The Effects of Pesticides On Farmworker Health

Prepared for the Center for Food Safety

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Acknowledgments

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Introduction

In Florida, a notable case highlighting the dangers of pesticide exposure among farmworkers is that of Carlos Candelario. Born on December 17, 2004, Carlos was diagnosed with tetra-amelia, a rare condition marked by the absence of all four limbs. His mother, Francisca Herrera, had unknowingly been exposed to a mix of toxic pesticides while working in Ag-Mart's tomato fields during the early stages of her pregnancy when Carlos's brain, spinal cord, heart, and limbs were beginning to develop. The family later filed a lawsuit against the company over Carlos' birth defects. Herrera shared that Ag-Mart workers were frequently sprayed with chemicals and that those who felt unwell weren't given proper medical attention. Instead, they were told to take a quick break, drink water, and return to work. In 2008, an agreement between the family and Ag-Mart established a trust fund to cover Carlos's expenses for the rest of his life.

Carlos Candelario, *Palm Beach Post*

The story of Carlos Candelario reminds us of what's at stake. Addressing the effects of pesticide exposure is not only a matter of justice for farmworkers but also a moral imperative that affects the health of communities, the integrity of our food supply, and the values we uphold as a society.

Note: There is a lack of comprehensive data on the working conditions of farmworkers (Ferguson et al., 2019). The informal and seasonal nature of agricultural labor complicates data collection, and the significant number of undocumented workers adds another layer of complexity. Farmworkers may be hesitant to report health issues due to fear of retaliation; lack of symptom recognition; or not knowing where to report them. Consequently, this issue is underreported, posing challenges for research and advocacy efforts.

Client Overview

The problem of farmworker pesticide exposure aligns directly with the Center for Food Safety's (CFS) mission to protect human health, the environment, and the integrity of food systems. Addressing this issue as an organization dedicated to advancing sustainable agriculture and promoting stronger regulatory safeguards represents a critical opportunity to ensure farmworker safety and long-term agricultural sustainability. Pesticide exposure not only jeopardizes the health and well-being of farmworkers but also raises broader concerns about environmental sustainability and food safety, which are core focus areas for CFS.

With the agricultural sector facing increasing reliance on pesticides and regulatory enforcement gaps persisting at the federal and state levels, the risks to workers, communities, and ecosystems are compounding. By prioritizing this issue now, CFS can build momentum for policy reforms that protect vulnerable populations, strengthen enforcement mechanisms, and transition the industry away from heavy pesticide reliance and toward more sustainable farming practices. CFS is uniquely positioned to tackle this problem through legal action, policy advocacy, public awareness campaigns, and coalition building.

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Executive Summary

Farm labor is essential, providing the food that sustains our nation, fuels economic growth, and strengthens our communities. However, farmworkers face disproportionate exposure to harmful pesticides, leading to severe health risks. This systemic issue is rooted in both external and internal challenges, including the prevalence of monoculture farming, weak regulatory enforcement, limited legal protections, and the inherent vulnerabilities of an immigrant-dominated workforce. The health and well-being of farmworkers are crucial for their personal quality of life and the long-term sustainability of the agricultural sector.

Addressing pesticide exposure requires a preventative approach that tackles the agricultural systems driving pesticide reliance. Monoculture farming heightens pest pressures, leading to increased chemical use, while economic pressures and weak enforcement leave farmworkers vulnerable to unsafe conditions. Current federal protections, such as the Worker Protection Standard, are insufficient due to limited oversight and inconsistent compliance. Furthermore, the EPA's approach to pesticide regulation, which balances benefits against health risks, allows harmful chemicals to remain in use despite growing evidence of their dangers.

This analysis evaluates three policy alternatives to reduce farmworker pesticide exposure: 1) supporting organic farming practices under the USDA National Organic Program, 2) expanding the Conservation Stewardship Program to incentivize sustainable farming practices, and 3) enhancing Whole-Farm Revenue Protection insurance to encourage diversification. Based on an analysis of cost-effectiveness, equity, profitability, and quality of evidence, expanding the Conservation Stewardship Program emerges as the most promising strategy. This program leverages existing infrastructure to scale up sustainable practices; promotes equity among socially disadvantaged farmers; and addresses the root causes of pesticide reliance.

Toxic pesticides affect us all. While most consumers are several steps removed from direct application, exposure can still occur through contaminated food, drifting chemicals in the air, and polluted water sources. Transitioning to more sustainable farming practices protects not only farmworkers but also regular consumers, the environment, and our overall food system.

Background

The extensive use of pesticides in American agriculture has put farmworkers and their families at an elevated risk level. This risk is intensified by a long-standing system of agricultural exceptionalism, which has historically denied agrarian workers the same labor and safety protections provided to other industries (Liebman et al., 2013). This systemic disparity becomes even more concerning when considering the demographics, health challenges, wages, and working conditions of farmworkers, which altogether exacerbate their vulnerability to the harmful effects of pesticide exposure.

Demographics

The agricultural workforce in the U.S. includes an estimated 2.5 million individuals (Martin, 2020). Within this group, 15 percent identify as migrant workers, while the remaining 85 percent are settled workers. A majority (70 percent) of workers are foreign-born, with 63 percent born in Mexico, 30 percent born in the United States or Puerto Rico, and five percent born in Central American countries (Gold et al., 2022). Nearly 80 percent of farmworkers identify as Hispanic. Most workers (62 percent) also report that they are most comfortable speaking Spanish. Specifically, 30 percent of farmworkers said they could not speak English at all, 38 percent said they could talk some English, and the remaining 32 percent said they could speak English well. In terms of completed education level, the average level of completed education was 9th grade.

Between 2020 and 2022, U.S.-born individuals comprised 32 percent of crop farmworkers, while seven percent were naturalized citizens (Castillo, 2024). Another 19 percent were authorized immigrants, mainly permanent residents with green cards, and the remaining 42 percent lacked legal work authorization.

Health

Approximately 52 percent of U.S. farmworkers lack health insurance, a significant disparity compared to the national uninsured rate of 7.7 percent (Castillo, 2024; U.S. Department of Health and Human Services, 2023). In a survey of 1,200 California farmworkers from August 2021 to January 2022, over one-third reported that their health was fair (31 percent) or poor (5 percent) (Brown et al., 2022). The most reported chronic conditions were diabetes (20 percent), hypertension (19 percent), and anxiety (10 percent). In terms of women's health, nearly a quarter (24 percent) reported not having regular menstrual cycles. In comparison, suspected fertility issues were noted by 8 percent of women and 4 percent of men. Additionally, 22.1 percent of women reported experiencing a miscarriage at some point in their lives; 14 percent reported having preterm births; and 15 percent reported having delivered babies with low birth weight.

Farmworkers experience many barriers to accessing health care. Living and working in rural areas often creates logistical challenges, such as difficulties in obtaining transportation to medical appointments (Hoerster et al., 2011). Fear of immigration enforcement further discourages them from seeking care. Language barriers also pose a major challenge, with limited English proficiency affecting access to and the quality of care. Without essential primary care, farmworkers face limited opportunities for preventive measures, increasing their risk of undiagnosed chronic illnesses.

Furthermore, farmworkers who struggle to access primary care often rely on urgent or emergency services, which are more expensive and riskier for their health.

Wages

Agricultural workers represent some of the most economically disadvantaged workers in the country. Findings from the National Agricultural Workers Survey 2019-2020 found that farmworkers were employed on farms for 39 weeks out of the year, working an average of 46 hours per week (Gold et al., 2022). Most were paid hourly (82 percent), earning an average of $13.59; the piece paid seven percent,[1] earning $14.63 an hour, and eight percent were salaried. Their incomes typically ranged from $20,000 to $24,999 annually, while total family incomes averaged between $25,000 and $29,999.

Working Conditions

According to 2019 data from the U.S. Bureau of Labor Statistics, agriculture remains one of the most hazardous industries in the United States, with 573 fatalities, translating to a rate of 23.1 deaths per 100,000 workers (Mulhollem, 2022).[2] While the Worker Protection Standard was established to provide baseline workplace safety procedures, compliance and enforcement are low (Scott et al., 2023). In a survey of 1,200 California farmworkers, one in five reported experiencing, at one point or another, not being paid wages by an employer (Brown et al., 2022). Almost half (43 percent) reported that their employer never provided a heat illness plan, which is legally mandated. Regarding reporting their employers for non-compliance, slightly over one-third said they would not be willing to file a report against their employer. Out of this group, about two-thirds said they would be unwilling because of fears of retaliation or job loss. A majority of respondents (67 percent) reported feeling a constant and intense fear of being separated from their families due to deportation.

Pesticides

Farmworkers endure disproportionate exposure to harmful pesticides, which can result in serious health risks such as neurological disorders, cancer, reproductive issues, and chronic illnesses (Kim et al., 2017). Between 2007 and 2011, the rate of acute pesticide-related illnesses among agricultural workers was 37 times higher than that of non-agricultural workers (Calvert et al., 2016). Additionally, the EPA estimates that 13,000 to 15,000 agrarian workers are diagnosed annually with acute illnesses caused by pesticide exposure (McDonald et al., 1992). When undiagnosed cases are included, the number of acute diseases could reach up to 300,000 annually (U.S. Government Accountability Office, 1992). Many cases remain unreported or untreated due to barriers like language, fear of retaliation, and insufficient access to healthcare.

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[1] Piece rate as a basis of payment is when crops are weighted and measured. Some employers prefer this form because it promotes quicker harvesting speeds.

[2] It should be noted that these data are likely underreported. Leigh, Du, and McCurdy (2014) found that the Bureau of Labor Statistic's official count of agricultural injuries and illnesses in 2011 on both farm was crop farms was underreported. The official count was 32,100, but researchers found that this number did not include injuries or illnesses sustained by workers on farms with less than 11 employees. It also did not account for failures to report injuries. The adjusted count estimated that the number of job-related illnesses and injuries was 143,436. Inadequate data not only distorts the true scale of the issue but also hinders efforts to address unsafe working conditions.

In addition to direct handling, farmworkers are often also exposed to pesticides indirectly. According to the CDC, most reported pesticide poisoning cases involved individuals not directly working with pesticides (CPDR, 2019). This is mainly due to inadequate workplace protections, such as employers failing to notify workers when fields have been sprayed, neglecting mandatory re-entry intervals, and not providing proper personal protective equipment. Data from the 2015–2016 National Agricultural Workers Survey further highlights this gap, revealing that only 57 percent of workers received pesticide safety training in the past year (Hernandez & Gabbard, 2018). The risks extend beyond the fields; pesticide residues carried home on clothing, shoes, and skin can expose workers' families, particularly children, to harmful chemicals. Additionally, the proximity of agricultural fields to homes, schools, and playgrounds increases the risk of exposure through pesticide drift.

Pesticides are also costly to farmers. In the US, farmers spend about $16 billion a year on pesticides (Chandler, 2024). In Washington state, the average farmer spent $21,000 on pesticides in 2022, a 45 percent increase over the 2021 average of $15,000. Washington farmers paid $7.5 billion on pesticides and disease control (Martin, 2024). More sustainable practices have the potential to help farmers lower their costs.

Brief overview of two widely used pesticides in American agriculture

Glyphosate Most widely used herbicide in the world. It is mostly commonly sold under the name *Roundup* and *Ranger Pro.* In 2020, Bayer, the maker of *Roundup,* agreed to pay more than $10 billion to settle claims that linked the herbicide to non-Hodgkin's lymphoma (Cohen, 2020).
Usage: Approximately 280 million pounds of glyphosate are applied to 298 million acres of farmland each year in the U.S. From 1992 to 2009, usage in the U.S. increased nearly sixteen-fold (Thelin & Stone, 2013).
Health Effects: Exposure to glyphosate increases the risk of a cancer called non-Hodgkin lymphoma by 41 percent (Zhang et al., 2019). Exposure during childhood may raise the risk of liver inflammation and/or cardiometabolic disease in young adulthood (Eskenazi et al., 2023). In 2015, the International Agency for Research on Cancer (IARC) labeled glyphosate as "probably carcinogenic to humans" (World Health Organization, 2015). However, EPA did not agree with the IARC's conclusion. In the EPA's independent evaluation in 2022, the agency found that there are no risks of concern to human health, no indication that children are more sensitive to glyphosate, and no evidence that it causes cancer in humans (U.S. Environmental Protection Agency, 2024).

Neonicotinoid (Neonics) Most widely used insecticide in the world.
Usage: Usage: It is estimated that the U.S. uses more than four million pounds of neonics on 140 to 200 million acres of farmland annually (Cimino et al., 2017).
Health Effects: Cimino et al. (2017) identified links between neonic exposure and developmental malformations in the heart and brain, as well as neurological symptoms such as memory loss and finger tremors. Living near agricultural areas with imidacloprid (type of neonics) use in California's San Joaquin Valley was linked to a statistically significant 2.4-fold increased risk of tetralogy of Fallot, a rare congenital heart defect (Carmichael et al., 2014). The same population in California showed an almost three-fold increased risk of anencephaly, a severe brain and skull malformation, in babies born to mothers living near areas of high imidacloprid use (Yang et al., 2014).

Potential Approaches to the Problem

Pesticide approval and banning process

Adopt a more stringent and precautionary approach to pesticide approval and banning

The European Union (EU) maintains the most precautionary approach to pesticide approval among global regulatory systems. EU regulations are designed to "ensure that industry demonstrates that substances or products produced or placed on the market do not have any harmful effect on human or animal health or any unacceptable effects on the environment (European Parliament, 2005, 2009)." Additionally, the EU prohibits approving and using pesticides the European Commission recognizes as mutagens, carcinogens, reproductive toxicants, or endocrine disruptors unless exposure to humans is deemed negligible (European Parliament, 2009). The strength of this framework lies in its precautionary approach, which places the burden of proof on the pesticide producer to demonstrate that the product does not harm humans or the surrounding environment.

In contrast, the EPA uses a cost-benefit analysis to evaluate pesticides, assessing the health and environmental risks associated with the pesticide's costs and efficacy (Donley, 2019). Several pesticides approved for use in the US are banned or phased out in the EU, Brazil, and China. This suggests the EPA's approach to pesticide approval and banning is less precautionary and more permissive. Under federal regulations, the pesticide producer must only demonstrate that the product "will not generally cause unreasonable adverse effects on the environment (U.S. Environmental Protection Agency, 2002)." These effects are defined as "any unreasonable risk to man or the environment, taking into account the economic, social, and environmental cost and benefits of using pesticides (U.S. Environmental Protection Agency, 2002)." Essentially, the EPA interprets this standard as a certain level of risk is allowed and often overstates a pesticide's benefits to farmers and understates the adverse health and environmental effects (Rhoads & Colangelo, 2021; Sass & Wu, 2013).

Despite its mandate to prevent unreasonable adverse effects, the EPA faces a slow and cumbersome process when removing hazardous pesticides from the market. A major obstacle is that current federal pesticide law makes it difficult and resource intensive to revoke prior approvals, even when new evidence reveals health risks. Before banning a pesticide, the EPA must assess alternatives and evaluate potential effects on agricultural production, creating additional delays. As a result, bans are rare and often occur only when companies voluntarily withdraw their products. In the past two decades, the EPA has unilaterally removed just five pesticides, while companies have requested the removal of 60 (Donley, 2022). Even in cases of clear public health violations, bans typically follow years of litigation. For example, the EPA banned chlorpyrifos for use on food crops in 2021, only after a six-year delay and multiple lawsuits from farmworker and health advocacy groups, despite strong evidence linking the pesticide to neurological harm in children. However, in 2023, a federal court reversed the decision, adding that the EPA could have passed a partial ban instead (Red River Valley Sugarbeet Growers Ass'n v. Regan, 2023). This decision was likely influenced by industry pressure. While the U.S. struggles to enforce lasting protections, Chlorpyrifos have been banned in the United Kingdom since 2016; EU and Thailand since 2020; and in Canada since 2023 (Trager, 2024). Some states, including California, Hawaii, New York, Maine, Maryland, and Oregon have already limited the use of chlorpyrifos on food.

What can states do?

Some states have attempted to fill this regulatory gap through independent pesticide restrictions. The table below lists state laws that limit or ban the use of glyphosate and neonics.

	Glyphosate
Maine (2021)	HP 382 prohibits use of glyphosate on or within 75 feet of schools
Massachusetts (2021)	H 4002 funded a scientific evaluation of the environmental and public health impacts of glyphosate and its commonly used alternative herbicides; assesses whether glyphosate's current applications result in unacceptable harm to the environment; and provides recommendations on whether its approved uses should be modified or discontinued.
Nevada (2019)	SB 2015 classifies glyphosate as a recognized carcinogen linked to an increased risk of multiple myeloma.
	Neonics
New York (2023)	S 1856 banned residential use and neonicotinoid-treated seeds in agricultural use for corn, soybeans, and wheat production.

Minnesota (2023)	HF 2310 requires that treated seeds are handled in human and environmentally safe manners and prohibits neonicotinoids' application to wildlife management areas, state parks, state forests, aquatic management areas, and scientific and natural areas.
Colorado (2023) and Maryland (2016)	SB 23-266 and SB 375, respectively, prohibit the purchase and sale of neonicotinoids to certified applicators and dealers.

Worker Protection Standard

Enhance enforcement of the Worker Protection Standard

While most occupational safety standards are overseen by the U.S. Occupational Safety and Health Administration (OSHA), farmworker safety has been relegated to the EPA. The Worker Protection Standard (WPS) is a federal regulation issued by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act to protect agricultural workers and pesticide handlers from the risks associated with pesticide exposure (U.S. Environmental Protection Agency, 2015). WPS includes requirements for pesticide safety training, use of personal protective equipment, restricted-entry intervals, decontamination supplies, notification of pesticide usage, and emergency medical assistance. However, researchers found that employer compliance with WPS varies, but it is generally low in most localities and not thorough enough (Scott et al., 2023). Additionally, Scott et al. (2013) identified several WPS compliance issues, including inadequate pesticide safety training; inaccessible or nonexistent information on pesticides; insufficient or poor compliance with application exclusion zones; insufficient or poorly fitted personal protective equipment; and inaccessible decontamination supplies. Responses from the National Agricultural Workers Survey (NAWS), a nationwide survey of farmworkers, confirm findings on inadequate pesticide safety training. Respondents were asked if, in the last 12 months, their employer had provided training or instruction on the safe use of pesticides – 68 percent responded yes in 2019-2020, suggesting that about 30 percent of employers are out of compliance with WPS (Department of Labor, 2020).[3] Studies in Oregon, North Carolina, Texas, and California also found low rates of pesticide training (Scott et al., 2023).

Inspections and violations are also likely to be underreported. In 2019, states conducted 3,407 inspections, and the EPA completed 12 (WPS Dashboard, 2019), meaning that only about one percent of the 346,000 WPS-regulated farms were inspected (WPS Dashboard, 2019). Further, only 19 percent of entities with violations are penalized (Gulino, 2024). The top three WPS violations in 2021 were central posting (437 violations), pesticide safety training (412 violations), and personal protective equipment (218 violations). While these are critical components of worker safety, they are generally more straightforward to correct through improved compliance and oversight. In contrast, other violations, such as the failure to provide timely emergency assistance or instances of workers entering treated fields before re-entry intervals had passed, are more complex and systemic.

[3] It is important to note that compliance rates reported in these survey findings may be inflated, as the data is collected through surveys that require employer consent before employees can be surveyed (Department of Labor, 2020).

Photo: John Nakata / Adobe

In 2022, the California Department of Pesticide Regulation reported that failing to post application-specific information, such as the start and end times of pesticide applications, before allowing farmworkers to enter treated areas was the sixth most common pesticide violation (Valley Ag Voice Staff, 2023).

Implementing biological monitoring for certain pesticides is a more challenging yet crucial strategy in strengthening workplace safety. Biological monitoring for chemical exposure is a standard practice in many industries, with OSHA establishing over 25 chemical guidelines to screen workers exposed to hazardous substances (U.S. Department of Labor, n.d.). However, farmworkers, who frequently come into contact with harmful pesticides, lack a national mandate for medical monitoring to prevent chronic exposure. This gap is concerning, particularly as perceived pesticide exposure often does not align with actual exposure levels (Runkle et al., 2013). States like California and Washington have implemented biological monitoring for certain pesticides to safeguard farmworkers (California Office of Environmental Health Hazard Assessment, 2015; Donley et al., 2022). The Washington Biomonitoring Pesticides Program tracks blood pesticide levels among farmworkers and uses the data to inform their pesticide risk reduction strategies (Gulino, 2024). Findings from these programs reveal alarming trends: pesticide exposure resulting in physiological effects often occurred even when pesticide use adhered to the WPS and pesticide product labels, indicating that label directions alone do not always protect against harm (Donley et al., 2022).

While the WPS establishes legal protections for farmworkers, weak enforcement and limited compliance monitoring often leave these safeguards unmet, offering little incentive for employers to comply fully. However, states can strengthen workplace safety standards and improve enforcement efforts. Because nearly all pesticide enforcement has been delegated to states through cooperative agreements with the EPA, state agencies can adopt additional safety measures, provided they meet the baseline requirements set by WPS.

Diversified farming practices

Replacing monoculture farming with diversified practices

Monoculture farming grows a single crop type across large areas (Salaheen & Biswas, 2019). In the United States, 440 million acres (80 percent of agricultural land) are dedicated to monoculture farming (Jacobo, 2021). While this method is highly efficient and profitable, it makes the land more vulnerable to pests and diseases (Salaheen & Biswas, 2019); depletes soil nutrients (Kopittke et al., 2019); and reduces biodiversity (Sánchez et al., 2022). Monoculture farming increases vulnerability to pests, leading to pesticide use and reliance; pests develop resistance, leading to even more potent chemicals (Balogh, 2021).

Alternatively, diversified farming practices reduce reliance on pesticides because they incorporate a variety of crops and animals, mimicking natural ecosystems and improving soil health, water retention, and pest control. In theory, diversified agriculture can offer better financial stability by reducing risks related to yield, prices, inputs, and markets (Bowman & Zilberman, 2013). For example, planting a mix of crops that respond differently to markets and weather helps protect farmers from losing everything if one crop fails or becomes less profitable. Diversification also supports ecological practices, like crop rotation and cover cropping, that improve soil health and reduce pest and weather-related yield losses. In one study, pesticide reliance and associated health and environmental risks were reduced on 65.7 percent and 60.3 percent of farms, respectively, indicating progress toward pesticide reduction (Nandillon et al., 2024). In another study, using data from 1,285 cropping systems, researchers found that crop species and crop diversity account for 37.1 percent and 1.3 percent of pesticide use variance, respectively (Zhang et al., 2024).[4] Further, an additional crop in the system reduced pesticide use by 0.09 units on average (Zhang et al., 2024). Other factors not directly related to crop type or diversity account for 38.7 percent of the differences in pesticide use. These could include variables like climate, soil health, pest pressure, and farming practices, which also affect pesticide needs. Further studies are needed to shed light on the effects of crop species characteristics.

While the research demonstrates that diversified farming practices diminish pesticide reliance, the effects of diversified systems on profits are mixed. Evidence suggests crop rotation and intercropping are associated with yield increases; however, outcomes are highly variable, and additional studies are needed to confirm the strength (Beillouin et al., 2019). Further, Bowman and Zilberman (2013) found that the ecological benefits may not exceed the economic costs of diversification. However, in a global meta-analysis of 119 peer-reviewed articles, Sanchez et al. (2022) found evidence that diversified systems are at least as profitable as conventional farming systems. In a subset of articles, the researchers found that labor costs increased in diversified systems, but so did gross incomes, which led to profits comparable to those in conventional systems.

If diversified farming can reduce pesticide reliance and maintain comparable profitability, then why hasn't the market naturally shifted in this direction? Diversified systems often require higher upfront labor, more complex management, and a longer timeline to realize returns, which are all factors that make them less attractive in a market driven by short-term margins and high productivity per acre. In addition, government subsidies, insurance programs, and procurement systems tend to favor and are currently designed to cater to monoculture operations, reinforcing the dominance of conventional practices.

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[4] Crop species (the specific types of crops grown) account for 37.1% of the differences in pesticide use across cropping systems. This suggests that some crops naturally require less pesticide than others, significantly influencing overall pesticide needs. Crop diversity (the variety of crops grown together) explains only 1.3% of the variation in pesticide use, indicating that while adding diversity has some effect, it's relatively minimal to crop species.

What can states do?

States can also actively encourage diversified practices. For example, California Assembly Bill 2113 would require the Department of Pesticide Regulation to establish a Sustainable Pest Management Workgroup to identify strategies to reduce pesticide use and expand integrated pest management practices (A.B. 2113, 2024). States can also offer financial incentives like grants, tax credits, or crop insurance subsidies tailored to diversified farming systems. They can update procurement policies to prioritize products from diversified farms; invest in research and extension services to provide training; and support local food infrastructure to strengthen markets. Additionally, states can revise zoning laws to promote mixed-use agriculture, fund integrated pest management programs, and provide targeted technical assistance to socially disadvantaged farmers. Together, these strategies reduce barriers to diversification and make sustainable practices more accessible and economically viable.

Focusing on Diversified Agriculture

The previous section explored three potential approaches for reducing pesticide exposure among farmworkers: reforming the EPA's regulatory framework; strengthening enforcement of the Worker Protection Standard; and promoting diversified farming practices. While each strategy offers meaningful strategies for reform, they vary in feasibility, scalability, and impact. Diversified agriculture stands out for its potential to reduce pesticide use at the source by transforming how we grow food, yet it remains underutilized due to structural barriers like policy misalignment and economic risk. To evaluate which policy alternatives are best suited for reducing pesticide reliance and safeguarding farmworker health, the next section outlines a set of criteria used to assess cost-effectiveness, equity, profitability, and the strength of supporting evidence. These criteria serve as a framework for identifying the most promising strategies in addressing this problem.

Criteria

The following criteria were used to compare, analyze, and evaluate the proposed policy alternatives. Each criterion and its corresponding weight were selected based on CFS's key objectives, stakeholder concerns, and the broader goals of reducing pesticide exposure among farmworkers through sustainable agricultural practices. These criteria reflect the need for cost-effective, equitable, and evidence-based solutions that support long-term viability and systemic change within the agricultural sector.

Cost-Effectiveness

Cost-Effectiveness (Weight = 50 percent): This criterion evaluates the ratio of program expenditures to the amount of pesticide reduction achieved – measured as dollars spent per pound of pesticide eliminated. The goal is to maximize the reduction of pesticide use while making efficient use of funding. Given that many proposed strategies involve substantial upfront investments, cost-effectiveness is essential not only for long-term success but also for securing funding and support. With the primary source of funding likely coming from the Farm Bill under a fiscally conservative federal administration, cost-effectiveness justifies the assigned 50 percent weight in the analysis.

Ratio	Points	Range
Very low	5 points	$0.63 – $31.07
Low	4 points	$31.08 – $61.52
Medium	3 points	$61.53 – $91.97
High	2 points	$91.98 – $122.42
Very high	1 point	$122.43 – $152.83

Equity

Equity (weight = 30 percent): This criterion measures the percentage of socially disadvantaged groups (SDGs) represented in the policy alternative. USDA defines an SDG as a group whose members have been subject to racial or ethnic prejudice. SDGs consist of American Indians or Alaskan Natives; Asians; Blacks or African Americans; Native Hawaiians or other Pacific Islanders; and Hispanics. Given CFS's commitment to equity, this criterion holds a 30 percent weight in the analysis.

Scale	Points	Percentage Range
Very low representation from socially disadvantaged groups	1 point	4.6% to 5.08%
Low representation from socially disadvantaged groups	2 points	5.09% to 5.56%
Moderate representation from socially disadvantaged groups	3 points	5.57% to 6.04%
High representation from socially disadvantaged groups	4 points	6.05% to 6.52%
Very high representation from socially disadvantaged groups	5 points	6.53% to 7.00%

Profitability

Profitability (weight = 10 percent): This criterion assesses the extent to which a policy alternative allows farmers to maintain financial stability while transitioning to and sustaining diversified agricultural practices. Profitability is defined as the number of years it takes a farmer to become profitable after transitioning. The long-term viability of any policy depends on farmer buy-in. Without a clear path to profitability, farmers may resist adopting new practices or abandon them over time. This makes profitability a critical factor in determining the real-world success and sustainability of the policy, warranting a 10 percent weight in the analysis.

Profitability Level	Points	Time Frame
Very low profitability	1 point	More than 5 years
Low profitability	2 points	4 years
Medium profitability	3 points	3 years
High profitability	4 points	2 years
Very high profitability	5 points	1 year

Quality of Evidence

Quality of Evidence (weight = 10 percent): This criterion assesses the quality and reliability of existing evidence supporting the alternative's ability to reduce pesticide use. While some strategies, such as organic farming, are backed by well-documented research showing significant pesticide reduction, others, have more limited or inconclusive data regarding their impact on pesticide use. Given that several of the proposed alternatives are under-researched, evaluating the strength of the available evidence is important in assessing the credibility and potential effectiveness of each approach. Alternatives were rated based on causality, data source, sample size, peer review, study origin, and whether it is a direct study of the alternative and pesticide reduction. While the research is limited, this remains a relevant consideration in policy selection, warranting a 10 percent weight in the analysis.

	1 point	0 points
Direct study	It is a study assessing the relationship between the alternative and pesticide reduction	It is not a study assessing the relationship between the alternative and pesticide reduction
Causality	Randomized experiment or strong quasi-experimental design	Observational, correlational, or anecdotal evidence
Data Source	Administrative data	Self-reported survey data
Sample Size (N)	Large sample (>1,000)	Small sample (<1,000)
Peer Review	Published in peer-reviewed journal	Unpublished or industry report
Study Origin	Data is from the US	Data is from a country outside the US

Policy Alternatives and Analysis

As previously mentioned, the widespread reliance on monoculture farming often leads to increased pesticide use to sustain crop yields and control pests. The policy alternatives included in this analysis focus on promoting agricultural diversification as a means to reduce farmworkers' exposure to harmful pesticides. The proposed policy alternatives aim to shift away from monoculture by encouraging more diverse and sustainable farming practices, ultimately creating safer working conditions and healthier environments. While there are multiple ways to address this issue, focusing on monoculture takes a preventative approach by targeting the root cause of pesticide overuse and reliance, rather than responding to its effects after the fact.

Alternative 1: Continuing USDA's National Organic Program

Cost Effectiveness	Equity	Profitability	Quality of Research
5 (2.5)	1 (0.3)	3 (0.3)	5.5 (0.55)
Total: 14.5 (3.65)			

Continuing the National Organic Program (NOP) is the status quo alternative. The organic-related programs and funding should, at a minimum, remain the same. Organic farming is one common way to improve the sustainability of agricultural production. USDA defines organic agriculture as "the application of a set of cultural, biological, and mechanical practices that support the cycling of on-farm resources, promote ecological balance, and conserve biodiversity ("Introduction to Organic

Practices," 2015). Organic farmers focus on natural processes and strategies and may not utilize irradiation, sewage sludge, synthetic fertilizers, synthetic pesticides or genetic engineering. Pesticides are used as a last resort; when they are used, organic farmers are limited to 25 materials, which pose little risk to human and environmental health, as opposed to the 900 pesticides approved for conventional farming (Carlson, 2023). Instead of synthetic pesticides, organic farms employ more natural pest reduction techniques such as integrated pest management (IPM), crop rotation, and cover cropping ("Introduction to Organic Practices, 2015). Given the minimal use of synthetic pesticides, organic farming techniques have the potential to reduce pesticide exposure for both farmworkers and consumers.

Cost Effectiveness (weight 50%): score 5, weighted score 2.5

Given that USDA has dedicated over $100 million over five years to the Transition to Organic Partnership Program (TOPP), the estimated annual budget in this analysis is $60 million. According to USDA National Agricultural Statistics Services (2021), there are 3.6 million acres of organic farmland. As a result, I estimate that USDA spends $16.67 per acre to support organic farming. Larsen et al. (2021) found that the expected probability of spraying pesticides reduced by about 30 kilograms per hectare for organic relative to conventional fields. When converted to acres per pound, this is a reduction in pesticides of 27.23 pounds per acre. The cost-effectiveness ratio is $0.61 per acre, meaning this alternative is expected to cost the USDA $0.61 ($0.65 in 2025 dollars) to reduce one pound of pesticide. This alternative receives a score of five.

Equity (weight 30 percent): score 1, weighted score 0.3

The accessibility of organic farming to SDGs is limited. In 2017, approximately 4.5 percent of organic producers identified as members of SDGs (Perdue & Hamer, 2019). While some groups had representation levels comparable to their share of the national population, there was an overall underrepresentation of SDGs among organic producers. This alternative receives a score of one.

Organic Producers by Ethnicity or Race in 2017 (Perdue & Hamer, 2019)		ACS Demographic Data (2017) (United States Census Bureau, 2017)
American Indian or Alaska Native	1.7%	0.8%
Asian	0.7%	5.6%
Black or African American	1.3%	12.7%
Hispanic, Latino or Spanish origin	1.9%	18.1%
Native Hawaiian or Other Pacific Islander	0.1%	0.2%
White	95.4%	72.3%
More than one race reported	0.79%	3.3%
SDGs	**4.5%**	**40.7%**

Profitability (weight 10 percent): score 3, weighted score 0.3

Despite the environmental and health benefits, organic farming requires upfront costs for transitioning farmers (Delbridge et al., 2017). To become certified organic, farmers must first adopt organic practices, including ending the use of common pesticides and fertilizers. A complete transition to organic means the farm or ranch cannot use prohibited substances for three years. During this transition period, many farms achieve lower yields than they do under conventional farming, resulting in lower revenues. Farmers may also purchase new machinery and equipment to become organically certified. Given this transition period, organic farmers tend not to profit until at least after the three-year transition period; this alternative receives a score of three.

Quality of Evidence (weight 10 percent): score 5.5, weighted score 0.55

Given the pesticide restrictions mandated by NOP, it is reasonable to assume that farmworkers on certified organic farms are exposed to significantly lower levels of pesticides than those on conventional farms. Two studies support this assumption, directly comparing pesticide use and exposure between organic and conventional farming systems. The average of the two scores is 5.5, hence a 5.5 score for this criterion.

Larsen et al. (2021): *Identifying and characterizing pesticide use on 9,000 fields of organic agriculture*

In this study, researchers found that the expected probability of spraying pesticides on organic fields is reduced by approximately 30 percent compared to conventional fields.

	Score (0 or 1)	Justification
Direct Study	1	The study assesses the relationship between organic farming and pesticide reduction
Causality	0.5	Observational study
Data Source	1	Uses administrative data on 9,000 organic fields
Sample Size	1	9,000 fields from 2013-2019
Peer Review	1	Articles on Nature.com are peer-reviewed
Study Origin	1	Kern County, California
Total score: 5.5		

Larsen et al. (2024): *Spillover effects of organic agriculture on pesticide use on nearby fields*

In a second study, Larsen et al. (2024) found that organic farms surrounded by other organic farms used fewer pesticides, but conventional farms surrounded by organic farms used more. Pest management approaches in organic fields push pests to migrate to traditional fields, prompting growers to increase their pesticide use to offset the reduction in organic fields.

	Score (0 or 1)	Justification
Direct Study	1	The study assesses the relationship between organic farming and pesticide reduction
Causality	0.5	Observational study
Data Source	1	Uses administrative data on 14,000 fields
Sample Size	1	14,000 fields from 2013-2019
Peer Review	1	Articles on Nature.com are peer-reviewed
Study Origin	1	Data is from Kern County, California
Total score: 5.5		

Alternative 2: Expand USDA's Conservation Stewardship Program

Cost Effectiveness	Equity	Profitability	Quality of Research
5 (2.5)	5 (1.5)	2 (0.2)	4 (0.4)
Total: 16 (4.6)			

This alternative proposes an expansion of the USDA's Conservation Stewardship Program (CSP). In the fiscal year 2023, 31 percent of CSP applicants (11,038 of 35,683) were awarded contracts encompassing 69 million acres of farmland (Institute for Agriculture and Trade Policy, 2024; Schewe & Womack, 2024). CSP provides farmers with financial and technical assistance to implement and enhance conservation practices and, in turn, strengthen their resiliency to weather and market changes; improve soil conditions; decrease their need for agricultural inputs; and improve wildlife habitat conditions (Schewe, 2024). Farmers seeking to adopt conservation strategies above the minimum practice standards can collaborate with the National Conservation Services (NRCS) planners to implement enhancements.[5] CSP offers 140 enhancements, some explicitly targeting pesticide reduction.[6]

The underlying assumption is that increasing access to CSP should lead to decreased pesticide use on more farms. I propose increasing the application acceptance rate to 50 percent in this alternative. To do this, USDA must allocate additional funding to support the new applicants.

Cost Effectiveness (weight 50 percent): score 5, weighted score 2.5

In the fiscal year 2023 (FY23), there were 69 million acres of CSP land and USDA provided $835 million in CSP assistance. Given this, CSP payment rates were approximately $12.11 per acre in FY23. Using estimates from a French crop diversification study, the estimated amount of pesticides reduced when engaging in sustainable farming practices is 0.94 pounds per acre. The cost-effectiveness ratio is $12.88 ($13.74 in 2025 dollars), meaning this alternative is expected to cost the USDA $160.68 to reduce one pound of pesticide. This alternative receives a score of five.

Equity (weight 30 percent): score 5, weighted score 1.5

Under the 2018 Farm Bill, NRCS must set aside five percent of CSP acres for SDPs (Schewe & Womack, 2024). NRCS exceeded this in FY23, setting aside seven percent of CSP funds to socially disadvantaged farmers in FY23, so this alternative receives a score of five.

Enrollment of CSP acres by SDGs reached a high of 23 percent under the Inflation Reduction Act of 2022 (IRA), which substantially boosted funding for the CSP, leading to the creation of 2,400 additional contracts and the enrollment of 3.28 million more acres in FY2023. This was more than double the typical range of eight to 12 percent in prior fiscal years – suggesting that SDG farmers are interested in conservation practices and that additional funding would increase equity. In contrast, regular FY2023 CSP enrollment showed just nine percent of acres going to socially disadvantaged producers, consistent with previous years and potentially suggesting that IRA-specific outreach and support made a meaningful difference in acreage enrolled by SDGs. Although further data is needed to fully explain the increase, it may reflect the early impact of several years of Equity in Conservation Outreach Cooperative Agreements, administered by NRCS.

Additionally, enrollment of SDGs in CSP varies widely across states; while places like New Mexico, Hawaii, and Oregon show strong participation, others, particularly in the Midwest and Northeast, have minimal enrollment despite large SDG farmers (Schewe & Womack, 2024).[7] This is an opportunity for USDA and states to focus outreach efforts on low participate areas and states.

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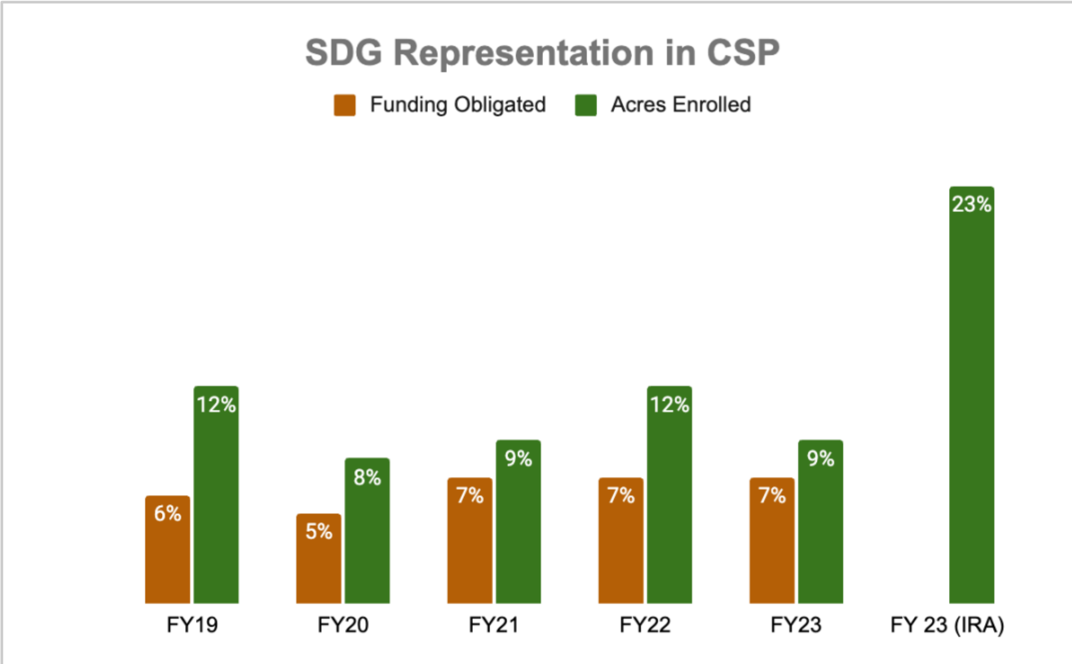
[5] Enhancements are additional conservation activities aimed at addressing resource concerns and improving environmental outcomes.

[6] One example is Conservation Practice 595: Integrated Pest Management (IPM), designed to mitigate water quality degradation by promoting precision application techniques, such as "smart sprayer" technology, which optimizes pesticide use and minimizes runoff.

[7] See appendix for more details about CSP enrollment by state



Profitability: score 2, weighted score 0.2

According to Science for Georgia (2022), transitioning to sustainable farming practices typically takes about four years to break even due to the initial investment costs, changes in soil health, and the learning curve associated with new methods. These transition years typically present financial challenges as farmers invest in new equipment, cover crops, soil amendments, and infrastructure to support more diversified or regenerative practices. Additionally, soil health improvements, such as nutrient cycling, take time to develop. This alternative receives a score of two.

Quality of Evidence: score 4, weighted score 0.4

While there are no studies directly examining the relationship between the CSP and pesticide reduction, CSP's emphasis on sustainable and conservation-based farming practices suggests a likely decrease in pesticide use. Because of this, the quality of evidence is assessed based on broader studies that explore the impact of sustainable agricultural practices on pesticide use and associated risks.

Nandillon et al. (2024): *Crop management strategy redesign enables a reduction in reliance on pesticides: A diachronic approach based on a diversity of French commercial farms*

Nandillon et al. (2024) examined the effects of crop management strategy redesigns on pesticide reliance across a range of commercial farms in France. The researchers found that 65.7 percent of farms successfully reduced their dependence on pesticides, and 60.3 percent experienced a decline in pesticide-related health and environmental risks. These findings support the assumption that conservation practices encouraged through CSP can contribute to pesticide reduction, even if direct data linking CSP to pesticide outcomes is limited.

	Score (0 or 1)	Justification
Direct Study	0	The study does not assess the relationship between CSP and pesticide reduction
Causality	0.5	Observational study
Data Source	1	Uses administrative data from 913 farms monitored over an average of 9 years
Sample Size	1	913 farms
Peer Review	1	Published in Agriculture, Ecosystems & Environment, a peer-reviewed scientific journal by Elsevier.
Study Origin	0	While the study provides useful insight, the data is from France, which may not fully translate to the US context.
Total	**3.5**	

Pecenka et al (2021): *IPM reduces insecticide applications by 95% while maintaining or enhancing crop yields through wild pollinator conservation*

Pecenka et al. (2021) assessed the effectiveness of Integrated Pest Management (IPM)[8] strategies in reducing insecticide use while maintaining or improving crop yields. The study focused on the role of wild pollinator conservation in enhancing the sustainability and productivity of farming systems. Results showed that farms implementing IPM experienced a 95 percent reduction in insecticide applications compared to those using conventional pest management approaches. Notably, this significant reduction in pesticide use did not compromise crop yield; in fact, it often enhanced productivity due to improved pollination services.

This study is highly relevant to CSP, which promotes practices aligned with IPM, such as habitat conservation, crop rotation, and reduced pesticide dependency. The findings provide strong evidence that shifting toward ecologically informed pest management can dramatically decrease pesticide use while supporting both

[8] According to the EPA, Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

environmental health and agricultural profitability. Although this research does not evaluate CSP directly, it supports the assumption that CSP practices can lead to similar reductions in pesticide reliance when such methods are implemented.

	Score (0 or 1)	Justification
Direct Study	0	Not a study on the direct relationship between CSP and pesticide reduction
Causality	0.5	Observational study
Data Source	1	Collected data from five sites in Indiana across four years
Sample Size	1	Planed 12,141 plants per hectare (4,913 plants per acre) across five sites
Peer Review	1	Published in PNAS
Study Origin	1	Indiana
Total	**4.5**	

The average score of both these studies, this alternative receives a score of four. While more program-specific data would strengthen the case, the existing research provides a reasonable basis for assuming positive impacts on pesticide use through CSP participation.

Alternative 3: Expand the Whole-Farm Revenue Protection Program

Cost Effectiveness	Equity	Profitability	Quality of Research
1 (0.5)	3 (0.9)	2 (0.2)	3.7 (0.37)
Total: 9.7 (1.97)			

Farming is a highly risky given the variability in market and weather changes. Because of this uncertainty, many risk-averse farmers rely on inputs like pesticides to protect their income, though this practice is often unsustainable and expensive. Crop insurance offers a solution by sharing risk, which in turn encourages farmers to adopt safer, more sustainable practices. By reducing their reliance on pesticides and enabling the use of modern technologies, crop insurance plays a key role in promoting more sustainable farming practices.

The Whole-Farm Revenue Protection (WFRP) program, administered by USDA's Risk Management Agency (RMA), provides crop-neutral insurance coverage for diversified farms (National Sustainable Agriculture Coalition, 2022). Unlike traditional single-crop insurance policies, WFRP allows producers to insure the revenue of their entire operation under one policy, making it especially appealing to farms practicing diversification. In 2024, 2,125 farmers purchased WFRP policies (U.S. Department of Agriculture, 2024). For this alternative, I propose doubling program participation by increasing the number of WFRP policies sold. Achieving this goal would require additional USDA funding to subsidize insurance premiums and expand outreach.

Cost Effectiveness (weight 50 percent): score 1, weighted score 0.5

There is no publicly available data on the number of acres currently covered under WFRP. To estimate cost-effectiveness, I assume that each WFRP policy covers one farm, and that each farm is approximately 463 acres – the national average. Based on 2,124 sold policies, this results in an estimated 983,412 acres covered. With USDA subsidies totaling $136,556,438, the average cost to insure one acre is $138.86. Using the same sustainable farming-to-pesticide reduction ratio from Alternative 2 (0.08 pounds of pesticide reduced per acre), I estimate the cost to reduce one pound of pesticide under this program is $147.72 ($152.83 in 2025 dollars). As a result, this alternative receives a score of one.

Equity (weight 30 percent): score 3, weighted score 0.9

There is currently no publicly available data on the race and ethnicity distribution of WFRP policyholders. In the absence of WFRP-specific demographic data, I rely on broader crop insurance participation trends. According to Belasco et al. (2023), only about 5 percent of socially disadvantaged farmers had any form of crop insurance between 2018 and 2021. This suggests that SDGs are significantly underrepresented in federal crop insurance programs, and likely with WFRP as well.

Without targeted outreach or structural changes, expanding WFRP may primarily benefit farms already familiar with and able to navigate crop insurance systems—often larger, white-owned operations. Additionally, the complexity of the WFRP application process and historical mistrust of federal agencies may pose further barriers to access for underserved producers. As a result, this alternative receives a low equity score, unless accompanied by specific efforts to improve outreach, technical assistance, and accessibility for SDGs.

Profitability (weight 10 percent): score 2, weighted score 0.2

WFRP does not directly promote crop diversification so profitability is unknown, however, the assumption is that expanded access to WFRP will encourage more farms to engage in diversified practices. As a result, the timeline for this is the same as it is in alternative two; I am assuming that a farm can expect to begin earning profits four years after the initial implementation of diversified practices (Science for Georgia, 2022).

Quality of Evidence (weight 10 percent): score 4, weighted score 0.4

There are no studies on the relationship between WFRP and pesticide reduction. As a result, the quality of evidence for this alternative is based on the relationship between crop insurance and pesticide use.

Biram et al. (2024): *Empirical Challenges for Estimating Moral Hazard Effects of Crop Insurance on Pesticide Use*

Biram et al. (2024) found that there was no consistent relationship between crop insurance and pesticide use across four major crops: corn, soybeans, wheat, and cotton. In some cases, the effect flipped depending on the model specification, such as how time trends and crop insurance participation were measured. Overall, the researchers caution against drawing strong conclusions based on existing literature. More research is needed to understand the effect of crop insurance on pesticide use.

	Score (0 or 1)	**Justification**
Direct Study	0	Not a study on the relationship between WFRP and pesticide reduction
Causality	1	Two-way fixed effects, instrumental variables, difference-in-differences
Data Source	1	State-level administrative data from USDA
Sample Size	1	Includes about 5,000 state-year crop observations spanning 45 states from 1965-2019 (55 years)
Peer Review	1	Published in the Journal of Agricultural Resource Economics, a peer-reviewed journal
Study Origin	1	Data on farms across the US
Total: 5		

Li et al. (2022): *The role of crop insurance in reducing pesticide use: Evidence from rice farmers in China*

Li et al. (2022) found that farmers who purchase crop insurance use 33.3 percent less pesticides than farmers who do not have crop insurance. The researchers also found that the pesticide-reducing effect of crop insurance was weaker among farmers with more experience, education, training, and access to fieldworkers, suggesting that these farmers may already be using pesticides more efficiently. Additionally, the effect was stronger for farmers who were more likely to purchase crop insurance, indicating that insurance may be especially effective for those who are more risk averse.

	Score (0 or 1)	Justification
Direct Study	0	Not a study on the direct relationship between WFRP and pesticide reduction
Causality	1	Instrumental variables
Data Source	0	Uses survey data
Sample Size	1	Collected 3,410 questionnaires from 2018-2019 across 12 rice-producing provinces in southern China
Peer Review	1	Published in the Journal of Environmental Management, a peer-reviewed journal
Study Origin	0	Study conducted in China
Total: 3		

Enjolras and Aubert (2020): *How does crop insurance influence pesticide use? Evidence from French farms*

Enjolras and Aubert (2020) examined the long-term effects of crop insurance on pesticide use in France by comparing insured and uninsured farmers across two high-pesticide sectors: field crops and quality wine-growing. Their results showed that pesticide use declined overall, but crop insurance had no significant effect on reducing pesticide use in either crop type. Instead, insured farmers were more likely to reallocate land among different crops, suggesting they adjusted their production strategies rather than reducing pesticide input.

	Score (0 or 1)	Justification
Direct Study	0	Not a study on the direct relationship between WFRP and pesticide reduction
Causality	1	Combination of propensity score matching and difference-in-differences
Data Source	0	Administrative data from Farm Accountancy Data Network

Sample Size	1	Includes data from 35,087 farms between 2008 and 2012.
Peer Review	1	Published in Review of Agricultural, Food and Environmental Studies, a peer-reviewed journal
Study Origin	0	Study conducted in France
Total: 3		

The average of these three scores is 3.7, so this alternative receives a 3.7 score.

Outcomes Matrix

	Cost Effectiveness	Equity	Profitability	Quality of Evidence	Total (weighted)
Organic Program	5 (2.5)	1 (0.3)	3 (0.3)	5.5 (0.55)	14.5 (3.65)
CSP	5 (2.5)	5 (1.5)	2 (0.2)	4 (0.4)	16 (4.6)
WFRP	1 (0.5)	3 (0.9)	2 (0.2)	3.7 (0.37)	9.7 (1.97)

Each of the alternatives discussed – organic farming, the Conservation Stewardship Program, and Whole-Farm Revenue Protection – represents an existing USDA effort with promising potential to reduce harmful pesticide exposure. These programs focus on prevention through diversified, sustainable practices rather than reactive solutions to pesticide use. Rather than developing new policy alternatives, we can build on and scale up these promising approaches to unlock their full impact – both in supporting resilient agricultural systems and in protecting the health and safety of farmworkers. With investment and policy support, these strategies can drive meaningful progress in reducing pesticide use.

Recommendation

After evaluating each alternative based on cost-effectiveness, profitability, equity, and quality of evidence, I recommend expanding the CSP to accept at least 50 percent of the applicants. Expanding CSP would provide financial incentives for farmers to adopt diversified agricultural practices, which can improve long-term farm profitability, enhance environmental sustainability, and reduce reliance on pesticides. By rewarding conservation efforts that improve soil health, increase water retention, and enhance crop resilience, CSP helps reduce input costs and boost yields over time. Additionally, CSP prioritizes small and mid-sized farmers, providing them the support needed to remain competitive against more extensive agricultural operations. While direct evidence linking CSP to pesticide reduction is limited, CSP promotes strategies that contribute to lower pesticide use, including integrated pest management (IPM) and drift reduction practices, such as using drift-reducing nozzles and maintaining low spray pressures to minimize off-target pesticide drift. Expanding CSP would increase access for farmers of all sizes, enabling more agricultural operations to implement sustainable practices while improving farmworker safety by reducing exposure to toxic pesticides.

Implementation

Promote cross-sector coordination

While CSP is a federal program, it heavily depends on state and local partners for most of its implementation. If there are changes to the program at the federal level, NRCS should promptly communicate this information to state and local partners so that they can relay it to applicants and adjust their outreach or technical assistance strategies. NRCS should also offer training programs and resources to aid state and local partners in implementation. Given the nature of this work, it is beneficial to leverage land-grant universities, particularly farm extension programs, to deliver technical assistance and provide the latest technology and research on conservation activities (U.S. Department of Agriculture, 2025). All agencies should work together to advocate for additional funding for CSP in the next farm bill.

Scale up the workforce to match the increased demand

If application acceptance rates increase, investments in NRCS office staff size, hiring, and retention will be necessary. Farmers require assistance to apply for and receive contracts. More staff are needed to provide application support and outreach. In particular, there’s a need for personnel to assist applicants from underserved groups and first-time applicants. Currently, the focus has been on helping those who already know how to navigate the process or can afford to hire support. The next step is to ensure that staff are trained in using the application software, connected and knowledgeable about local farms, well-versed in conservation priorities and techniques, and experts on program offerings and functions. Salaries for local NRCS staff remain low, even in rural areas with a low cost of living (Happ, 2024).

Get better data on why applications get rejected

Invalid applications lack detail, making it unclear whether rejections are due to applicant error, staff error, or land control issues (Happ, 2024). More transparency is needed to understand why applications are invalid so that staff can provide better application assistance and feedback.

Launch a survey to gather feedback on program improvements

NRCS or individual states should develop a survey to collect feedback on how to make the application and implementation process better for farmers and identify where the gaps are in terms of service delivery and inefficiencies. Survey results can inform the outreach strategy, application process, and technical assistance.

Stakeholder perspectives

Given that almost 70 percent of applications are denied, there is significant demand for CSP. Farmers, technical assistance providers, researchers, and extension program staff support this alternative. However, the Trump administration is unlikely to be supportive, given that it initially paused the Inflation Reduction Act funding set aside for CSP (Wiesemeyer & Morgan, 2025). Following the new White House directives, the USDA later released $20 million of IRA funding to honor the existing CSP contracts.

Worst Case Scenarios

If Congress does not approve expanded funding, public-private partnerships should be explored. Alternatively, states could replicate and independently fund the program. To prevent delays in implementation, NRCS should streamline the application process and ensure adequate resource allocation for program administration.

Given the time, cost, and uncertainty involved in transitioning to more sustainable farming practices, some farmers – particularly smaller operations or those already under financial pressure – may hesitate to enroll in CSP. The up-front investment required for conservation practices, paired with concerns about short-term yield loss or unfamiliar techniques, can discourage participation. This hesitancy may be further exacerbated if technical assistance is hard to access or not tailored to the characteristics and needs of each farm. To reduce perceived risk and build confidence, USDA should ensure that technical assistance is localized, practical, and timely, and that it is delivered by individuals who understand the specific needs of the communities they serve (e.g., through farm extension programs or peer-to-peer mentorship). Additionally, to further alleviate concerns about financial losses during the transition period, USDA could actively promote WFRP alongside CSP. WFRP can serve as a safety net, reassuring farmers that their overall revenue is protected even if crop yields fluctuate in the short term. Integrating messaging and access to WFRP within CSP outreach materials would allow farmers to see these programs not as separate options, but as complementary programs.

Evaluation

To evaluate whether an expanded CSP is effectively reducing pesticide exposure among farmworkers, we can measure exposure in one of two ways. One approach is through biomonitoring, which involves collecting biological samples such as blood or urine to directly assess pesticide levels in the body. However, this method can be invasive, costly, and administratively burdensome, making it less feasible for large-scale implementation. A more practical alternative is the use of silicone wristbands, which passively absorb chemicals from air and water in a way that mimics human skin (Lopez, 2023). These wristbands are then analyzed in a lab to determine the type and concentration of pesticide exposure. Research has validated this method against urine samples, confirming its reliability. Because they are simple, non-invasive, and cost-effective, silicone wristbands offer a promising tool for monitoring pesticide exposure in field settings and assessing the impact of CSP over time.

Researchers at Oregon State University developed silicone wristbands to monitor chemical exposures

Suggested Implementation Timeline
CSP applications are accepted year-round, but there are two main deadlines throughout the year. To ensure effective scaling of CSP, implementation should occur in five phases over a suggested 18-month timeline:

- Phase 1 (0–3 months): Strengthen coordination and planning
    - USDA should promptly notify state and local partners of any federal program changes and initiate regular coordination meetings.
    - Include an opportunity to participate in the evaluation study of CSP using silicone wristbands. If farmers are hesitant or uptake is low, offer a financial incentive.
    - Training modules should be developed or updated for state and local partners, in partnership with land-grant universities and farm extension programs.
    - A national task force, including USDA, state agencies, university researchers, and technical assistance providers, can be formed to oversee rollout planning.
- Phase 2 (3–7 months): Invest in staffing and outreach
    - Increase NRCS office staff by region, prioritizing rural areas with historically low application success rates.
    - Train new and existing staff in CSP software, local conservation practices, and outreach to underserved communities.
    - Conduct community outreach to promote CSP expansion
- Phase 3 (7-12 months): Application support and technical assistance
    - Host application workshops and set up office hours for farmers interested in applying
    - Conduct community outreach in rural or historically underserved agricultural areas
- Phase 4 (12–15 months): Improve data systems and transparency
    - Collect and analyze data on application denials to identify common issues.
    - Begin piloting a national survey to collect farmer and staff feedback on improving the application and service delivery process.
- Phase 5 (15–18 months): Evaluate impact and adjust strategies
    - Distribute and analyze feedback surveys.
    - Assess the progress of the wristband exposure monitoring program
    - Adjust technical assistance strategies, application support tools, or staffing needs based on feedback and early evaluation results.

Conclusion

Pesticide exposure among farmworkers is not just an agricultural issue – it spans multiple policy areas, including public health, labor rights, immigration, environmental protection, and agricultural policy. While various interventions exist, addressing the root cause, an overreliance on pesticides due to monoculture systems, offers the most potential in reducing exposure among farmworkers.

Diversified, sustainable agriculture has emerged as a promising strategy for reducing pesticide use and improving farmworker health. Expanding the **Conservation Stewardship Program** represents one of the most immediate and scalable ways to drive this change. CSP already exists within the USDA and is supported by technical experts, farmers, and policymakers. CSP supports a shift toward reduced pesticide use by providing farmers with financial incentives and practical tools to adopt conservation practices.

With sufficient outreach, staffing, training, and evaluation investments, CSP can be the cornerstone of a safer and more sustainable agricultural system. By scaling up this program and pairing it with complementary supports like Whole-Farm Revenue Protection, policymakers can take meaningful action to protect farmworkers, safeguard ecosystems, and ensure a more just and sustainable food system.

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Appendix

Alternative 1
Cost Effectiveness
See Table 1 in Larsen et al. (2021), column "mean pesticide product applied"

1) I calculated the difference between conventional and organic farms

$$47.62 - 17.10 = 30.52 \text{ kg ha}^{-1}$$

2) I divided 30.52 by 2.471 to convert to acres and multiplied by 2.20462 to convert from kg to lbs. So organic farming uses reduces 27.23 lbs of pesticide per acre
3) $60 million divided by 3.6 million acres of organic farmland is $16.67 per acre.
4) $16.67/acre divided by 27.23 lbs/acre is $0.61 per acre or $0.65 in 2025 dollars to reduce 1 lb of pesticide

Alternative 2
Cost Effectiveness
1) FY 2023, there were 69 million acres of CSP land
2) FY 2023, $835,288,468 funding spent on CSP contracts
3) CSP funding per acre

$$835{,}288{,}468/69{,}000{,}000 = \$12.11\ per\ acre\ of\ CSP\ land$$

4) Pesticide reduction calculations based on Guinet et al. (2023) supplementary table 3. Diversified agriculture reduces pesticide use by 0.94 pounds per acre.

A	B	C	D	E	F	G
Crop	Average Pesticide Use (lbs/acre)	Slope	Pesticide reduced (lbs/acre) (B*C)	Acreage Across Country	Total amount (lbs) of pesticide decreased for that crop	Total pesticide used post diversification (B-D)
Soybean	1.106	0.088	0.097328	86,100,000.00	86,846,659.20	1.01
Sunflower	0.8	0.075	0.06	1,270,000.00	939,800.00	0.74
Maize	0.95	0.071	0.06745	90,000,000.00	79,429,500.00	0.88
Oilseed rape	0.67	0.018	0.01206	20,200.00	13,290.39	0.66
Sugar beet	0.94	0.081	0.07614	1,110,000.00	958,884.60	0.86
			Total	178,500,200.00	168,188,134.19	
				Weighted Average	81,951,787.92	0.94

5) To find the cost to reduce one pound of pesticide, I divided 12.11 by 0.94 to get $12.88 per pound of pesticide reduced.

Equity

USDA has raised concerns about a recent NRCS data suppression policy that limits access to information on farmers from socially disadvantaged groups, with 60 percent of states missing CSP data in 2023, making it difficult to assess participation.

State	Percent of CSP Acres Enrolled by SDGs	State	Percent of CSP Acres Enrolled by SDGs
Alabama	9%	Montana	8%
Alaska	supp.	Nebraska	supp.
Arizona	3%	Nevada	supp.
Arkansas	5%	New Hampshire	supp.
California	30%	New Jersey	supp.
Colorado	2%	New Mexico	6%
Connecticut	supp.	New York	1%
Delaware	supp.	North Carolina	2%
Florida	3%	North Dakota	1%
Georgia	9%	Ohio	supp.
Hawaii	60%	Oklahoma	28%
Idaho	6%	Oregon	supp.
Illinois	supp.	Pennsylvania	supp.
Indiana	supp.	Rhode Island	supp.
Iowa	supp.	South Carolina	3%
Kansas	17%	South Dakota	supp.
Kentucky	supp.	Tennessee	3%
Louisiana	9%	Texas	22%
Maine	supp.	Utah	0%
Maryland	2%	Vermont	supp.

Massachusetts	supp.	Virginia	1%
Michigan	supp.	Washington	supp.
Minnesota	supp.	West Virginia	supp.
Mississippi	9%	Wisconsin	supp.
Missouri	supp.	Wyoming	2%

Supp means data was suppressed

Alternative 3
Cost effectiveness

1) 2,124 WFRP policies multiplied by the average size of a farm which is 463 acres (Keller, 2024). This means 983,412 acres were covered.
2) USDA WFRP subsidies were $136,556,438 so the average cost to insure one acre is $138.86 – $136,556,438 divided by 983,412 acres.
3) Taking the cost per acre ($138.68), I divided it by 0.94 (lbs reduced per acre due to diversified agriculture) to get $147.74 (or $152.83 in 2025 dollars) to reduce one pound of pesticide.

Cost Effectiveness Table

Cost Effectiveness	Cost (per acre)	Pesticide Reduction (lbs/acre)	Ratio (cost to reduce 1 pound of pesticide)	Cost Year	Adjusted for Inflation
Organic Program	$16.67	27.23	$0.6121	2024	$0.63
CSP	$12.11	0.94	$12.88	2023	$13.74
WFRP	$138.86	0.94	$147.72	2024	$152.83