Investing in Farmworker Health

How Research Can Help Protect the People Who Produce Our Food

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Highlights

The estimated 2.4 million farmworkers in the United States encounter a variety of occupational hazards—dangerous equipment, exposure to toxic pesticides, extreme heat, and more. US law and agricultural employers afford only limited protections to these workers, many of whom are immigrants and people of color who experience ongoing systemic racism in the industry and broader society.

Policymakers have access to substantial evidence of the hazards—including the firsthand experience of farmworkers—yet important data gaps persist, particularly around the cumulative and synergistic health and safety impacts of climate change and exposure to pesticides and other agrochemicals. Policymakers, farm owners, and health care providers must act urgently on available information, while simultaneously seeking to better inform efforts to reduce workplace risks and protect on-the-job health. Key to that search is federally funded research on critical topics in farmworker health.

To understand the current extent and focus of such research, the Union of Concerned Scientists (UCS) conducted a first-of-its-kind review of relevant spending across leading US government research agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the National Institute of Food and Agriculture (NIFA) within the US Department of Agriculture (USDA). While farmworkers perform labor that underpins the food and agriculture industry that contributed on average $1.223 trillion to the US economy between fiscal years 2019 and 2022, these agencies together allocated an average of $16.2 million a year in research and education on farmworker health, roughly $6.75 per worker.

Farmworkers deserve safe and dignified working conditions—and not only because the federal government has designated them as essential. To help ensure those conditions, policymakers and employers must have a comprehensive, up-to-date understanding of the risks and hazards farmworkers face and of the best ways to mitigate the dangers. Federal research funding should prioritize underrepresented farmworker populations, such as women, youth, elderly, and LGBTQ+ farmworkers, as well as research that incorporates the equitable participation of farmworkers and the organizations that represent them.

Farm Labor Puts the Health of Farmworkers at Risk

Farmworkers are among the most vulnerable worker groups in the United States, and their occupational hazards make agriculture one of the nation's most dangerous industries. The 2021 fatality rate—20 deaths per 100,000—is more than five times the average of 3.6 deaths per 100,000 workers in other industries (NIOSH, n.d., BLS 2022).[1] Injuries resulting from accidents with farm equipment and machinery are the most common, followed by musculoskeletal injuries caused by the physically demanding labor and hearing loss due to loud farm equipment (Rabinowitz et al. 2005; Barneo-Alcántara et al. 2021; NIOSH, n.d.).

Among the serious threats to farmworker health is exposure to toxic synthetic pesticides and other chemicals; this can lead to acute poisoning or long-term chronic diseases such as cancer (Ferguson, Dahl, and DeLonge 2019). In addition, working long hours outdoors makes farmworkers particularly vulnerable to climate-related events like smoke from wildfires and extreme heat, both of which are projected to increase substantially across the country in the coming decades (Dahl et al. 2019; Dahl and Licker 2021; Fenske and Pinkerton 2021). It has been estimated that the rate of farmworker deaths from heat-related causes is 20 times that of any other civilian occupation (CDC 2008). Another study found that the rate of heat-related deaths in agriculture was 2.7 times higher than in construction, 5.5 times higher than in support, waste, and remediation services, and 35 times higher than in all other industries combined (Gubernot, Anderson, and Hunting 2015).

Extreme heat can contribute to both acute and chronic health issues. For instance, it has been linked to both acute kidney injury and chronic kidney disease (Mix et al. 2018; López-Gálvez et al. 2021). What's more, exposures to pesticides and extreme heat can interact to amplify adverse health outcomes. For instance, heat stress may make farmworkers more vulnerable to pesticides. Workers who try to protect themselves from harm—such as by wearing clothing and protective equipment—may experience the adverse effect of increasing body temperatures, heightening the risk of heat stress (Ferguson, Dahl, and DeLonge 2019). Adverse working conditions, including insufficient shade, lack of access to drinking water, and limited or no periods of rest from exertion, may also contribute to and exacerbate health risks, specifically those compounding heat stress.

Beyond the direct workplace hazards, various social and economic factors contribute to poor health among farmworkers. These include low wages, substandard housing, and lack of access to health care, childcare, and transportation. Weakened legal protections stemming from immigration status can affect the wellbeing of farmworkers, including their mental health and food and nutrition security (Goldman et al. 2021; Elver 2018).

Reports have also documented widespread sexual harassment, assault, and gender-based violence in agriculture. In a recent study, about half of surveyed female farmworkers reported they had been a victim of or witnessed workplace sexual harassment (Prado, Rivera-Heredia, and McCurdy 2021).

Moreover, the farmworker population is aging, heightening the risk and severity of injuries. Because employers often pay farmworkers per piece harvested, older farmworkers may earn less if they cannot work as fast as younger farmworkers, or they may suffer injuries while pushing themselves to speed up (Soper 2020; Tonozzi and Layne 2016; Hertz 2019). Youth farmworkers are vulnerable to hazards exacerbated by limited labor protections: children as young as ten may work on farms (Arcury et al. 2014; US DOL 2016).

Systemic economic exploitation and discrimination function to normalize poor working conditions and high rates of injury and illness in agriculture, an industry heavily reliant on the labor of immigrant populations and people of color. Of the 2.4 million farmworkers on US farms (NASS 2019), 66 percent were born outside the United States, according to the Department of Labor's 2019–2020 National Agricultural Workers Survey. Also, 44 percent of all farmworkers lacked legal authorization to work, making them particularly vulnerable to labor abuses (Gold et al. 2022).

Language barriers between workers and employers can both increase the likelihood of occupational injury and limit workers' ability to raise or get redress for health and safety concerns (Goldman et al. 2021; Snipes, Cooper, and Shipp 2017). Seventy-eight percent of farmworkers identify themselves as members of a Hispanic group, and 62 percent report Spanish as their primary language. Many farmworkers report not being able to speak (29 percent) and read (40 percent) English well (Gold et al. 2022).

Indigenous workers can face additional unique barriers to good health. A California study found that Indigenous Mexican farmworkers—at least 165,000 of whom work in that state—are far less likely to have access to health care than the general population or other farmworkers from Mexico (Mines, Nichols, and Runsten 2010). Ten percent of all farmworkers and nine percent of California farmworkers identify as members of an Indigenous group. While fewer than one percent of all workers and three percent of California workers report an Indigenous language as their preferred language, the diversity of languages may further limit workers' ability to communicate their concerns to employers, advocacy organizations, government agencies, or health care provides (Gold et al. 2022, Ornelas et al. 2022).[2]

Finally, national and state policies rooted in slavery have excluded farmworkers from a number of the rights and protections held by most workers in the United States. Primarily intended to permit the continued exploitation of Black sharecroppers, these policies weaken laws and regulations around minimum wages, overtime pay, the right to organize, and child labor standards (Perea 2010; Guild and Figueroa 2018; Ferguson, Dahl, and DeLonge 2019).

Federal Support Can Help Fill Gaps in Farmworker Health Research

Clearly, many occupational hazards in agriculture have been documented—both from workers' firsthand experiences and in recent studies of the disproportionate impact of such hazards as pesticide exposure on BIPOC and low-income communities (e.g., Donley et al. 2022). Yet significant knowledge gaps persist when it comes to specific health outcomes for various farmworker populations, as well as how the interaction of multiple exposures may produce outcomes that are worse than the sum of their parts. Some of the negative health effects may take years to appear or, in some cases, emerge in future generations.

Recent reviews of the public health threats to US farmworkers have identified additional gaps. Few studies focus on specific farmworker populations, such as Indigenous farmworkers, farmworkers living with disabilities, and older farmworkers. Although women are 34 percent of the nation's farmworkers, few studies focus on them (Goldman et al. 2021; Bloss et al. 2021). And there is a complete lack of data documenting farmworkers who are LGBTQ+, gender nonconforming, or nonbinary, yet clinicians, community health workers, and common sense tell us that this community exists and that these workers may face a range of challenges, including harassment, risks to employment, and stress and other related negative outcomes from hiding one's identity (Farmworker Justice and National LGBTQIA+ Health Education Center 2022).

As a whole, research on farmworker health frequently fails to examine the underlying social structures that create such high-risk environments in the first place. A related and important factor is that researchers often conduct studies with no meaningful involvement of farmworkers themselves and without providing direct or immediate benefits to the

populations studied (Goldman et al. 2021). This further silences an already "invisible" population.

Moreover, the need for robust research and action has only grown more urgent. Threats from extreme heat and other climate impacts have escalated and pesticide use is increasing as farms seek to mitigate the harmful effects of these threats on crop yields. Beyond the devastating toll on farmworker populations, climate change has the potential to severely disrupt domestic and global food supply chains, threatening food security and political stability (ODNI 2021). And the COVID-19 pandemic added alarming risks to agricultural workers, who were deemed "essential" but still not afforded the same protections as workers in other industries (Ferguson, Dahl, and DeLonge 2019; Lusk and Chandra 2021).

To advance research and interventions designed to protect farmworker populations, the federal government has a critical role to play. In particular, the CDC, the NIH, and NIFA are key federal entities funding research on topics related to farmworker health.

For the work of these and other agencies, exemplary research design considers cumulative exposures, measures outcomes over multiple generations, and benefits from the active participation of farmworkers themselves. One example is The Center for the Health Assessment of Mothers and Children of the Salinas (CHAMACOS) Study that has amassed more than 20 years of data on the impact of cumulative exposures on the health of mothers and children in California farmworker communities. To date, the CHAMACOS Study has resulted in almost 200 publications on topics investigating the connections between pesticide exposure and health outcomes, including neurodevelopmental problems in offspring, respiratory health, and obesity (UC Berkeley, n.d.). These and other topics requiring greater research include climate change impacts on farmworker health, the role of social determinants of health (e.g., housing conditions and immigration policy), and other risks to farmworker families and communities (Goldman et al. 2021).

Assessing the Extent of Federal Investments in Farmworker Health Research

To help guide policymakers in responding to these many challenges, UCS has conducted what we believe is the first review of federal funding for research on critical issues in farmworker health. Understanding the landscape of projects receiving federal funding in recent years can help identify outstanding research needs, assess the adequacy of research program funding, and determine how effective leading research agencies are at encouraging projects that generate meaningful improvements in farmworker health and safety.

UCS used two searchable public online databases maintained by federal agencies, the NIH RePORTER and the NIFA Data Gateway, to identify relevant scientific project awards, including scientific research, education, and extension programs, between FY 2019 and FY 2022. The NIH RePORTER contains data from primary research agencies, including the CDC and the NIH; the NIFA Data Gateway details projects funded by the US Department of Agriculture.

To identify relevant projects in these databases, we defined farmworkers and health outcomes of interest:

- Farmworkers were defined in accordance with that in the USDA's National Agricultural Library Thesaurus: "people gainfully employed by a farm operator to assist with the farm work, including regular, seasonal, local, migratory, full-time or part-time employment" (NAL 2016).[3]

- Health outcomes of interest included acute illnesses; chronic diseases; communicable diseases; environmental exposures, including air and water pollution, extreme heat, and pesticides and other chemicals; food and nutrition insecurity; physical injuries; psychological disorders, including addiction, anxiety, and depression; and measures of overall morbidity or mortality.

Based on those definitions, we designed a search strategy to capture projects focusing on farmworker health, drawing from a recent review of public health issues facing farmworkers and relevant terms from the USDA National Agricultural Library Thesaurus and the NIH Research, Condition, and Disease Categorization thesaurus (Goldman et al. 2021 ; NAL 2016; NIH 2022). We then reviewed 440 search results to determine which projects met certain inclusion criteria. The primary criteria were a location clearly in the United States and a reference to a relationship between farmworkers employed on farms and one or more health outcomes as defined above. We further reviewed projects for additional characteristics, including the type of health outcomes studied and the target populations.

Note that the two databases do not represent all federal agencies that may fund research related to farmworker health. For this and other reasons, our study underestimates to some extent total federal funding for farmworker health projects.[4] See the Appendix for the complete methodology, including limitations.

FEDERAL PROGRAMS UNDERFUND FARMWORKER HEALTH RESEARCH

We identified 55 projects taking place between FY 2019 and FY 2022; they received a total of $64.9 million from federal research programs to address farmworker health, for an average of $16.2 million per year. Based on the data available in the NIH RePORTER and the NIFA Data Gateway, NIFA funded over half of the projects (32 projects), followed by the NIH (15), the CDC (7),[5] and the Department of Veterans Affairs (VA) (1).[6] NIFA provided an average of $8.1 million per year (50 percent of total funding), the NIH provided $6.2 million per year (38 percent), the CDC, $1.8 million (11%), and the VA, $0.16 million (1 percent) (Table 1).

For comparison, NIFA distributed $1.8 *billion* for extramural research, extension, and education activities in 2022 (USDA 2022). The NIH spent about 84 percent of its $45.2 *billion* funding that year on extramural research and 10 percent on intramural research (NIH Office of Budget, n.d.; NIH, n.d.). The CDC disbursed nearly $9.1 *billion* to research and health programs in the United States and globally (CDC 2022).[7]

Comparison with the magnitude of agricultural industry investment is similarly instructive. Syngenta, one of the world's largest agrochemical companies and a top producer of pesticides, reported spending $969 million on product research and development in 2020 (Syngenta 2021). Every seven days, this one company spends more on research and development than the federal government's average annual investment in research on farmworker health identified in the UCS study. Currently, hundreds of US farmworkers are pursuing lawsuits against Syngenta for its failure to warn workers about the potential links between Parkinson's disease and Paraquat, a widely used herbicide (Marshall and Prior 2022).

Table 1. Average Awards by Agency, FY 2019–2022

	Agency Average per Year	Percent of Total Funding
National Institute for Food and Agriculture (NIFA)	$8,127,438	50
National Institutes of Health (NIH)	$6,203,745	38
Centers for Disease Control and Prevention (CDC)	$1,728,250	11
Veteran Affairs (VA)	$161,549	1

Some federally funded projects include more than one topic or subtopic (Table 2), which makes it difficult to assign dollar amounts to each topic. Twenty-one projects focused on environmental exposures, and 15 focused on injuries. Communicable diseases and chronic diseases were the focus of 12 projects each. Mental health and substance use appeared in ten projects; animals, insects, and pests in six projects; and disability in five projects. One project focused on food insecurity.

With respect to target populations, five projects included youth farmworkers and five focused on farmworkers with disabilities. Three projects explicitly listed veterans. No project named women, LGBTQ+, gender nonconforming, or nonbinary farmworkers as a population of interest. Only 12 projects specified farmworkers as the only target population. Many projects included other agricultural populations, such as farmers and families of farmers and farmworkers. Other projects included other populations, including other outdoor workers, community residents, or the general population.[8] Thus, not all research and other activities in the UCS survey would directly benefit only farmworkers. For example, a project titled "CNIP 2022: Meeting California's Growing Food and Nutrition Security Needs" provides nutrition incentives and other services to all SNAP recipients in California. This project is funded at $12.9 million for four years, but farmworkers constitute only one of many target groups of SNAP recipients. The funding for that single project is significant. Without it, NIFA would only contribute $4.9 million dollars annually toward farmworker health research, education, and extension, only slightly over 60 percent of the annual NIFA funding reported in our study.

Research in Action: The Farmworker Association of Florida

In the UCS review of project abstracts and objectives, very few institutions appeared to use community-based research approaches. Out of those that did, it is difficult to say to what extent they engaged farmworkers or farmworker organizations in designing and implementing research projects and programs. The limited information about these grants does not provide enough information about whether and how grantees engage with farmworkers or farmworker organizations. This represents an important gap in research.

Table 2. Project by Topic and Subtopic

	Subtopic and Number of Projects
Environmental Exposures (21)	Pesticides/Chemicals (8); Heat (5); Air Pollution (5); Lead (1); Wildfires (1); Noise (1)
Injury (15)	Not Specified (8); Hearing Loss (2); Acute Kidney Injury (2); Fatality (1); Falls (1); Musculoskeletal Disorders (1)
Communicable Diseases (12)	COVID-19 (7); Influenze (2); HIV/AIDS (2); Respiratory Viruses (1)
Chronic Diseases (12)	Lung Disease (4); Cardiovascular Disease (3); Prediabetes/Diabetes (2), Chronic Kidney Disease (2); Colorectal Cancer (1)
Mental Health and Substance Use (10)	Stress (4); Substance Misuse (3); Not Specified (2); Violence/Trauma (1)
General Health and Safety (9)	
Animals, Insects, and Pests (6)	Mosquitoes (3); Antibiotic Resistance (2); Stinging Ants (1)
Disability (5)	
Food and Nutrition Security (1)	
Other (4)	Neurological Issues (2); Gastrointestinal Issues (1); Fatigue and Exertion (1)

Note: Some projects addressed more than one topic and/or subtopic, making the total project count greater than the total number of projects included in the UCS study.

An example of the value of community-based research and ways to do it effectively comes from the Farmworker Association of Florida, an organization whose "mission is to build power among farmworker and rural low-income communities, to respond to and gain control over the social, political, economic, workplace, health, and environmental justice issues that impact their lives" (Farmworker Association of Florida, n.d.). The association has long partnered with universities and other research institutions on research and programming that contributes critical scientific knowledge on farmworker health issues, *and,* at the same time, provides direct and immediate benefits to farmworkers (Farmworker Association of Florida 2022).

Several association collaborations over the years serve as exemplary case studies on the use of federal funding to reduce occupational risks and advance farmworker health.

Together for Agricultural Safety (1997–2001) aimed to design, implement, and evaluate a program to reduce adverse health outcomes associated with pesticide exposure among fernery and nursery workers in five Florida counties. Funded by the NIH's National Institute of Environmental Health Sciences (NIEHS), the project was conducted in collaboration with health science researchers from the University of Florida and the University of South Florida, as well as with the nonprofit Best Start Social Marketing (Farmworker Association of Florida 2001).

Partnership for Citrus Worker Health (2000–2014) identified common causes of eye injuries among citrus workers in Immokalee, Florida. It also developed a camp health aide program for eye safety based on the research, provided training in eye safety and first aid, and distributed specialized safety glasses to workers. A collaboration with the University of South Florida funded through a CDC cooperative agreement, the project continues to support the use of safety glasses among local citrus workers (USF Health 2021).

Improving Pregnancy Health Among Florida Farmworkers (2010–2013) was designed to minimize occupational dangers—including extreme heat, exposure to chemicals, and ergonomic stressors—to farmworker women of reproductive age. Conducted in partnership with Emory University and the Farmworker Health and Safety Institute, the project designed an interactive workshop to improve reproductive health and birth outcomes for farmworker women in Florida (NIEHS 2016).

Los Girasoles (Sunflower) Project (2014–2018) examined the threat of heat-related illness in Florida farmworker populations, using biomonitoring surveillance to evaluate physiologic responses to heat stress. Carried out with Emory University and funded by the NIH National Institute for Occupational Safety and Health (NIOSH), the project provided farmworkers with health exams. In a pilot project, farmworkers also received protective equipment, such as cooling vests and bandanas, for a short period (Emory University 2021).

Putting Farmworkers First: Recommendations for Research and Policy

Our analysis points to the ample need *and* opportunity to improve the landscape of research, education, and extension programs supporting farmworker health, highlighting the important role of the federal government in making policy and program shifts that can help meet the needs of farmworkers. UCS recommends that Congress, federal research agencies, and researchers take the following actions:

Increase USDA funding for research on farmworker health in the next food and farm bill, and also increase such funding for the NIH and the CDC. The amount Congress currently allocates to research, education, and extension programs addressing farmworker health falls far short of what is needed to protect workers now and in the future. The 2023 federal food and farm bill presents an opportunity for Congress to authorize higher funding for key USDA research agencies, particularly NIFA, which has a track record of funding research supporting farmworker health. UCS recommends that Congress at least double the amount of funding in the next food and farm bill for research, education, and extension programs supporting

farmworker health at NIFA to a minimum of $16.2 million per year. Funding for the NIH and the CDC should also increase through appropriate funding mechanisms.

Many areas of research would benefit from cross-agency collaboration. In such cases, UCS recommends that the USDA collaborate with other agencies such as the CDC (particularly NIOSH) and the NIH as discussed in this report, as well as with the National Science Foundation (NSF) and the Environmental Protection Agency (EPA). It is important to conduct this critical research in a systematic fashion that takes full advantage of resources and expertise at the disposal of the relevant federal government agencies. As an example, research on the combined impacts of pesticide use and heat exposure to farmworkers would greatly benefit from cross-agency collaboration as pesticide regulation is under the EPA's purview, while NIH funding can support multiyear studies assessing a broad range of health outcomes.

Prioritize research on how the combination of climate change with pesticide exposure and other hazards affects farmworkers. The dangers of extreme heat, wildfire smoke, extreme weather events (e.g., hurricanes and floods), and other climate-related impacts are great and rapidly increasing. The risks presented by climate change add to and amplify those posed by exposure to pesticides and other agrochemicals commonly used by farmworkers—and to which their families are secondarily exposed—as well as other hazards farmworkers face. These threats lead to both acute outcomes and chronic diseases that may not fully appear until decades later. Research is essential on cumulative, longitudinal effects that may emerge across generations, followed by evidence-based programs and interventions designed to reduce the cumulative risks. For instance, research on heat exposure could strengthen and inform a science-based national heat standard for indoor and outdoor workers. Federal agencies across the government could incentivize this area of research in numerous ways, including incorporating it into program-area priorities of the Agriculture Food and Research Initiative within NIFA, within the USDA's Research, Education, and Economics mission area, and through cross-agency collaborations. The research should be designed to include immediate benefits to the farmworker communities that participate in such studies, which should also help build their capacity, leadership development, and resiliency.

Create funding opportunities that serve populations underrepresented in research. The UCS analysis indicates that current research underserves many populations that may face unique health risks—including Indigenous populations, women, aging and youth farmworkers, and LGBTQ+, gender nonconforming, and nonbinary farmworkers. Women, for example, constitute 34 percent of farmworkers, yet none of the projects in our study named them as a target population (Gold et al. 2022). Other populations are studied so infrequently that their representation in the agricultural workforce is unknown. Federal agencies must create and expand funding for research designed to generate useful information for serving and supporting these populations. It is also important that research considers the intersection of identities and identify unique barriers or challenges that different populations may face as a result. An example of a program that fosters collaborative partnerships to serve a population with specific health needs is AgrAbility, a set of NIFA-funded, state-level projects that serve farmers and farmworkers with disabilities (National AgrAbility Project 2022).

To facilitate partnerships between research institutions and farmworker communities, increase funding for community-based participatory research. Farmworkers should lead in informing research that affects them. Community-based participatory research can help ensure that research addresses the most pressing health risks for various farmworker

populations, and that the assumptions embedded in the frameworks of federally funded research accurately reflect the experience of workers on the ground. Trusted community-based organizations that collaborate with farmworker communities bring experience, history, and knowledge that can help foster such partnerships; they should be treated as equals to academic counterparts within research projects and included in research designs and funding decisions. This can also improve the use of federal funding, lessening the waste of time and resources on projects that are built on flawed assumptions and therefore fail to result in workable solutions for the populations of interest. In addition, it is essential that a worker population participating in a study or research project benefit directly, as in the efforts codesigned by the Farmworkers Association of Florida.

Provide health and safety information to farmworkers in English, Spanish, and other languages. Given that many farmworkers feel uncomfortable speaking and reading English, it is essential to translate all materials regarding their health and safety to relevant languages. This includes not only Spanish but also other languages spoken by local farmworker communities. Federal agencies must require that the projects they fund are inclusive of all farmworkers.

Provide transparent, consistent, and frequently updated data on federal research funding. As our research shows, public access to data about federally funded research is in short supply. Yet such access is critical for guiding policymaking and understanding the implications of all research, advancing equity, ensuring accountability, and maximizing returns on investments in research (Marcum and Donohue 2022). In the absence of a single comprehensive database that captures project support on various farmworker related topics, it is challenging to estimate accurately the amount of funding disbursed by all federal agencies. In addition, not all federal programs report dollar amounts for each funded project. Simply put, federally funded data resources on research are difficult to access and often incomplete. We recommend that the federal government establish a single, comprehensive database of awards. Awards should be reported in a timely manner, in a format similar to that of the NIH RePORTER. Databases should be searchable and include a description, award amount, and other relevant information about each project.

Across these recommendations, it is important to keep in mind the changing needs of farmworkers—for example, as levels of risk change and new risks emerge. At the same time, advances in our knowledge identify both new challenges and new solutions. For example, the COVID-19 pandemic introduced an urgent need for funding to address health and safety protections for farmworkers and other essential workers; indeed, UCS found seven projects addressing this hazard.

As needs shift, it is particularly important to consult farmworkers and the entities that represent them. Farmworkers and these organizations should be included as equal partners in conversations about research, education, and the development of funding mechanisms, as well as decisions about how to disburse funds and ways to design and operate extension programs aimed at supporting these essential workers.

COMBINING POLICY CHANGES WITH ADEQUATE RESEARCH FUNDING

The millions of US farmworkers who produce our food face a multitude of health hazards, many of which can be reduced through policy improvements and other innovations. Better

research can help us understand these health and safety hazards, design and pilot innovations, target interventions, and provide policy recommendations. However, the findings by UCS indicate significant underfunding of this field by the leading research agencies on farmworker health, pointing to several specific areas urgently needing attention that currently receive limited or no funding.

Moreover, our analysis focuses on federally funded research, but protecting the health of farmworkers requires policy changes in other areas as well. These include improving federal regulation of pesticides and other chemicals used in agriculture and effectively regulating the industries producing, distributing, and using agrochemicals. Also essential are changes to immigration policies to guarantee the rights and protections to which farmworkers are entitled, regardless of their immigration status. This is the appropriate action given the importance of the labor they contribute as well as the need to transition from exploitative practices in agriculture. A parallel track should be the work to provide a path to citizenship for those laborers who desire it. Finally, policies are needed to improve labor protections, strengthen enforcement of occupational health and safety standards, expand access to health care and benefits, and include agricultural workers in wage laws (Donley 2019; APHA 2017; Farmworker Justice, n.d.).

Taken together, these policy *and* funding changes could translate into significant strides toward protecting the health of the people who produce our food and ensuring the health and long-term sustainability of the food system.

Appendix: Methodology

To identify government spending on farmworker health, the Union of Concerned Scientists (UCS) focused on FY 2019 through FY 2022 as a sample period and selected federal agencies most like to fund farmworkers health research. The agencies were the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the National Institute of Food and Agriculture (NIFA).

No comprehensive database of federal spending on external science award has existed since the termination of the NIH Federal RePORTER in March 2022. The NIH RePORTER (https://reporter.nih.gov), which includes data from the NIH and the CDC, and the NIFA Data Gateway (https://www.nifa.usda.gov/data/data-gateway) served as the primary sources of data for this project.

Databases and Data

The NIH RePORTER transparently provides financial, textual, spatial, and temporal data on awards from the following agencies:

- National Institutes of Health
- Administration for Children and Families
- Agency for Healthcare Research and Quality
- Centers for Disease Control and Prevention
- Health Resources and Services Administration
- US Food and Drug Administration
- Department of Veterans Affairs

The database was designed to describe federal science investments and provide empirical data for science policy. The NIH updates the NIH RePORTER weekly.

NIFA is the external research arm of the US Department of Agriculture. As such, the NIFA Data Gateway provides information on external awards from the USDA Research, Extension, and Education office. The NIFA Data Gateway provides the same type of data as the NIH RePORTER, updated each fiscal year. However, FY 2022 was not completely updated as of February 2023.[9]

Framework for Project Selection

To identify relevant projects in the database, we defined the scope of interest for farmworker health research as follows:

- Farmworkers were defined in accordance with the definition provided by the USDA National Agricultural Library Thesaurus: "people gainfully employed by a farm operator to assist with the farm work, including regular, seasonal, local, migratory, full-time or part-time employment" (NAL 2016).

- Health outcomes included acute illnesses; chronic diseases; communicable diseases; environmental exposures, including air and water pollution, extreme heat, and pesticides and other chemicals; food and nutrition insecurity; physical injuries; psychological disorders, including addiction, anxiety, and depression; and measures of overall morbidity or mortality.

Relevant projects clearly identified farmworkers among the target populations and included one or more aspects of farmworker health as a target area of study.

Search String Development

NIH REPORTER

Our first NIH RePORTER search string drew from a recent review of scientific literature, published between January 2016 and January 2020, on occupational hazards and social conditions that affect farmworker communities (Goldman et al. 2021). That report's methodology, including the search terms, was developed by experts in farmworker health in collaboration with the Center for Agriculture and Food Systems at Vermont Law School and with technical support from the Welch Medical Library. We adapted these search terms based on UCS internal expertise and recent research on heat stress and pesticide exposure (Ferguson, Dahl, and DeLonge 2019).

We added variations of terms to this search string to accommodate the limitations of the NIH RePORTER search tool, which does not allow for operational functions such as truncation. For example, instead of including only the truncated term for "labor" (labor*), we included variations such as "laborer" and "laborers."

To ensure we captured all relevant projects, we developed a second NIH RePORTER search string by cross-referencing terms in the first search string with terms in the NIH Research, Condition, and Disease Categorization (RCDC) thesaurus. The RCDC system, a computer-based process, sorts NIH-funded projects into categories based on research area, disease, or condition. At the time of the string search development, the RCDC had 299 terms based on research areas, diseases, or conditions, and each included various subcategories to create the RCDC taxonomy (NIH 2022). We grouped like terms in the RCDC together and nested them under broader categories. For example, the RCDC term "heat stress disorder" is nested under the term "wounds and injuries," nested under "disorders of environmental origin," nested under "disease." To build this second search string, we started with terms cross-referenced from the first search string, then added parent terms under which they were nested. If a term

from the first search string did not have a corresponding term in the RCDC thesaurus, it was omitted from the second search string.

NIFA DATA GATEWAY

The NIFA Data Gateway search string included the grouping of farmworker terms from the first NIH RePORTER string. However, Boolean logic did not function properly in the NIFA Data Gateway; thus, we expanded all search terms to eliminate the need for any complex Boolean logic.

The results were filtered by NIFA knowledge areas relevant to health. This included all subtopics of Human Nutrition and Human Health under Topic VII. Human Nutrition, Food Safety, and Human Health and Well-Being. A complete list of knowledge areas is included in the Manual of Classification for Agricultural and Forestry Research, Education, and Extension (NIFA 2013).

SEARCH STRING AND SEARCH ENTRY DETAILS

NIH REPORTER FIRST SEARCH STRATEGY

Filters: Search project abstract only; exclude subprojects

Dates: FY 2019–2022

Search date: 11/3/2022

Results: 250

(farmhand OR farmhands OR farmworker OR farmworkers

OR

((agriculture OR agricultural OR crop OR farm OR migrant OR seasonal) AND (worker OR workers OR labor OR laborer OR laborers OR labour OR labourer OR labourers)))

AND

(hygiene OR pesticide OR pesticides OR wound OR wounds OR injury OR injuries OR accident OR accidents OR bites OR stings OR “mechanical damage” OR sounds OR noise OR pollution OR “ultraviolet radiation” OR “poisonous plants” OR “poisonous weeds” OR “air quality” OR “air pollution” OR pesticides OR herbicides OR fertilizers OR disasters OR lightening OR radiation OR influenza OR “climate change” OR “global warming” OR disparity OR suicide OR depression OR stress OR cancer OR “chronic disease” OR “chronic diseases” OR “cardiovascular disease” OR “cardiovascular diseases” OR “substance abuse” OR alcoholism OR addiction OR “food security” OR hunger OR nutrition OR health OR heat OR death OR stroke OR dehydration OR “water pollution” OR “water quality” OR “morbidity” OR “mortality”)

NIH REPORTER SECOND SEARCH STRATEGY

Filters: Search project terms only; exclude subprojects

Dates: FY 2019–FY 2022

Search date: 11/3/2022

Results: 137

("Agricultural workers" OR farmer OR "farm worker" OR "migrant worker")

AND

(Health OR "activities of daily living" OR hygiene OR "environmental health" OR "accidents" OR "environmental exposure" OR "carcinogen exposure" OR "particle exposure" OR "radiologic health" OR "health disparity" OR "mental health" OR "public health" OR "accidents" OR "environmental pollution" OR "noise" OR "water pollution" OR "radiologic health" OR medicine OR nutrition OR disease OR "cardiovascular disease" OR "chronic disease" OR "disorders of environmental origin" OR "wounds and injuries" OR accidents OR "bites and stings" OR bite OR "sting injury" OR "heat stress disorders" OR wound OR infection OR "respiratory tract infection" OR influenza OR injury OR "electrical injury" OR "lightning injuries" OR "mental disorders" OR addiction OR "behavior disorders" OR "self destructive behavior" OR "suicide" OR "mental depression" OR "depressive disorder" OR "substance abuse problem" OR "alcohol-related disorders" OR "suicide attempt" OR "nutritional and metabolic disease" OR dehydration OR "nutrition disorders" OR "food security")

NIFA DATA GATEWAY SEARCH STRATEGY

Filters:

Search fields: keywords, methods, nontechnical summary, objectives, progress: accomplishments, progress: publications, project title

Knowledge areas: All knowledge areas categorized under "human nutrition" and "human health" (Topic VII: Human Nutrition, Food Safety, and Human Health and Well-being); [701] Nutrient composition of food; [702] Requirements and function of nutrients and other food components; [703] Nutrition education and behavior; [704] Nutrition and hunger in the population; [721] Insects and other pests affecting humans; [722] Zoonotic diseases and parasites affecting humans; [723] Hazards to human health and safety; [724] Healthy lifestyle

Project start fiscal year: FY 2019–2022

Search date: 10/28/2022

Results: 53

farmhand OR farmhands OR farmworker OR farmworkers OR "agricultural worker" OR "agricultural workers" OR "agricultural labor" OR "agricultural laborer" OR "agricultural laborers" OR "crop worker" OR "crop workers" OR "crop labor" OR "crop laborer" OR "crop laborers" OR "farm worker" OR "farm workers" OR "farm labor" OR "farm laborer" OR "farm laborers" OR "migrant worker" OR "migrant workers" OR "migrant labor" OR "migrant

laborer" OR "migrant laborers" OR "seasonal worker" OR "seasonal workers" OR "seasonal labor" OR "seasonal laborer" OR "seasonal laborers"

Inclusion And Exclusion Criteria

Before reporting the total number of results, we note here that the NIH RePORTER and NIFA Data Gateway report results differently. For each multiyear project, the NIH RePORTER prints a unique entry for each year of the project. All projects that had at least a single year between FY 2019 and FY 2022 had at least a single entry in our final data table, regardless of whether other years of the project fell outside of this time frame. This means that each project could have appeared multiple times to represent each year of the project period within FY 2019 and FY 2022. We aggregated multiple entries for each project into a single entry. In other words, for each project in the NIH RePORTER, we captured the funding for all years of the project between FY 2019 and FY 2022. The NIFA Data Gateway prints multiyear projects as a single entry and only projects with an identified starting date between FY 2019 and FY 2022 were printed, even if the grant continued after FY 2022. Projects with starting date prior to FY 2019 were not included. In addition, NIFA entries included initial and cumulative awards. We included the cumulative award when both the start of the project and the most recent award of the project fell within the search years.

We combined the results from the first (n=250) and the second (n=137) NIH RePORTER searches and removed duplicates. After aggregation of multiyear projects, the final number of unique NIH RePORTER projects was n=145. The final number of NIFA Data Gateway unique projects was n=53. The total number of projects in this study was n=198.

For all inclusion criteria, researchers reviewed the abstract and public health relevance for projects reported by the NIH RePORTER and the non-technical summary and objectives for projects reported by the NIFA Data Gateway. The first inclusion criterion was location; we only considered projects located within the United States. We acknowledge that the application of projects from other countries can be relevant to farmworkers' health in the United States, but it may not always be the case. For instance, environmental exposures may differ based on climate and pesticides used in each country. One researcher reviewed the combined dataset for this criterion and excluded all projects that were not clearly located in the United States. After the application of the first exclusion criteria, the dataset included n=83 projects from the NIH RePORTER and all (n=53) projects from the NIFA Data Gateway, yielding a total of n=136 projects.

Two researchers then independently reviewed the remaining projects for two inclusion criteria:

- The project included farmworkers among its target populations. This included agricultural workers such as livestock workers and orchard workers. With respect to the first criteria, populations that were not considered farmworkers included farmers and farm operators[10]; workers in aquaculture, fisheries, or hatcheries; workers in the food industry beyond the farm gate (processing, distribution, sales, etc.); farmer or farmworker family or community members; agriculture or agricultural industry without naming the specific workers; and general populations that may include farmers or farmworkers but did not explicitly name them as a target population.

- The project named one or more hazards or health outcomes affecting farmworkers. With respect to the second criteria, search terms not considered relevant included social determinants of health, including healthcare, housing, immigration status, income, or wages; economic health, farm viability, or other measures of financial success; and food safety issues affecting the general population, without distinguishing outcomes for farmworkers. While these may mediate or moderate the relationship between hazards and health outcomes, they also represent separate concepts.

Also excluded were projects employing farming or gardening as a health intervention for the general population or a specific community—for example, programs providing education and training to improve community food security or food sovereignty through food production. While such programs were meant to train communities in food production, they did not affect an existing population of farmworkers.

Although most funding reported in the NIH RePORTER and NIFA Data Gateway pertains to research, funding is also reported for extension programs, educational opportunities (e.g., conferences), and intervention strategies (e.g., services for farmworkers with disabilities). We considered these projects within the realm of farmworker health research and included them in the results. Evidence-based programming and educational materials and events contribute to the field of farmworker health by providing opportunities for fostering knowledge and innovation through learning and cross-disciplinary collaboration.

After reviewing all remaining projects, we excluded the annual funding for the 12 Centers for Agricultural Safety and Health funded through the National Institute for Occupational Safety & Health. These centers receive funding for both operations and project costs. We excluded them because they did not report research costs separately, and project descriptions in abstracts were not inclusive of all their projects and did not provide enough detail.

Following independent review, discrepancies in the two reviewer sets were resolved through discussion among the two reviewers. The final data set included 55 projects.

Data Analysis

Our data analysis had two components: a quantitative analysis of total government spending on farmworker health and a qualitative analysis of topics addressed in the projects as well as their target populations. We also calculate the average contribution of the food and agriculture industry into the overall US economy for FY 2019-2022 for comparison.

For the cumulative awards, we added the research spending for all projects and divided spending by the total number of fiscal years in this study to get average funding per year. However, we encountered two issues: some projects did not report an award amount, and the NIH RePORTER and the NIFA Data Gateway reported award amounts in different ways.

The NIH RePORTER did not show award amount data for a single project funded by the Department of Veterans Affairs. However, the VA database had a comprehensive record of awards; we used that to fill in the missing amounts (VA 2019; 2020; 2021; 2022).

Three types of project did not report award amount in the NIFA Data Gateway: projects at State Agricultural Experiment Stations (SAES) funded by the Hatch Act of 1887, projects at

1890s Land-Grant institutions (Evans-Allen projects) authorized by the Second Morrill Act of 1890, and one project funded through SAES (designated as "State" funding).

An SAES is a research center at a land-grant college or university that investigates potential improvements in food production and agribusiness. The two types of this funding are regular research and multistate. Our final list of projects included nine regular research projects and one multistate project. We estimated the average value of each of these awards based on the total funding authorized for SAES research projects and the total number of active projects between FY 2016 and FY 2020 (Federal Grants Wire 2022). Only those years were available. The 2020 values were estimated by the source; the values for all other years were reported. Over this five-year period, each project received annually an average of $33,894 for regular research (Table 3) and $1,008,393 for multistate research Table 4).

To estimate the award for each multiyear project, we multiplied the average project award ($33,894 and $1,008,393) by the number of fiscal years between the project's start and end date. We included all fiscal years, including fiscal years past FY 2022 and incomplete fiscal years.

1890 Land-Grant institutions are historically Black universities; they can receive funds through the NIFA to strengthen research, extension, and teaching in the food and agricultural sciences. Award amounts for one project completed at South Carolina State University through an Evans-Allen capacity grant were not reported. We estimated the average value of each of these awards based on the total amount of funding for South Carolina State University funded by Evans-Allen awards (NIFA 2019) and the number of projects at South Carolina State University in 2019 as identified by the NIFA Data Gateway (Table 5).

Table 3. Total Payment to States and Active Hatch Act Projects (Regular Research), FY 2016–2020

	Payment to States	Active Research Projects	Average Project Award
2016	$172,423,744	5,667	$30,426
2017	$172,423,744	4,712	$36,592
2018	$172,705,011	5,874	$29,402
2019	$183,367,803	4,513	$40,631
2020	$172,382,319	5,000	$34,476
Total	$873,302,621	25,766	$33,894

Note: The payment to states and active research projects are from Federal Grants Wire (2022).

Table 4. Total Payment to States and Active Hatch Act Projects (Multistate), FY 2016–2020

	Payment to States	Active Research Projects	Average Project Award
2016	$56,263,470	57	$987,078
2017	$56,120,901	57	$984,577
2018	$56,348,551	N/A	N/A
2019	$60,050,909	57	$1,053,525
2020	N/A	N/A	N/A
Total	$228,783,831	171	$1,008,393

Note: The payment to states and active research projects are from Federal Grants Wire (2022). We do not include 2018 and 2020 in our calculation since it does not include a number of Active Research Projects.

Table 5. Average Evans-Allen Project Award at South Carolina State University (2019)

	South Carolina State University
Fiscal Year	2019
Evans-Allen Projects	4
Allocated Evans-Allen Funding	$2,356,077
Average Project Award	$589,019

We could not determine or estimate the award amount for one project because the mechanism for funding was through the State Agricultural Experiment Station; no data were available.

Due to the discrepancy between how the NIH RePORTER and the NIFA Data Gateway report data, projects from the NIH RePORTER only include funding for project years between FY 2019 and FY 2022, while the NIFA Data Gateway projects include multiyear funding for projects that started between FY 2019 and FY 2022.

To describe the health-focus and population for each project, one researcher coded the abstract and public health relevance for the NIH RePORTER projects and the non-technical summary and objectives for the NIFA Data Gateway projects. Most projects included more than one population (including populations not of interest in this study) and more than one topic. Among the projects that included more than one topic, several investigated connections between topics (e.g., the connection between chronic kidney disease and environmental exposure to heat leading to acute kidney injury). Our results table (in XLS format , online at www.ucsusa.org/resources/investing-farmworker-health) reports all projects.

To calculate the average contribution of the food and agriculture industry into the overall US economy, we reproduced the methodology of USDA Economic Research Service using data from the US Department of Commerce Bureau of Economic Analysis (USDA ERS, n.d., US BEA, n.d.).

Limitations

Our methodology had several limitations.

First, the research framework did not capture all adverse health outcomes that farmworkers may experience due to social or economic conditions, nor did it capture health risks that may be transferred to children and families of agricultural workers (e.g., exposure to residual pesticides on clothing in the home) or to surrounding communities. We also did not include health outcomes for farmers of small and medium-size farms who may be exposed to similar conditions as farmworkers. Future research should elevate these critical topics.

Our methods utilized two federal research databases of the agencies most likely to fund research on farmworker health rather than a complete catalog of research agencies or research among included agencies. Since the discontinuation of the Federal RePORTER in March 2022, no comprehensive federal research database exists. According to the National Science Foundation Survey of Federal Funds for Research and Development (Table 15: Federal Obligations for Research, by Agency and Performer: FY 2019), 82 agencies across 15 departments had federal obligations for research in FY 2019. Other notable agencies included OSHA-funded work related to farmworker health.

Our inclusion criteria likely did not capture all projects that could support farmworker health in the United States. We discovered several technology-development projects that did not identify the United States as a specific location and other projects that identified "agricultural industry" as a primary target population, without specifying farmworkers. On the other hand, it was unclear how several projects would benefit farmworkers despite mentioning them as a target population; nor was it clear how the benefits would be disseminated to farmworkers. In other projects, farmworkers were only one among many target populations and therefore it was unlikely that all the funding would benefit them.

Finally, the availability of data on federal research grants imposed various limitations. The NIFA Data Gateway did not include all the data for FY 2022. Exact funding amounts were missing or incomplete for some projects; we estimated most of these awards. Also, because the NIH and NIFA report data differently, the total amounts may overestimate or underestimate the totals reported here.

Our limitations mean that the funding as reported by both the NIH RePORTER and NIFA Data Gateway likely underestimated the true amount of federal research spending on farmworker health. Supplementing our results with information from other databases and including the rest of NIFA projects for FY 2022 would likely lead to higher values.

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ENDNOTES

1. The figure of 20 deaths per 100,000 includes deaths among workers in agriculture, forestry, fishing, and hunting industries rather than farmworkers, the focus of this report.

2. Indigenous languages reported in this survey included Acateco, Amuzgo, Chatino, Chuj, Mam, Nahuatl, Popti, Purepecha/Tarasco, Tlapaneco, and Triqui (Ornelas et al. 2022).

3. Definitions of "farmworker" vary. For example, a recent literature review used the term to refer to migrant and seasonal workers, using definitions of those subgroups provided by the Health Resources and Services Administration (Bloss et al. 2021). Our analysis used a definition intended to capture research into the health and wellbeing of all farmworkers, regardless of the duration of their employment.

4. Neither database includes the Department of Labor, which funds the National Agricultural Workers Survey as well as training grants pertaining to farmworker health through the Occupational Safety and Health Administration. See, for example, the Susan Harwood Training Grant Program, which distributed approximately $1.4 million for training workers in agricultural industries in FY 2022 (US DOL, n.d.). This amount included grants for projects that also trained workers other than agricultural workers. Our study also did not include the Health Resources and Services Administration which, among other responsibilities, supported the training of health professionals and improvements in health care delivery.

5. The CDC also provides funding for the National Institute of Occupational Safety and Health. NIOSH distributes funding for research but also to 12 Centers for Agricultural Safety and Health including the Great Lakes Center for Farmworker Health founded in 2022 (NIOSH, 2022). These centers conduct intramural research and other activities, some of which are relevant to farmworker health. Even though some (but not all) annual appropriations for the centers appeared in our search (with funding between $1.2 and $1.9 million as identified in the NIH RePORTER), we did not include them; this funding included both general operations and other activities and funds multiple different projects.

6. Although our search did not focus on the VA specifically, the NIH RePORTER includes VA data along with data on the Administration for Children and Families, the Agency for Healthcare Research and Qualityt, the Health Resources and Services Administration, and the US Food and Drug Administration. We found no awards from these agencies.

7. We did not include VA funding for comparison; it sponsored only one research project.

8. The Appendix Table 4 denotes these with an asterisk in the Population column.

9. Each fiscal year between 2019 and 2021, the NIFA Data Gateway reported between 4,369 and 4,584 projects. At the time of data collection for this project, FY 2022 only included approximately 2,900 projects.

10. Although many farmers and farm operators may work on the farm and therefore face similar risks, UCS focused on farmworkers. Farmworkers are disproportionately affected by health and safety hazards. At the same time, farmworkers are a vulnerable population due to immigration and labor laws. They are less likely to access resources and protection.

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