wear personal protective equipment proves that these chemicals are deleterious to the health of the community: "If it's that bad for me to touch it with my hands, then why isn't it bad for them to spray it over our houses?" Similarly, Dario, a Mexican-origin farmworker, added that these chemicals form part of a cascade of events that may lead to a concentration of poor health

outcomes: "[Farmers practice their agriculture but it affects the community. Although everything is following the norms, is regulated and strict, legal and all that, it will always affect us]". Dario's skepticism about regulatory efforts to limit agricultural pollution was shared among farm workers and nonfarm employees during our English- and Spanish-language focus groups. It indicates a general lack of trust with the institutions responsible for risk and its management.

CONCLUSION AND DISCUSSION

The environmental justice literature consistently demonstrates how and why environmental health hazards are disproportionately located near minority and disadvantaged communities in the United States and abroad (Holifield et al., 2018). Using participatory research and qualitative methods, this study finds that residents of the case study community overwhelmingly perceive their community as contaminated by agricultural hazards in the airs, waters and soils, leading to a collective sense of *toxic certainty* regarding exposure and resulting health outcomes. This includes a working knowledge about the potential routes of migration associated with agricultural hazards, namely pesticides. As such, contrary to research in other marginalized and resource-dependent communities (e.g., Greenberg, 2019), our case study demonstrates that residents possess working knowledge and acute perceptions of risk regardless of any affiliations with the main extractive industry-- i.e., agriculture.

As an agriculturally-structured community, qualitative analysis reveals that residents experience toxic certainty resulting from their unique *awareness* about the intensity and frequency of pesticide applications in the community which, in turn, impacts perceptions about the extent of contamination. *Thinking critically* about the fate and transport of chronic agricultural emissions yields working knowledge about the potential for human exposure. This enables residents to adequately *assess the risk* of agricultural hazards to human health despite the absence of a successful risk communication program for residential exposures to agricultural pesticides. Although there is a wealth of research linking human exposure to agricultural pesticides with health disparities including cancers and reproductive outcomes, pesticide

exposures are mainly studied in occupational settings (Teyssere et al., 2020). Due to their proximity to agricultural operations, people residing in rural areas are the subject of greatest concern for experiencing pesticide exposure through pesticide drift (Harrison, 2011). Therefore, it is critical to expand the study of residential exposure to agricultural pesticides, especially among health disparity populations at risk for developing worse health outcomes.

By framing residents' experiences through the heuristic of toxic certainty, this article highlights tensions between the risk society's need to restrict information to experts and the community's ability to define and interpret risks. Whereas residential experiences are typically excluded from decision-making processes that impact the health of rural residents, our case study demonstrates the importance of participatory research and qualitative methods for uncovering valuable and descriptive data that could help guide the creation of risk communication activities founded in knowledge, understanding, and potential barriers faced by the target audience. In particular, the adoption of *promotora-researchers* to oversee research activities including project development, implementation, and evaluation is a powerful model for understanding the historically grown power relations and embodied biopolitics of place while engaging with communities as equal partners in the research process (Montag, 2019). While our study has shown the usefulness of this approach, there are noted limitations, such as our ability to generalize our findings to other farmworker communities in the United States and around the world. Nevertheless, our findings can be analytically generalizable (Yin, 2017) by extending the logic of toxic certainty to examine other similarly situated cases.

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FIGURES

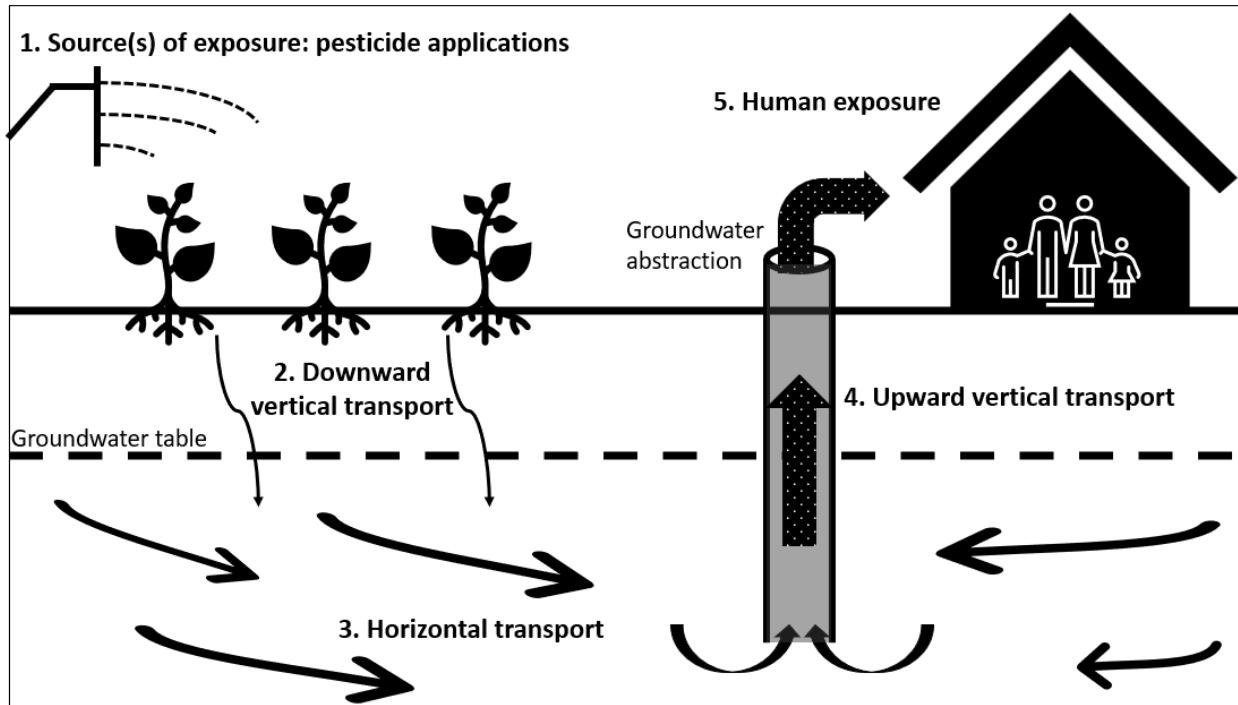


Figure 1: The fate and transport of suspected contaminants as described by rural residents

ARTICLE II

Risk perceptions and the maintenance of environmental injustice in an agriculturally-structured community

ABSTRACT:

In this article, I use the risk society thesis to explain why and how environmental inequality, in this case living near agricultural hazards, is maintained in a farmworker community. I use a community-based participatory research (CBPR) approach to examine a single community case study through participant observation and focus groups (n=5). I focus on participants' perceptions about living near chronic agricultural pollution in the heart of California's Central Valley, where farmworker communities disproportionately suffer from the presence of agricultural hazards (CalEPA, 2021). Results highlight how contextual (place-based) and institutional resources produce an ambiguous climate for community response to environmental inequality. Consequently, the responsibility of managing agricultural hazards in the case study community is relegated to the household and individual levels. I discuss implications of the intersections of risk studies and environmental justice.

INTRO:

This article connects the literature on risk studies and environmental justice in farmworker communities. Risk studies has long examined community responses to risk with an emphasis on environmental, health, and sociotechnological hazards (Burgess et al., 2016). These studies are important for understanding the complex technical, psychological, and social-contextual processes that shape general risk attitudes and behaviors (Tierney, 2014). In California's Central Valley-- the largest and most productive agricultural region in history--, numerous case studies illustrate why and how environmental justice organizations form and mobilize against the siting of landfills and toxic waste (Perkins, 2022) and mass pesticide poisoning events (Harrison, 2011). While the activism that stems from acute contamination incidents

draws attention, much less is known about community responses to chronic forms of pollution and the contextual (place-based) and institutional factors that maintain environmental injustice in agriculturally-structured communities.

My ethnographic research offers deep insight into why and how residents of a farmworker community in California's Central Valley organize themselves around the risks associated with chronic forms of agricultural pollution. These insights highlight the contextual (place-based) and institutional resources that ensure the long-term maintenance of environmental injustice in resource-dependent communities. My article argues that agricultural pollution represents a unique aspect of the risk society: first, agricultural hazards are *subtle*-- mostly emitted by nonpoint sources and difficult to identify (Xu, 2014). Therefore, they represent a more hidden risk compared to fixed sources of emissions from a concentrated area. Second, agricultural hazards are experienced by rural residents *every day*, rather than exclusively through acute contamination crises like pesticide poisoning incidents. So, residents' responses to agricultural hazards offer insights into the attritional lethality of environmental injustice. Lastly, agricultural hazards are *necessary* for producing and harvesting agricultural commodities at scale (Cochrane, 1958). Therefore, residents' beliefs and attitudes towards the local agricultural industry are likely to influence community responses to environmental risks.

I first connect the literature on risk studies and environmental justice in resource-dependent communities. I then describe my community-based participatory research (CBPR) approach and its accompanying methods. An initial assessment of residents' perceptions about the risk of agricultural pollution is supported by an analysis of participant observation results from residents' homes and county offices. I conclude with a discussion about the implications of the intersections of risk studies and environmental justice.

RISK AND RISK STUDIES

Risk studies are mostly composed of technical, psychological, and sociological perspectives. From a technical perspective, ‘risk’ is defined as the statistical probability of a known event occurring (e.g., the chances of landing heads in a coin toss or the likelihood of developing an illness). Key to this understanding rests on the idea that experts can identify and measure risks through technical practices like the use of formal risk assessment tools whose findings may be integrated into various government practices (Gregory et. al, 2009; Fischhoff & Kadvany, 2011; Doron, 2016). Scholars also attempt to measure, predict, and understand how people perceive risk, with cognitive psychologists leading the way. According to the literature, early psychological studies in the 1960s-70s sought to reassure the public about hazards such as synthetic compounds and nuclear power by comparing perceptions of ordinary people with those of experts in scientific-technological knowledge. These studies were quick to characterize public perceptions of risk as “extreme” and “irrational”-- thus paving the way for pioneering research in the 1980s that sought to explore how people perceive different risks; the factors that influence risk perception; and the relationship between public perceptions and public policy (Tierney, 2014).

Chief among these psychological frameworks is what behaviorist Paul Slovic terms the *psychometric paradigm*. This large body of literature posits risk perception as a subjective experience that can be measured via study, observation, and quantification to predict how individuals and groups negotiate and respond to probability, uncertainty, and unpredictability. For example, Slovic (2000) recalls sophisticated risk studies that found expert opinion to be closely aligned with technical estimates of risk while public perceptions were thought to be distorted by other perceived properties of risk including voluntariness, controllability, catastrophic potential, equity, and threat to future generations. Likewise, psychometric research has discovered that risk perceptions are influenced by individual social factors including age, gender, income, ethnicities and race, education, and attitudes towards government (Zhang et al., 2021). According to Tierney (2014), the major assumption underlying psychometric research is that probabilities are difficult to understand so the public relies on often-inaccurate intuitions (or cognitive heuristics) to assess the risk of adverse and uncertain events. For example, Tversky and Kahneman’s (1974) classical

cognitive heuristics-- *availability*, *anchoring*, and *representativeness*-- are heavily cited in the risk perception literature of the past and present.

Since the rise of social construction theory-- which posits risk as the byproduct of discursive practices--, sociological research has gained much theoretical ground by situating risk and risk perceptions within a social context (Tierney, 2014; Burgess et al., 2016). Of note, the cultural/symbolic perspective draws upon the writings of Mary Douglas (1966) who employs a social constructionist approach to hypothesize contemporary responses to risk as expressions of deep-seated cultural knowledge passed down from traditional societies. According to Douglas, ideas and practices about risk serve as cultural strategies used to maintain social cohesion in the face of adverse and uncertain events, conditions (Lupton, 2006; Beamish, 2015). Contrary to Douglas, Ulrich Beck's seminal *risk society* thesis argues that society experienced a major change in the way it maintains social cohesion and that this change occurred in consequence of WWII. For Beck, society's post-war efforts at managing a new inventory of hazards serves as the chief organizing strategy of late-modernity: individuals and institutions are primarily focused on the identification, prevention, minimization, channeling, management, distribution, and avoidance of environmental hazards-- namely, pollution (Hannigan, 2014). In the review that follows, I connect the literature on (1) risk society and (2) environmental justice in agriculturally-structured communities.

Risk society and the maintenance of environmental injustice

Following Beck's thesis, wealth production within "risk societies" is driven by a social compact that emphasizes the public's acceptance of environmental hazards in exchange for the technologies that are associated with modernity (1991). It follows that the institutions that create and manage risks tend to restrict information about such exposures to experts in scientific-technological knowledge (Cable, Shriver, and Mix, 2008; Cannon, 2021). As observed by Cable, Shriver, and Mix (2008), information restriction often translates into a public that is unable to assess specific risks and make informed decisions

about where to live and work, “nor are they prepared to protect themselves from the risks they cannot avoid” (pp. 380-81). In minority and disadvantaged communities, Auyero & Swistun (2008) argue that information restriction may lead to a collective sense of “toxic uncertainty”-- the normalization of risk and the uncertain exposure to toxic environments (Cannon, 2021). For years, the environmental justice (EJ) literature has documented the process of communities overcoming uncertainty and confusion to mobilize against the imposition of toxic environments (Bullard, 1993; Holifield et al., 2018).

At heart, EJ scholarship draws on two important and often overlapping concepts for examining community responses to environmental risks: environmental inequality and environmental racism.

Environmental inequality can be defined as the unequal access to non-toxic environments disproportionately experienced by low-income communities and communities of color (Pellow, 2000).

Environmental racism, meanwhile, is a recurring concept in the EJ literature first used by local activists and national EJ assemblies to describe the official sanctioning of pollutants and poisons in racial and ethnic minority communities (Sutter, 2018). According to EJ scholars and activists, *environmental justice* implies deliverance from all forms of environmental inequality and environmental racism (People of Color Environmental Leadership Summit, 1991). Most importantly, it is argued that the struggle for environmental justice must confront the key institutions responsible for environmental risk and its management (Pulido, 2017).

Numerous EJ studies, for example, document why and how local environmental justice groups form and mobilize in response to the disproportionate burden of industrial pollution and lack of regulatory enforcement in low-income communities and communities of color. Cutting across this research is a focus on communities whose activism has led to the successful remediation of environmental hazards at the local level (Auyero & Swistun, 2008). A central lesson that stems from these studies is that individuals and institutions respond more readily to acute contamination incidents than to chronic yet insidious forms of environmental hazards (Altman et al., 2011). While the activism that stems from acute contamination

incidents draws attention, much less is known about the ways in which communities negotiate and respond to more subtle and long term forms of exposure. Farmworker communities, because of their unique ties to the production and extraction of resources, provide for valuable cases in examining the contextual (place-based) and institutional factors that ensure environmental injustice.

The case of agriculturally-structured communities

Since WWII, society's adoption of agricultural science and technology has raised agricultural productivity across the world. And society, according to Beck (1991), has organized itself to account for these changes. Agricultural activities that cause pollution include barnyard and feedlot operations, cropland management, processing, and the use of heavy machinery. These activities are known to produce excesses in livestock waste, grain particles, fertilizers, herbicides and insecticides, oils, grease, and other toxic hazards. In California, the state's Office of Environmental Health Hazard Assessment (OEHHA) demonstrates that Central Valley communities are disproportionately burdened by the presence of agricultural pollution (e.g., drinking water contamination and extensive pesticide applications; CalEPA, 2022). Likewise, OEHHA ranks many Central Valley census tracts in the topmost percentiles for population characteristics such as low educational attainment, linguistic isolation, poverty, and unemployment. Similar cases of environmental inequality have been reported in other resource-dependent communities, which often organize to live with the risks posed by extractive industries (Greenberg, 2019).

In Greenberg's (2019) assessment of resource-dependent communities, it is argued that community context and industry trust may determine a community's ability to mobilize against environmental inequality. Citing examples from mining and natural gas, Greenberg notes how extractive industries commonly supply the majority of jobs in rural areas, which decreases the likelihood of residential opposition to the risks posed by industry. In Appalachia, for instance, research shows that most residents have yet to mobilize against the local coal industry despite the constant risk of drinking water

contamination from coal slurry impoundments-- and industry trust is widespread. Together with employment patterns, Greenberg posits community support for extractive industries as potentially driven by factors such as industry-led public relations campaigns, the prevalence of market-based ideologies, residential conceptions of 'home,' and time since the last acute disaster event in the region. While the subject of community (non)response to environmental hazards in Appalachia draws considerable scholarly attention, relatively less is known about the ways in which farmworker communities negotiate and respond to the risk of everyday exposure to agricultural hazards. Until now, most environmental justice studies in farmworker communities emphasize the process of mobilization following acute contamination incidents like mass pesticide poisoning events (Harrison, 2011; Berkey, 2017).

COMMUNITY CONTEXT AND METHODOLOGY

Knights Landing, California, is an unincorporated, farmworker community with undocumented environmental health risk concerns. Despite local activism against healthcare and educational dispossession, the community has not experienced a widespread and sustained movement for environmental justice. According to the latest demographic estimates, Knights Landing's population is composed of Hispanic/Latinos (90.82%) and white non-Hispanics (9.17%), and of the 981 residents, approximately 24.6% are ranked below the poverty level (United States Census Bureau, 2020).

Furthermore, the US Census Bureau estimates that Knights Landing exhibits a higher than expected number of residents working in Farming, Fishing, & Forestry (approximately 21.3 times higher compared to other places). While the region has historically relied on the cultivation of high value commodities like tomatoes, melons, cucumbers and beans, industry changes have led to a growth in fruit and nut production that requires year-round maintenance. Concurrently, the community continues to face acute challenges posed by California's ongoing droughts and seasonal wildfires. Knights Landing is a good candidate for an environmental justice study, given its demographic profile; its connection to agricultural production; and its long-standing concerns about environmental health exposures.

Despite the lack of comprehensive information about environmental risks in the Knights Landing community, background research of publicly available data reveals two important facts about the area:

1. CalEnvironScreen 3.0 ranks the two census tracts surrounding KL in the top 55-70% when accounting for environmental exposures in California (CalEPA, 2020). Of note, indicators for exposures such as ozone, pesticides, impaired water, and solid waste.
2. County measurements of arsenic in the public drinking water approach the state maximum contaminant level of 10ppb (maximum of 6.9ppb in 2015, 8.2ppb in 2014, and 8.2ppb in 2013; Consumer Confidence Reports by the Knights Landing Service District).

These findings corroborate the presence of environmental hazards in the Knights Landing area. In a previous study (Aranda, 2022), I discovered that residents of the case study community are not only aware of environmental hazards but they possess a working understanding about the sources, pathways, and consequences of human exposure to suspected contaminants such as pesticides, low-quality drinking water, and particulates in the air. Despite these insights, however, and despite concerns that agricultural hazards are impacting community health status, a widespread and sustained environmental justice movement against agricultural pollution has yet to develop in the case study community. In what ways, then, do residents of a farmworker community respond to the risk of living under chronic agricultural pollution and why?

Community-based participatory research (CBPR)

In order to explore how rural communities perceive, respond to, and live with the risk of chronic agricultural pollution, I conducted community-based participatory research (CBPR) consisting of participant observation and focus groups (n=5). Following a CBPR approach, community members and I shared in the responsibility of project development, implementation, and evaluation (Manzo et al., 2020). This is important because local residents are the experts on the environmental hazards they experience, and most cases of environmental exposures are first reported by community members (King et al., 2007).

Further, CBPR is cited by environmental justice scholars as a powerful investigative approach for improving environmental conditions given its imperative of centering local concerns and knowledge (Bacon et al., 2013). In this study, *promotora-researchers* and I shared in the goal of improving community health status through the process and outcomes of environmental justice research.

Promotora-researchers

In anticipation of data collection, a number of community members formally joined this study as *promotora-researchers*. Typically the academic literature depicts *promotoras* (or community health advocates) as cultural and linguistic brokers between Spanish-speaking communities and research professionals (Johnson et al., 2013). In this study, the roles of *promotoras* were extended to include research question development, study design, participant recruitment, qualitative research training and implementation, and project evaluation. A total of five residents representing the Knights Landing community completed CITI-Certification training to fulfill the role of *promotora-researchers* on this study. *Promotora-researchers* were paid in gift cards at the rate of \$20/hour for any time spent on this study including meetings, workshops, and community events (See Aranda, 2022c for a full description of methodology).

Participant observation

Participant observation is described by Kearns (2016) as a method used by researchers to explore “the meanings of place and the contexts of everyday life” (pp. 317-18). While the more structured forms of data collected focused on risk perceptions and behaviors (see below), I employed participant observation to better understand the social, geographical, and institutional contexts behind residential responses to everyday exposure. From the start of the project until the end of its funding (approximately 3 years), I conducted participant observation of recruitment meetings, resident’s homes, county offices, and community events. Although the method of participant observation is thoroughly explored in the social sciences, there is little consensus about how to execute it in the field (Kearns, 2016; Conroy, 2017). In my

community case study, I performed participant observation through the use of research logs with field notes recording my experiences and interpretations of participants' meanings and perceptions.

Additionally, my observations draw on agendas and minutes, attendance logs, recruitment material, powerpoint slides, and post-data collection interviews with *promotora-researchers*.

Focus groups

Qualitative data was collected in a structured form through the use of community-led focus groups (n=5) in English and Spanish. The target population's hard-to-reach status (Goodman, 2011) prompted *promotora-researchers* to initiate focus group recruitment following a non-probability form of snowball sampling beginning with a convenience sample of initial subjects who served as "seeds" through which successive "waves" of participants were added (Heckathorn, 2011).

All five focus groups were conducted in the span of a week during the fall of 2017. The number of focus group participants at each session ranged between four to nine adult residents. Although we did not select by race, Spanish-dominant *promotora-researchers* enlisted Spanish-dominant study participants for sessions in Spanish while English-dominant *promotora-researchers* recruited participants for focus groups in English. Spanish language focus groups (n=3) were composed entirely of Mexican-origin residents; English language focus groups (n=2) were overwhelmingly white with a small number of Mexican-origin residents. Each session met once for 1-1.5 hours at the local family resource center or methodist church. Sessions were moderated by *promotora-researchers* following a focus group interview guide composed of eight semi-structured questions that was developed and validated in collaboration with myself. Audio was tape-recorded to ensure accuracy of data and tapes were later transcribed verbatim by undergraduate students paid and trained in transcription. I kept detailed hand-written notes during each of the sessions. Food and drinks were provided and, upon completion, each focus group participant received a \$25 gift card. Undergraduate and graduate students provided childcare during the sessions.

DATA ANALYSIS

Qualitative data was organized inductively into themes and subthemes on the basis of my observations and focus group results of two broad areas: (1) subtle and everyday exposures and (2) necessary exposures. The NVivo 11 qualitative data analysis program was used to independently code the transcripts and test the reliability of themes.

RESULTS

I. AGRICULTURAL HAZARDS ARE *SUBTLE AND EVERYDAY*

My ethnographic research demonstrates the ubiquity of agricultural hazards in the community, which leads residents to perceive a need for science information to visualize residential exposures. For example, when asked by *promotora-researchers* to describe any potential environmental hazards in the community, focus group data indicates that residents perceive they are regularly exposed to pesticides, low-quality drinking water, and polluted air. Of these, pesticides are particularly noted because of the perceived intensity and frequency of applications in the area. As indicated by Efren, a longtime resident and farmworker: [“You see today they add much more pesticides than ever. They used to add it before but now it’s too much, all summer-- for one thing or another.”] Similarly, at another session, Marissa--new to the community-- remarked: “I moved here from Capay Valley ... Here agriculture is a lot different. [In Capay Valley] you don’t hear crop dusters fly over doing circles.” Lou, a longtime resident now retired, further alluded to the proximity of pesticide applications to residential homes by stating: “the airplanes themselves are allowed to fly and they go right over our houses as low as they want!”

These testimonies indicate that residents perceive they are constantly exposed to environmental hazards through daily contact with contaminated media. According to participants, the principal source of contaminated media is agricultural nonpoint-source pollution either alone or in combination with other point-sources of pollutants. Compared to point-sources of agricultural pollution in the community (e.g., respirable dust released seasonally from a local grain mill), nonpoint-sources of agricultural pollution like

pesticides and fertilizers represent a more hidden risk because they are very difficult to identify, prevent, and manage (Qin, 2014). In Knights Landing, the subtleness and everyday nature of agricultural nonpoint source pollution is illustrated most dramatically through residents' perceptions of contaminated air and water as the exposure contact point with pesticides following intense and frequent applications in the area. Since chemical pesticide compounds are invisible to the naked eye, constant applications prompt residents to assume that pesticide toxins are prevalent in their physical environment. "If they tried to make these fields out here organic it would take a hundred years!", exclaimed Mikey-- another recent resident and focus group participant.

In response to the subtle and everyday risk of agricultural pollution, participants of all focus groups described undertaking a number of individual and household measures to manage exposure. "[At my house we always-- since forever-- buy bottled water. We don't drink from the faucet]," remarked Dario, a longtime resident and environmental compliance officer. "[At my house, too]," replied Pamela, longtime resident and community leader, while adding that residents regularly boil water for meal preparation. Across all focus groups, participants shared a similar sentiment: "I don't mind showers and washing dishes and washing the laundry, but drinking it is out of the question for me. I wouldn't do it," exclaimed Mary, a retired resident of ten years. Likewise, residents described the use of respiratory medicines and portable air filtration devices as means of protecting themselves against bad air quality. "[Dark, dark, dark]," remarked Estrella, a longtime resident and farmworker, when asked to describe the household air filter unit upon replacement. As indicated in participants' testimonies, residents perceive they are limited to purchasing bottled water and filters as means of managing the risk of exposure to agricultural hazards. Furthermore, my data indicates that residents perceive individual and household mitigation efforts as part of the normal functioning of community life. "Everyone" in Knights Landing buys bottled water, according to participants.

Visualizing exposure

While focus groups demonstrate residential perceptions of risk and their accompanying management efforts, participant observation confirms that residents perceive a need for science information as a visualization of the otherwise invisible risk posed by agricultural pollution. Specifically, I observed that residents were interested in establishing a scientific study that measures and interprets data collected from their physical and bodily environments. For example, my household observations show that residents express a willingness to participate in research involving the collection of public well water from residential faucets to examine the presence of toxins-- namely pesticides. Likewise, residents agreed to participate in hypothetical studies involving the collection and analysis of data obtained from human subjects as means of measuring the presence of suspected contaminants in the bodies of community members. As one of my interlocutors remarked, “[You can take some of my blood to see what’s there]!”

From the perspective of residents, the use of biological data and statistics will increase awareness and political commitment to address environmental injustice at the local level. In particular, I observed residents express a need for comprehensive studies “like in ‘Erin Brockovich’” that will thoroughly investigate the community’s longstanding and undocumented concerns over environmental health risks related to agricultural pollution. It follows that biological sampling was specifically noted for its perceived ability to reveal the truth about contamination by using human bodies as proxy data of environmental exposures. For residents, the detected presence of suspected contaminants in the bodies of community members will effectively prove to local government and health officials that unsafe levels of pollution are found in the area. “[And then the County can decide what to do with that information],” concluded another of my interlocutors, referring to the local authorities. In summary, I observed a strong perception among residents that if science information is collected and communicated to government and health officials, this information will impact policy and decision-making about local environmental exposures.

These accounts illustrate several points. First, Knights Landing residents' perceptions of risk are such that they have been exposed to so much agricultural pollution that any sense of uncertainty and confusion about exposures is all but extinguished. Rather, my observations indicate that residents have overcome toxic uncertainty to reach a collective sense of clarity and understanding about agricultural hazards in and around the Knights Landing community. Second, that while the majority of residents I encountered perceive agricultural pollution as impacting community health status, all are unable to prove it. Instead, in practice, residents often default to the most logical explanation about the health impacts of everyday exposure: "It *has* to affect you," underscored one of my interlocutors. Lastly, residents' inquiries about establishing a scientific study are in line with Brown and Mikkelsen's (1990) theorization of "popular epidemiology" as a process by which local communities search for what is true and false about contamination. While "popular epidemiology" focuses on the experiences of communities appropriating science information to successfully mobilize against risk, my case study highlights the Knights Landing community's perceived need for science as a factor that serves to maintain environmental injustice.

Together, my ethnographic research is suggestive of how risk societies tend to privilege scientific-technological knowledge above local knowledge to explain and manage exposures (Beamish, 2015). As indicated by Beck (1991), modern hazards like agricultural nonpoint source pollution and their consequences are difficult to calculate and understand, leading to an over-reliance on experts in scientific-technological knowledge to define and interpret risks. In Knights Landing, a farmworker community, qualitative research reveals that residential responses to agricultural hazards are indeed shaped by a lack of information about risk. Although residents have overcome toxic uncertainty to the point of explaining the sources, pathways and consequences of human exposure to suspected contaminants (Aranda, 2022), a need is perceived for scientific evidence to back these claims. However, for residents, this obstacle represents a mere formality-- a practice that is done simply to comply with the dominant set of beliefs about disease and its causes held by science, government, and industry (Brown et al., 2011). Without this evidence, local knowledge about exposures is perceived to be as invisible as the risks themselves.

II. AGRICULTURAL HAZARDS ARE *NECESSARY*

Another key finding from my ethnographic research is that agricultural hazards are perceived to be *necessary* in terms of the income earned from the production of agricultural goods and services in the region. Consequently, residents of Knights Landing perceive a need for county support to regulate the local agricultural industry. For example, I commonly observed residents describe their residency in the community relative to employment opportunities in nearby farms. “[Above all, one establishing themselves in this town-- more than anything-- on account of work because you can make a better living here than where you’re from],” declared Artemio, a longtime resident, farmworker, and focus group participant. Particularly among Mexican-origin immigrants, residents agreed that Knights Landing is an ideal place to live given the demand for farm labor in the area together with other factors such as lower costs of living and small town feel.

As my CBPR project developed, I was informed that agricultural holdings in Knights Landing are traditionally passed down from one generation of farmers to the next and, unlike absenteeism, the owners and operators of local agriculture tend to live and work in the area. I observed that these individuals are typically held not as polluters but as prominent fixtures in the community, responsible for producing and maintaining local employment in the face of persistent challenges. Under these circumstances, questions about agriculture’s role in polluting the community are confused and misconstrued as an indictment against the local businesses responsible for sustaining community life. For example, Mabel-- a longtime resident, farmworker, and focus group participant-- remarked: “[Well, I think living next to the fields is risky but the fields are what brings food to our table].” As a result, a careful response based on science and local guidance from the community’s de facto government is perceived as the most realistic way of approaching polluters.

Alerting the county

As an unincorporated community, Knights Landing residents depend on the leadership of county-wide elected officials for the provision of municipal services like police, public transportation, public drinking water, and healthcare. During my ethnographic fieldwork, I often observed residents invoke the county's regulatory powers in response to residential concerns about environmental health risks. According to my conversations with residents and *promotora-researchers*, if the county governs the Knights Landing community, it makes sense to assume that the county will do something about suspected exposures. As such, I met with county health officials to communicate residents' needs and concerns. In doing so, I became aware of Knight Landing's unincorporated status as an obstacle working against residents' efforts to address environmental injustice. Specifically, I observed that unincorporation may lead to uncertainty and confusion over who is responsible for investigating and managing risk at the community level.

During my meetings with county health officials, I observed that, despite residents' beliefs in the county's regulatory powers, there is a perception among officials that the county is limited in its ability to investigate and respond to community needs and concerns regarding pesticide risk. For example, when asked about county efforts to assess the risk of pesticide exposure on the health of rural residents, officials deferred to the state's Department of Pesticide Regulation (DPR) which has the capacity to conduct sophisticated human exposure evaluations in occupational and non-occupational settings. Rather, I was informed that the county is restricted to collecting health and community data for policy and decision-making purposes, and that these studies are not designed to assess the risk of human exposure to local environmental hazards (e.g., a longitudinal study design assessing associations between exposures and outcomes in Knights Landing and in a comparison community). Similarly, when asked about the county's enforcement strategies for residential pesticide exposure, officials cited the Agricultural Commissioner's authority to levy administrative fines for violations of state laws and regulations concerning agricultural pesticide use. In either case, officials noted that it usually takes something "big" to trigger a response from these agencies. For example, the publishing of new toxicology data about the adverse health effects of pesticides or a major contamination incident.

Compared to incorporated communities with city councils and ordinances, my observations show that Knights Landing's unincorporated status further serves to maintain environmental injustice by creating an ambiguous regulatory path for residents to address exposures. With the establishment of local leadership at the county level, community members and county health officials alike share in the belief that residential exposure to agricultural pollution is a problem that is addressed through external support and guidance from others. Residents, for example, perceive a need for science information as means of triggering a county response. County health officials, meanwhile, perceive that their investigative and regulatory enforcement powers are limited by the absence of a clear mandate to address residential exposures. Without a clear recourse for residents who believe they are suffering from the long-term health effects of agricultural pollution, environmental injustice will remain silent and hidden.

My observations are illustrative of how unincorporation serves to maintain environmental injustice in farmworker communities. As in the case of petitioning county health officials to consider residents' needs and concerns about everyday exposure, it is clear that any proposal to address environmental injustice in these communities will require a substantial investment of both resources and political capital. More pointedly, these accounts draw attention to the dominance and influence of the local agricultural industry in shaping community perceptions and responses to everyday exposure. Through their testimonies, residents raise doubts about the efficacy of challenging the main industry responsible for providing employment and income opportunities in the community.

Together, my observations demonstrate, quite strikingly, the *labor of confusion* performed by the institutions responsible for risk and its management in the Knights Landing community. Defined by Auyero & Swistun (2008) as strategies performed, not necessarily intentionally, by government and industry to obfuscate otherwise simple and clear situations, the labor of confusion makes it difficult for residents to assign blame for contamination. Although residents possess a working understanding about the sources, pathways and consequences of human exposure to suspected contaminants (Aranda, 2022),

government and industry actors complicate the path towards environmental justice through confusing and contradictory messages over who bears responsibility for investigating and managing risk at the community level. Is the responsibility of local farmers as the principal sources of pollution? If so, to what extent are county regulators investigating and litigating suspected agricultural pesticide use violations? Or perhaps the local service districts are responsible for managing air and water quality? And what about residents-- why do people live in Knights Landing if they perceive it as polluted? As a result of these uncertainties, residential responses to risk fall short of proscribing any concrete action plans for remediation because of the perception that such remedies might translate into the loss of much of the economic vitality of the community. Instead, the responsibility of managing agricultural hazards in the case study community is relegated to the household and individual levels.

CONCLUSION

My ethnographic research demonstrates the ubiquity and necessity of agricultural risks in the case study community, which leads residents to perceive a need for science information and county support to navigate the path toward environmental justice. My findings illustrate how the path is complicated by the community's status as an agriculturally-structured unincorporated community governed by the county. Specifically, I argue that residential activism against environmental injustice is blunted as a result of the *labor of confusion* performed by the institutions responsible for risk and its management: the county and the local agricultural industry. This produces an ambiguous climate for unincorporated residents of a farmworker community to address environmental justice concerns, especially when a need to demonstrate causality of health outcomes is perceived by residents as a starting point for triggering a government response against industry. Likewise, my case study illustrates how remediation strategies are perceived to be beyond the resources of either residents or local levels of government to effect because such interventions-- like the grounding of crop dusters-- might in fact mean the loss of economic vitality in the

community. As a result, the responsibility of managing the risk of everyday exposure is relegated to the household and individual levels while environmental justice remains a distant objective.

By framing residential perceptions of risk through the analytic of environmental justice, this article highlights the contextual (place based) and institutional factors that shape environmental risk and safety in a farmworker community. These insights, in turn, add empirical strength to risk society theories emphasizing social responses to risks that are created by modern agriculture and industrial production technologies. In doing so, the case of Knights Landing provides explanatory support for cultural and institutionalist theories of risk, extending them to illustrate how low-income communities and communities of color negotiate and respond to the social production of uncertainties surrounding the identification, management, and avoidance of agricultural pollution. These complex responses unfolding in resource-dependent, unincorporated communities resonate with recent work by Cannon (2021) on toxic uncertainty as a mechanism of environmental injustice. My case study extends this work by providing a deep ethnographic account of disadvantaged communities in a landscape dominated by industry. Findings here are analytically generalizable to similarly situated communities particularly in California's Central Valley with respect to resource dependency and the production of environmental risk.

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ARTICLE III

Establishing open communication and equity in a transdisciplinary and community-based research partnership for environmental justice in a farmworker community

ABSTRACT

I critically examine the development of a transdisciplinary and community-based research partnership that was established to address environmental justice concerns in a Northern California farmworker community. I first describe our environmental justice research project. Next, I identify key challenges in conducting environmental justice research in a farmworker community, highlighting open communication and equity. I then identify three factors that helped our team strike a balance between academic collaborations and community-based research partnerships to address environmental justice concerns. Throughout the paper I use examples from our project to illustrate issues. I conclude with recommendations.

INTRO

As an academic subject, environmental justice largely draws attention to the role of industry and waste in the complex pattern of disparate health status on the basis of race and class (Holifield et al., 2018; Morello-Frosch et al., 2002). With a focus on cities, environmental justice scholars have since the 1980s contributed to the literature from a number of theoretical and empirical standpoints, including the use of quantitative, qualitative, and mixed methods approaches. However, since the early 2000s, the experiences of rural communities has gained renewed significance in the environmental justice literature. Cole and Foster's "From the Ground Up," for example, documents the activism of low-income, rural Latinos responsible for halting the expansion of a hazardous waste landfill located near residents' homes in the Central Valley community of Kettleman City, California. Since its publishing in 2001, Cole and Foster's case study has cemented the imperative "We speak for ourselves" as a key principle of the environmental

justice movement as it privileges the voices, experiences, and knowledge of communities living under environmental health risks. Compared to urban areas, rural settings present a unique challenge to doing environmental justice research given the general unavailability of baseline environmental monitoring data combined with small population sizes that limit the power of epidemiological studies to link industrial sources of pollution with environmental health outcomes in rural contexts (Johnston and Cushing, 2020). This presents a need for additional research on account of rural communities' increased risk of experiencing structural and environmental inequalities.

This article describes a transdisciplinary and community-based participatory approach to environmental justice research in a rural Northern California farmworker community. I discuss the realities to doing environmental justice research in rural communities, namely the problems of open communication and equity. Next, I identify several challenges in establishing open communication and equity while conducting community-based, environmental justice research. I then identify three factors that have helped us navigate these challenges while striking a balance between academic collaborations and community partnerships. Throughout I use examples from our community-based participatory research partnership between residents of a farmworker community and graduate student researchers of seemingly opposing disciplines. I conclude with a few recommendations.

TRANSDISCIPLINARY AND COMMUNITY-BASED RESEARCH IN A FARMWORKER COMMUNITY

Transdisciplinary research is defined by de la Torre (2014) as a collaboration of researchers working under a shared conceptual framework by combining their respective theories, concepts, and approaches to address common problems. A transdisciplinary approach is particularly important for community-based participatory research, argues de la Torre, because its reflexive nature creates the perfect environment for bringing “different perspectives to address community issues of concern and a greater awareness of how to partner effectively with communities of interest” (pg. 120). Further, recent environmental justice

scholarship has argued that the field is overdue in its embrace of transdisciplinary perspectives (London, Sze, & Cadenasso, 2018). According to London, Sze & Cadenasso (2018), transdisciplinarity is crucial for the vitality of the field given the inherent dualities and contradictions of employing a plurality of approaches to environmental justice research. It is therefore argued that transdisciplinarity is, “especially important while conducting research on complex social-ecological systems such as regional waterscapes and urban agricultural landscapes that no one discipline can fully encompass” (pg. 259). Combined with community-based participatory approaches, the authors draw on Stokols (2006) to propose *transdisciplinary action research* as a powerful framework for navigating the disciplinary silos of understanding and practice towards a more meaningful account of the social and ecological dimensions of environmental injustice.

Our community-based, transdisciplinary environmental justice research approach and partnerships were developed in 2017 between residents of a farmworker community and graduate student researchers in the social sciences and laboratory sciences (See Table 1 for a timeline of research activity). Residents’ longstanding and undocumented concerns over environmental health risks prompted the need for an environmental justice research project in the case study community. The graduate student researchers who assumed leadership roles on the project included the author, a Chicano human geographer trained in mixed-methods research, and my colleague, a white toxicologist trained in environmental science. Further, this project attracted a number of undergraduate and graduate students to form part of our research either directly or indirectly through complementary projects of their own. These included students majoring in a variety of college disciplines including: Chicana/o Studies, Public Health Sciences, English, Animal Sciences, Environmental Studies, and Neurobiology, Physiology and Behavior.

The residents who initially assumed leadership roles on the project included Mexican-origin women (n=3) and a white women (n=1), representing both the Mexican-origin and white communities. Mexican-origin residents became aware of our plans to conduct an environmental justice research project mostly through

their involvement in a local women's group, and white residents were primarily contacted by graduate student researchers through the Methodist church. Residents' backgrounds ranged from concerned mothers to local leaders with and without direct experience in agriculture. As our project unfolded, the number of resident leaders fluctuated slightly. Following qualitative data collection, for example, one Mexican-origin resident left the project for personal reasons while two additional residents joined (Mexican-origin and white, respectively).

It was at our initial project development workshops that residents agreed to form part of an environmental justice study on the grounds of shared leadership and ownership over project design and implementation. The community partnerships we developed between 2017-2019 ensured that different organizations became aware of the community's efforts to document residential concerns over environmental health risks (see Table 2 for complete list of community partners). Notably, my colleagues and I consulted with county health officials to assess the availability of local health and exposure information for us to build on. For example, we acquired the latest countywide community health assessment, which indicates that diabetes, cancer and obesity are perceived by a sample of respondents to be the health issues most affecting the region (Community Health Assessment Regional Report: North East Region, 2014). The same sample ranked pesticide use, cigarette smoke, and lack of access to places for physical activity as the environmental issues most responsible for health issues. Our transdisciplinary approach was also intended to cover a number of study designs and methods for documenting residential concerns over environmental health risks related to agricultural pollution-- namely pesticides.

In anticipation of data collection, we conducted dozens of research development workshops designed to be of mutual benefit for residents (as *insiders*) and graduate student researchers (as *outsiders*). Scammell & Howard's *Guide for Making Informed Decisions* (2013) became a valuable resource for structuring discussions about the many types of environmental justice studies, the risks and benefits of conducting one, and our motivations as researchers/residents for doing so. Concurrently, we explored the principles

of community-based participatory research through a series of presentations led by graduate students and a university professor. Residents subsequently reviewed, amended and approved our data collection strategies, and they completed CITI-Certification training to work as *promotora-researchers* on this study at the rate of \$20/hour (IRB # 1042462-4). In the literature, *promotora-researchers* are described as community health advocates that not only conduct outreach and education but are actively engaged in the research process (St. John et al., 2013).

Participatory data collection and approach

As an initial assessment of environmental health and risk, we performed participatory research by collecting qualitative and mixed-methods data. In the subsequent phase, the quantitative phase, we drew on our initial results to perform environmental sampling of suspected contaminants (not included in this dissertation). After careful deliberation, our research partnership identified a *sequential transformative design* as the best approach for triangulating our respective strengths and assets to document residential concerns about environmental health risks. According to Mertens et al. (2010), a *sequential transformative design* is situated at the intersection of mixed-methods and social justice. It can go from qualitative to quantitative or the converse, so long as research activity is grounded in a philosophy that challenges social inequality and injustice (Mertens, 2007).

Following this approach, our research partnership agreed on a transformative study design that employs qualitative methods to document residential perceptions of risk (phase I) for the purpose of identifying variables for quantitative development through toxicological methods (phase II). Concurrently, we performed a cross-sectional community health survey as part of phase I to document the prevalence of disease and risk factors at a fixed point in time. As a geography graduate student trained in qualitative research and mixed methods, our transformative design enabled me to capacitate *promotora-researchers* to execute phase I while my academic colleague-- a toxicology graduate student-- relied on our qualitative findings to perform laboratory analyses of suspected contaminants. To strengthen our efforts, *promotora-*

researchers assisted in creating and validating qualitative and mixed-methods study instruments (see below) while advising on the best methods for environmental sampling in the area (e.g., we were advised to sample for the presence of pesticides during peak and off-peak periods of agricultural activity for a more representative assessment of community exposure). This approach reflected the need of local residents to document the perceived-high prevalence of environmental health risks through both qualitative and quantitative methods (see Aranda, 2022b for a more complete assessment).

Qualitative research

Participant observation

Participant observation is described by Kearns (2000) as a method used by researchers to explore “the meanings of place and the contexts of everyday life” (pp. 317-18). While the more structured forms of data collected focused on risk perceptions and behaviors, I employed participant observation to better understand the social, geographical, and institutional contexts behind everyday exposure to agricultural hazards. From the start of the project (Summer 2017) until the end of its funding (Summer 2019; see Table 1), I conducted participant observation of recruitment meetings, partnership meetings, residents’ homes, county offices, and community events. *Promotora-researchers* assisted in introducing me to various notable community organizations from which I collected data such as Empower Yolo; Rise, Inc. Woodland; Catholic Church; Methodist Church; and two local elementary schools (see Table 2). Although the method of participant observation is thoroughly explored in the social sciences, there is little consensus about how to execute it in the field (Kearns, 2000; Conroy, 2017). On this project, I performed participant observation through the use of research logs with field notes recording my experiences and interpretations of participants’ meanings and perceptions. Additionally, my observations draw on agendas and minutes, attendance logs, recruitment material, powerpoint slides, and post-data collection interviews with *promotora-researchers*.

Focus groups

Qualitative data was collected in a structured form through the use of community-led focus groups (n=5) in English and Spanish. The focus group method was selected to gain an ‘insider’s view’ of the community given the absence of published accounts about environmental health risks in the case study community. Focus groups are particularly useful for community-based studies and for studies requiring community-level rather than personal information (Kieffer et al., 2009). They promote a free-flowing discussion which allows participants to express attitudes and opinions about specific topics (Bers, 1989), while its interactive nature permits elaboration through the sharing of ideas (Saumure, 2001). Exploratory focus groups served as a foundation for this study insofar as subsequent steps were rooted within the experiences, concerns, and goals of residents.

During our project development workshops (see below), I drafted a focus group interview guide based on the literature about environmental health in agricultural communities. *Promotora-researchers* shifted attention away from questions about disease outcomes to questions about environmental exposures because of the perceived difficulties of exploring medical matters in a group setting. After several rounds of validation and reliability testing, a final interview guide was established in English and Spanish. It contained eight open-ended questions organized into three sections. The introductory section explored participants’ residency in the case study community and how the local environment changed over time. The second section consisted of key questions exploring residential perceptions about environmental health risks and how community members mediate suspected exposures. The final section explored participants’ thoughts about living in an agriculturally-structured community and how it can be improved, or not, to promote health. In preparation, each *promotora-researcher* and I participated in mock focus group sessions to practice the role of moderator.

The target population’s hard-to-reach status (Goodman, 2011) prompted *promotora-researchers* to initiate focus group recruitment following a non-probability form of snowball sampling beginning with a convenience sample of initial subjects who served as “seeds” through which successive “waves” of

participants were added (Heckathorn, 2011). Although we did not select by race, Spanish-dominant *promotora-researchers* enlisted Spanish-dominant study participants for sessions in Spanish while English-dominant *promotora-researchers* recruited participants for focus groups in English. Spanish language focus groups (n=3) were composed entirely of Mexican-origin residents; English language focus groups (n=2) were overwhelmingly white with a small number of Mexican-origin residents. Focus group participants reflected a non-stratified sample of community members. In this study, two of three *promotora-researchers* moderated two focus groups each while one *promotora-researcher* moderated one session.

All five focus groups were conducted in the span of a week during the fall of 2017. The number of focus group participants at each session ranged between four to nine adult residents. Each session met once for 1-1.5 hours at the local family resource center or methodist church. Sessions were moderated by *promotora-researchers* following a printed copy of the focus group interview we developed and validated together. Audio was tape-recorded to ensure accuracy of data and tapes were later transcribed verbatim by undergraduate students paid and trained in transcription. I kept detailed hand-written notes during each of the sessions. Food and drinks were provided and, upon completion, each focus group participant received a \$25 gift card. Undergraduate and graduate students provided childcare during the sessions.

Photovoice

To further document the experience of living under environmental risk, a subsample of focus group participants were recruited by *promotora-researchers* to form part of a photovoice project (n=6 individuals). According to Wang & Burris (1997), photovoice is a method that enables people to “identify, represent, and enhance their community through a specific photographic technique” (pg. 369). Using a project flier, *promotora-researchers* announced our plans for conducting a photovoice project at the conclusion of each focus groups session (n=5). Interested participants provided *promotora-*

researchers with their respective contact information and they were contacted either in-person or by telephone for directions about receiving a camera with instructions.

Although I set out to document community responses to risk, photovoice instructions reflected *promotora-researcher's* desire for residents to discuss the virtues of living in a small, rural community. A total of six individuals were supplied with a 35mm single-use camera containing 27 exposures, together with directions to identify and represent aspects of their community which they agreed and disagreed with. Participants were given 2 weeks to complete the photography assignment and, upon completion, I collected each camera and ordered film to be developed. A week later, participants were presented with paper copies of their photographs during a 1-hour focus group session where participants described their images and motivations for taking each shot. The session was tape-recorded to ensure accuracy of data collection, and the tapes were later transcribed verbatim by undergraduate students paid and trained in transcription. Upon completion, each photovoice participant received copies of their photographs and a \$50 gift card.

Mixed-methods research

Cross-sectional survey

Cross-sectional surveys assess the prevalence of disease and risk factors at a fixed point in time. We created and implemented a cross-sectional survey documenting the prevalence of disease, and household, occupational, and behavioral exposures (n=100). Questions assessed a number of environmental health concerns identified by community members. *Promotora-researchers* reviewed each question to assess content, scope, comprehensibility, and appropriateness. They tested the final surveys internally and with other community members to gauge timing, confirm readability, and practice survey administration. Several sampling options were considered including randomized door-to-door sampling, convenience sampling at community centers, and targeted convenience sampling in geographic zones. Ultimately, *promotora-researchers* assigned themselves to designated geographic zones, which were downtown

zones divided along major roads and periphery zones which included potentially vulnerable subpopulations in migrant farm-worker labor camps, farmhouses, and trailer parks. Recruitment primarily occurred at community events and door-to-door during evenings after work.

Promotora-researchers administered 100 surveys to adult residents from July to September 2017. They independently secured participant consent and administered surveys. Screening questions confirmed that participants were adult residents of the case study community. No identifying information was collected although a separate log was required by the university to document receipt of participant gift cards.

Promotora-researchers typically found interview-style administration to be the most effective, especially for participants with limited literacy. We conducted the initial 50 surveys in six days. The second half was completed in another six days

Graduate student researchers volunteered, completed graduation requirements, and/or secured grants and fellowships to support the project. *Promotora-researchers* were designated as temporary university affiliates and compensated hourly with gift cards for all time spent working on the project. Our community-based, transdisciplinary environmental justice study is noteworthy because of the strong community relations we established between students and community members and organizations (see Table 2 for full list of partners). Further, UC Davis' Office of Public Scholarship and Engagement identified our project as a promising practice for bridging the gap between nationally ranked universities and periphery communities (Public Scholarship and Engagement, 2020). Most importantly, our project successfully petitioned county authorities to enact policy changes through the investment of public funds towards a community garden and microtransit system.

CHALLENGES IN ESTABLISHING OPEN COMMUNICATION

Wilson et al. (2018) define open communication as, “the free flow of ideas, opinions, goals, and values in a bidirectional way” (pg. 292). It is also an important metric for maintaining strong community research

engagement on the basis of trust. There are many ways to engage with communities and stakeholders through open communication. Some researchers have used Scammell & Howard's *Guide for Making Informed Decisions* (2013) as a framework for leading community discussions about the values and challenges of conducting an environmental justice study. The guide begins with guidelines for discussing: 1. the impacts of and 2. motives for undertaking such a study. In the discussion that follows, the challenges of communicating each of these questions is highlighted.

The possible impacts of an environmental justice study in an agriculturally-structured community

As observed by Harrison (2011) and other analysts, rural communities in the central valley are limited in their ability to pursue remediation for environmental health hazards because of the polluting industries' power over the communities they put at risk. For an environmental justice research project such as ours, the likelihood of affecting structural change as a result of our work is small because these changes require a substantial investment of both resources and political capital (Davis & Ramírez-Andreotta, 2021). Furthermore, it is not appropriate for our transdisciplinary, community-based participatory research project to promise structural changes because these changes might in fact mean the loss of much of the economic vitality of the community in question (Rosenberg, 2014). Community members are unlikely to propose and participate in environmental justice research, for example, if its products are intended to be used for overthrowing local agriculture-- the principal source of employment in the region. Further, *promotora-researchers* decided against using our limited resources to address regional issues like traffic or agricultural sources of pollution on account of the high likelihood of conflict within the community regarding action plans; high barriers to reaching and mobilizing regulators and industry; and the perceived threat to the local economy if structural solutions are proposed. Through open communication, we implemented a study that observed the possible impacts of its undertaking.

Motives for undertaking an environmental justice study in an agriculturally-structured community

The second question proposed by Scammell & Howard (2013) promotes open communication regarding individuals' motivations for conducting an environmental justice research study. In rural central valley communities, Chicana/o Studies scholars have demonstrated that residents are motivated to participate in community-based research activities due to their desire to recreate culture and their sense of responsibility for action (Manzo, Flores, & de la Torre, 2017). While the motivations of graduate students often depend on their individual and unique contexts (Atalay and McCleary, 2022), it can be said that my colleague and I participated in this project for reasons that may differ from residents'.

As the son of farmworkers, for example, my motivations for conducting this project reflect my strong commitment to participatory research and qualitative methods as a platform for uplifting the voices of my community. *Promotora-researchers*, meanwhile, participated in our project not so much to produce academic discourses of inequality as to improve community health status through research and policy change-- a call we adopted as the project's mission. Compared to the rural health study described by Manzo, Flores, & de la Torre (2017), our rural environmental justice study proved it was challenging to even identify a central problem because of the complexity involved in determining the environment-disease process for chronic and rare forms of illness at the community level. During our initial meetings with community members, for example, it became clear that some residents of the case study community may not agree with claims of environmental health inequality for personal or political reasons. For example, a local farmer at one of our project announcement events once conceptualized cancer as a normal occurrence within families involved in local agriculture. As a result, we found that the motivations of individual community partners or researchers is not an adequate reason for conceptualizing and justifying the research at hand. It follows that our team spent significant time developing research questions and data collection strategies that reflect broader community issues within our respective skill sets.

CHALLENGES IN ESTABLISHING EQUITY

Equity in community-based research often refers to the power wielded by each participant involved in the process of knowledge creation and transfer (Wilson et al., 2018). It is also a fundamental metric for evaluation in studies involving disadvantaged communities, prompting the construction of a ‘community engagement continuum’ by which the most collaborative projects are considered more equal and therefore more successful than others. As such, central to community-based participatory research is the idea of partnership building and participatory research methods. Altogether, the movement represents a departure from traditional research design towards work that incorporates the strengths, knowledge, and expertise of traditionally ‘non-expert’ sources (Deeb-Sossa & Manzo, 2018). Although it may be impossible to ameliorate the power asymmetries inherent in academic research (Long et al., 2016), community-based participatory research is an ideal ground from which to establish transdisciplinary environmental justice studies because of its commitment to equity in the research process.

The challenge of establishing equity while navigating academic and community partnerships was illustrated by residents’ concerns over extractive research, whereby university personnel enter low-income communities and communities of color to collect data and then exit. It follows that our proposed research questions and accompanying methods and timelines reflect the needs of community members rather than the needs of researchers. In our environmental justice study, community-based research partnerships emerged as a responsive and sustainable model for conducting transdisciplinary research in collaboration with rural residents of a farmworker community (Deeb-Sossa, 2019).

Community-based research partnerships are distinguished by Manzo et al. (2021) for their lifelong solidarity in validating local knowledge and in bringing to the forefront the lived experiences of communities facing inequalities and injustices. The community-based participatory research literature shows that these principles are difficult to practice in the field. For example, Manzo et al. (2021) contend that it is not enough for researchers to rely on translating instruments or speaking the language of participants as means of achieving construct equivalence or understanding of culture. Instead, “[e]thical

researchers must ensure that at least some of the team members with decision-making power are from or familiar with the community where the research will take place” (pg. 20). This tension is most evident in the environmental justice literature on farmworker communities, where little work has been reported employing local residents to study environmental health risks through community-based participatory research. Furthermore, the environmental justice literature in farmworker communities is dominated by the scholarship of white women deriving from outside of the communities under investigation (e.g., Berkey, 2017; Harrison, 2011; Saxton, 2021).

SUCSESSES IN ESTABLISHING OPEN COMMUNICATION AND EQUITY IN COMMUNITY-BASED RESEARCH PARTNERSHIPS FOR ENVIRONMENTAL JUSTICE

In this article, I have illustrated a number of challenges to implementing a transdisciplinary and community-based research partnership for environmental justice that observes the principles of open communication and equity. Since 2017, my research partners and I have embarked on a long-term research project to study the longstanding and undocumented concerns of rural residents over environmental health risks in a central valley farmworker community. Our transdisciplinary approach to environmental justice employs a *sequential transformative design* (Creswell, 2014) from which qualitative data is collected to identify variables for quantitative development. In the following section, I reflect upon three factors that have contributed to our progress while highlighting the significance of each.

Engaging local communities and institutions

This project builds on the community-academic partnerships previously established by community leaders and university researchers in Chicana/o Studies and the Schools of Medicine and Veterinary Medicine (Sweeney et al., 2018). My colleague and I drew on these partnerships to inquire with members of a local women’s group, K12 administrators, and churchgoers about the possibility of launching an environmental justice project in the case study community (see Table 2 for a full list of partnerships). Notably, the county health department supported our plans for establishing a project by providing the

team with background research at workshops attended by graduate student researchers and *promotora-researchers*. Engaging with the county enabled local health authorities to become aware of the community's efforts in documenting residential concerns about environmental health risks while offering feedback and education. Further, our project was strengthened from the start by a student-run clinic operating within the community, from which we recruited undergraduate research assistants and later study participants. In addition to contributing to our project directly, students associated with the clinic contributed by leading various research projects that were developed in response to community input collected during the course of our environmental justice research. These included topics such as the relationship between community health assessments and primary care in rural areas (Rodriguez, 2020), mental health in rural areas (Ruiz Malagon, 2019), and pesticide applications in the region (Jow, 2018; Moher, 2018). Partnering with the clinic also provided us with a local venue from which to conduct meetings and collect data. Our partnership with the local methodist church led to similar resources. In return, the environmental justice research team provided our partnering sites with everyday items such as custodial supplies, snacks and drinks, arts and crafts, and we paid rental fees for most of our events excluding project workshops and meetings. Our undergraduate student research partners also presented results of their research at various conferences and events. *Promotora-researchers* also participated in a number of on-campus research conferences hosted by partner institutions such as the UC Davis Western Center for Agricultural Health and Safety, UC Davis Environmental Health Sciences Center, and UC Davis Citizen Science Center (see Table 2 for full list of university sponsors and collaborators).

Ensuring local leadership and knowledge is valued

In the community-based participatory research literature, the roles of academic researchers and community partners are often demarcated between 'outsider' and 'insider' perspectives. This distinction typically renders academic researchers as alien and potentially hostile agents who may take advantage of marginalized and disadvantaged communities. Following this perspective, community partners are perceived as the 'gatekeepers' of hard-to-reach populations, responsible for playing the role of cultural

and linguistic brokers between researchers and communities (WestRasmus et al., 2012; Johnson et al., 2013). In our research partnership, these distinctions were blurred as the two groups incorporated a common way of knowing and learning prior to the conceptualization of our research questions. As co-leader of the study, my status as the son of local farmworkers enabled me to foster trust and camaraderie among my academic and community partners. For example, during a post-data collection interview with one of my *promotora-researcher* partners, I was informed that they participated in this project on account of my unique background and commitment towards earning a doctoral degree on the subject of environmental health risks in farmworker communities. Inversely, by advancing the roles of *promotora-researchers* as equal partners in the research process, community members shared in the responsibility of study design and implementation, thereby ensuring that local leadership and knowledge is recognized, valued, and compensated. The existing community-academic partnership (Sweeney et al., 2018) was essential for identifying research partners and organizing project meetings across local venues.

Developing capacity alongside *promotora-researchers*

Franco and Tracey (2019) defined community capacity building as continuous enhancement of skills, processes, and resources that are required for communities to endure, adapt, and thrive.

To enhance the capacity of both graduate student researchers and *promotora-researchers*, we conducted dozens of project development workshops exploring local knowledge, participatory research, and methods for conducting an environmental justice study. All 2-hour workshops were held at the local community center and the methodist church. Food and drinks were provided as well as childcare upon request. Workshops included guest appearances by members of local schools and nonprofits, county agencies, and university professors and undergraduates. After our first ten workshops, we transitioned from a weekly to a bi-weekly (and then monthly) schedule which ran through the end of project funding. During this time, our team explored additional research questions following preliminary research about the community together with residential feedback and concerns (not included in this dissertation).

Promotora-researchers were paid in gift cards at the rate of \$20/hour for all time spent on the project.

This included participation in research meetings and workshops, community outreach, participant recruitment, informed consent, and data collection.

RECOMMENDATIONS

In our environmental justice study, community-based research partnerships emerged as a responsive and sustainable model for conducting transdisciplinary research in collaboration with residents of a farmworker community (Deeb-Sossa et al., 2022). It is important for scholars of environmental justice to recognize this context and to make a lifelong commitment to collaborating and supporting communities living under environmental health risks, recognizing and prioritizing residents' needs, and communicating these to dissertation committees, university departments, and funding agencies (Crooks & Snowshoe et al., 2013). "Because it isn't [sic] ethical to completely exit or disengage with a community," argue Manzo et al., "researchers need to consider how they might continue some level of engagement" (2021: pg. 188). As a direct consequence of our transdisciplinary environmental justice project, for example, we funded a number of undergraduate students to build and strengthen our research partnership through projects exploring community-relevant topics such as mental health, smoking, and covid. Until now, my graduate student research partner and I visit our community research partners to continue our friendship.

The strongest approach for establishing responsive and sustainable research partnerships in a farmworker community for environmental justice is the lifelong assurance of researchers that they will conduct research with *heart* (Manzo et al., 2021). Following this approach, the subsequent research will benefit the participating community while pushing the boundaries of environmental justice through methodological triangulation. To best support the community, transdisciplinary environmental justice research should (a) reflect residents' needs and concerns, (b) respect local ways of knowing and unknowing, and (c) produce notable outcomes for the community. Environmental justice scholars of diverse epistemologies must therefore be open to understanding multiple perspectives and critical attitudes in order to negotiate the challenges that arise in the process and outcomes of research (Crooks &

Snowshoe et al., 2013). Our environmental justice work in a farmworker community led to additional projects in the community grounded in lasting friendships.

CONCLUSION

Both urban and rural communities in the United States continue to be a focus for research on industrial sources of pollution and accompanying health impacts. In recent years, community-based research partnerships have emerged as an effective practice for solving these environmental justice concerns (Wilson et al., 2018). In rural settings, mitigating exposure to environmental hazards is complicated by a low prevalence of environmental monitoring practices and limited published environmental health studies, combined with the poor social and financial resources available to many rural residents. The case study community is no exception. In this context, the identification of environmental health risks was imperative for self-protection, pollution prevention, and remediation (Johnston and Cushing, 2020). By navigating academic collaborations and community-based partnerships, our project enabled the community to fill gaps in government data at the local level while drawing attention to the everyday experience of agricultural health hazards that are often dismissed by regulators and polluters. Most importantly, our research project garnered the credibility for action to reduce environmental health disparities following policy changes like the establishment of a local rideshare program and community garden.

This paper contributes to the environmental justice literature by demonstrating how a community-based research partnership is analyzed and implemented for transdisciplinary research on environmental health risks in a rural, farmworker community. Concurrently, it contributes to the literature on community-based participatory research by identifying key challenges in observing the principles of *open communication* and *equity* while navigating academic and community ways of knowing. I reflect upon three factors that have contributed to our progress while highlighting the significance of each: engaging with local communities and institutions, ensuring local leadership and knowledge is valued, and developing capacity

alongside *promotora-researchers*. I conclude with recommendations for developing responsive and sustainable community-based research partnerships for transdisciplinary environmental justice to best support farmworker communities. Nevertheless, I acknowledge that each environmental justice research project presents its own unique challenges based on the circumstances of participating communities and academic researchers. Future environmental justice research in farmworker communities must understand this context and recognize the values, strengths, and limitations of all participants involved in the research process.

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TABLES

Table 1: Timeline of research activity

Summer 2017 → Spring 2018 (data collection)				Spring 2018 → Summer 2019 (communication of findings)		
Recruit Promotoras	Continue Promotora Trainings	Field-test / refine focus group interview guide	Conclude focus group sessions (n=6)	Support expansion of project into new studies	Data Analysis / Progress Report	Generate ideas for publication
Initiate Promotora Trainings	Develop study design	Finalize recruitment of focus group participants	Recruit photovoice project participants (n=12)	Continue promotora meetings	Prioritize exposures	Share information with communities / local health agencies
Disseminate information about study participation	Develop focus group questions	Initiate focus group sessions	Initiate photovoice project	Focus group Transcription / translation	Choose sample population for environment samples (not included here)	Host town hall for community input
			Conclude photovoice projects	Focus group content analysis	Photovoice project public presentation	

Table 2: Community partnerships developed in 2017-19

Name	Type of Community Partner
UC Davis KL One Health Clinic	University sponsor and collaborator
<i>Grupo de Mujeres</i>	Community sponsor
KL Community Service District	Local utility services
California Rural Legal Assistance Foundation	Not-for-profit sponsor
Yolo County Health and Human Services Agency	County government
Yolo County Environmental Health Agency	County government
UC Davis Western Center for Agricultural Health and Safety	University sponsor and collaborator
UC Davis Environmental Health Sciences Center	University sponsor and collaborator
UC Davis Department of Chicana/o Studies	University sponsor and collaborator
UC Davis Center for Regional Change	University sponsor and collaborator
UC Davis Center for Health and the Environment	University sponsor and collaborator
UC Davis Citizen Science Center	University sponsor and collaborator
UC Davis Feminist Arts and Science Shop	University sponsor and collaborator
UC Davis Student Farm	University sponsor and collaborator
Woodland Community College Department of Ethnic Studies	College sponsor and collaborator
Empower Yolo	Not-for-profit sponsor
RISE, Inc. Woodland	Not-for-profit sponsor
Catholic Church	Community sponsor
Methodist Church	Community sponsor
Elementary schools	Community sponsor