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Occupational Safety in Agriculture: A Systematic Literature Review of Practices and Health Outcomes

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ABSTRACT
This study aims to conduct a systematic review of occupational safety practices in the agricultural sector and their impact on worker health. The agricultural sector remains one of the sectors with the highest rates of workplace accidents and exposure to hazardous chemicals, especially in developing countries. Using the Systematic Literature Review (SLR) method, 21 scientific articles published in the past ten years were analyzed. The review results indicated that the use of personal protective equipment (PPE), occupational safety training, and strict regulations contribute significantly to reducing the risk of pesticide poisoning and work injuries. However, in many regions such as Indonesia, Tanzania, and Nigeria, PPE use remained low due to limited access and quality. Safety training was effective in reducing symptoms of acute poisoning, but implementation was uneven. Furthermore, chronic pesticide exposure remained a serious threat with symptoms of respiratory, neurological, and even heart disease. Studies in countries such as Iran, Colombia, and the United States showed that strong supervision and community-based education can increase risk awareness and encourage safer work behaviours. This study concluded that an integrative approach encompassing education, regulation, access to PPE, and health services was key to improving occupational safety and health in the global agricultural sector.

INTRODUCTION

Occupational safety and health (OSH) in the agricultural sector is a crucial and relevant issue, particularly in developing countries. Agriculture is an economic sector that contributes significantly to employment and the global economy, but it is also known to pose high health and safety risks to its workers (ILO, 2020). Agricultural workers, particularly those engaged in intensive farming, are frequently exposed to various hazards, including pesticide exposure, the use of heavy equipment, and harsh and unstable working conditions (Flocks et al., 2012). Therefore, it is crucial to understand the factors that influence occupational safety in this sector and their impact on worker health.

According to Mostafalou and Abdollahi (2013), pesticides pose one of the greatest threats to the health of agricultural workers. Long-term exposure to pesticides has been linked to various serious health problems, including cancer, nervous system disorders, and respiratory diseases. In many developing countries, including Indonesia, this problem is exacerbated by farmers' low level of knowledge about the dangers of pesticides and lack of access to adequate personal protective equipment (PPE) (Susanna, 2017). In Indonesia, farmers often use pesticides without adequate protection, resulting in high rates of acute and chronic poisoning (Ginting et al., 2019). Most cases of pesticide poisoning go unreported, especially in remote areas far from health facilities.

In addition to chemical exposure, the use of heavy equipment in agriculture is another source of hazard frequently encountered by agricultural workers. Bhattacherjee et al. (2013) stated that workplace accidents involving tractors, harvesters, and other agricultural equipment are a major cause of serious injuries in the agricultural sector. Using heavy equipment without adequate training can cause significant physical injuries, such as broken bones, spinal injuries, or even death. In many developing countries, the use of advanced agricultural technology is often not accompanied by adequate safety training programs, increasing the risk of workplace accidents.

However, the implementation of safety interventions such as training and the provision of adequate PPE has proven effective in reducing health risks in the agricultural sector (Damalas & Eleftherohorinos, 2011). Research conducted by Lee et al. (2011) in the United States showed that structured training and the provision of PPE can significantly reduce the incidence of pesticide poisoning among agricultural workers. Similar findings were found in Greece, where strict safety inspections and regulations successfully reduced the incidence of workplace accidents involving the use of heavy equipment (Damalas et al., 2008). However, in developing countries, particularly in Africa and Southeast Asia, access to safety training programs and PPE is often limited due to cost, lack of infrastructure, and low government support (Ngowi et al., 2007).

The International Labour Organisation (ILO) has underscored the importance of strengthening regulations and law enforcement related to occupational safety in the agricultural sector. The ILO (2020) noted that this sector is often marginalised in occupational safety policies in many countries, particularly developing countries that focus more on the manufacturing and service sectors. This lack of attention to the agricultural sector leads to high rates of workplace accidents, which result in significant economic losses for workers and their families. As part of global efforts to improve working conditions in the agricultural sector, the ILO is pushing for strengthened national regulations and stricter oversight of pesticide use, as well as the provision of personal protective equipment (PPE) for agricultural workers.

In Indonesia, issues related to occupational safety and health in the agricultural sector are also a significant concern. Susanna (2017) stated that despite existing regulations regarding occupational safety, their implementation remains weak, especially in rural areas. Many farmers lack access to safety training programs, while most do not use PPE properly. This problem is exacerbated by the fact that many Indonesian farmers work under extreme climatic conditions, which makes them reluctant to use PPE such as masks or protective clothing, which are often uncomfortable. A study by Ginting et al. (2019) also showed that exposure to pesticides and other chemicals is often poorly recorded, making it difficult for health workers to diagnose and effectively treat cases of pesticide poisoning.

Several other countries face similar challenges. Ajayi and Akinnifesi (2007) reported that in Nigeria, the main obstacles to implementing safety practices in the agricultural sector are limited access to quality PPE and a lack of adequate safety training programs. Despite government efforts to educate farmers about the health risks of pesticides, the results have been less than optimal due to a lack of logistical support and infrastructure.

Against this backdrop, this study aims to conduct a systematic literature review examining various occupational safety practices in the agricultural sector and their impact on worker health. This review includes studies from various countries and evaluates the effectiveness of interventions, such as occupational safety training, provision of PPE, and enforcement of safety regulations. This research is expected to provide useful recommendations for improving occupational safety in the agricultural sector, particularly in developing countries like Indonesia.

METHOD

This study used a Systematic Literature Review (SLR) approach, following the steps established by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). A literature search was conducted through scientific databases such as PubMed, ScienceDirect, JSTOR, and Google Scholar using the keywords "occupational safety in agriculture", "health outcomes in farming", and "pesticide exposure in agriculture." Articles published between 2015 and 2025 were selected to ensure the relevance of the findings to current conditions.

Inclusion Criteria:

- An article examining occupational safety practices in the agricultural sector.
- A study assessing the health impacts of occupational exposure in the agricultural sector.
- Publication in English and Indonesian.

Exclusion Criteria:

- Articles that do not include health outcomes or safety practices.
- Studies that do not focus on the agricultural sector.
- A total of 21 articles were selected for in-depth analysis in this study.

RESULTS AND DISCUSSION

The summaries of the main findings from the literature identified in this study can be seen in Table 1.

Table 1
The Summarizes of the Main Findings from the Literature

No	Author & Year	Country	Safety Practices	Health Results
1	Farahmandfard & Khanjani, 2023	Iran	In-depth interviews with farmers & agricultural technicians	Many farmers receive no training or supervision; pesticide exposure is uncontrolled.
2	Rafsanjan Cohort, Mohammadi et al., 2025	Iran	Face-to-face survey & pesticide exposure history	Prolonged exposure is associated with an increased risk of ischemic heart disease.
3	Susanna, 2017	Indonesia	Use of PPE when spraying pesticides	Pesticide exposure is still found in farmers, especially on the hands and face areas due to incomplete PPE.
4	Kapeleka et al., 2025	Tanzania	Cross-sectional survey of 1,074 cotton farmers and field workers	30% experienced acute poisoning, indicating that the risk of exposure is still high even though the survey was conducted.
5	Corral et al., 2023	Colombia	Direct survey + spirometry on avocado farmers; identification of pesticide mixtures including	Decreased lung function (night cough and obstructive pattern) associated with exposure to mixed pesticides

No	Author & Year	Country	Safety Practices	Health Results
			pyrethroids and organophosphates	
6	Tsakiris, Damalas & Koutroubas, 2024	Greece	Direct survey & analysis of PPE usage behaviour of 93 fruit farmers	Positive correlation between high-risk perception and PPE use — 82.6% of farmers use masks and gloves
7	Ginting et al., 2019	Indonesia	Safety training, use of PPE	Pesticide poisoning cases have decreased, but exposure to heavy equipment remains high.
8	Solomon M. & Nazziwa, 2024	Uganda	Education program + SMS reminders (RANAS), direct training on the use of PPE and safe farmer behaviour	Significant reduction in acute symptoms of poisoning and increased use of PPE compared to controls.
9	Kurniawan et al., 2018	Indonesia	Training and counselling on PPE	The use of PPE has increased, but implementation is inconsistent in the field.
10	ILO, 2020	Global (Review)	Safety inspections, strict regulations on pesticides	Significant reduction in work-related accidents involving agricultural equipment and chemical exposure.
11	Abubakar et al., 2015	Nigeria	Use of PPE, spraying training	High levels of pesticide exposure are still found due to limited access to quality PPE.
12	Forouzan Rezapur-Shahkolai et al., 2017	Iran	Cross-sectional questionnaire on 474 farmers; identification of APP risk factors	60% experienced acute pesticide poisoning (symptoms: runny nose 29.8%, headache 25.1%)
13	Bereznyak et al., 2022	Russia	Establishment of hygiene standards and toxicological classification of pesticides, restrictions on the use of hazardous chemicals	Reducing the risk of chronic exposure such as teratogenic, carcinogenic, and mutagenic effects through regulatory control and classification of chemicals.
14	ban, Inayah & Nurul Azizah, 2025	Indonesia	The use of Personal Protective Equipment (PPE) & duration of pesticide spraying (length/day & frequency) were analysed.	Health declines experienced by workers with more than 5 years of service, pesticide spraying durations exceeding 4 hours per day, and incomplete use of PPE indicate a significant risk of health problems. Although spraying frequency is not significant, long-term exposure remains a health threat.
15	Díaz-Criollo et al., 2020	Colombia	Cross-sectional survey & AChE biomarker measurement,	Decreased AChE enzyme indicates exposure, as well as an increased risk of asthma, allergic rhinitis, and respiratory

No	Author & Year	Country	Safety Practices	Health Results
			pesticide mixture pattern identification	disorders.
16	Gorucu et al., 2022	United States of America	Analysis of primary data from the Emergency Department (NEISS) related to work injuries in the agricultural sector	There has been a reduction in fatal cases, but there are still many non-fatal injuries, such as broken bones and open wounds from agricultural tools and machinery.
17	Rattanawitoon et al., 2023	Thailand	Safety training based on an educational approach for female farmers	Pesticide exposure levels have decreased, but long-term exposure remains a major problem.
18	Sookhtanlou & Allahyari, 2021	Iran	Survey of potato farmers (n = 370) on the use of PPE (masks, gloves, eye protection) when spraying	Many farmers wear at least 3 types of PPE, but still experience neurological and respiratory symptoms due to the pesticides paraquat & chlorpyrifos.
19	Arora et al., 2020	United States of America	Direct survey of farmers about work hazards, stress, and PPE use	Significant reduction in work accidents and increased awareness of hazards, but work stress remains high.
20	Bai et al., 2023	United States of America	Farmer survey on work stress and work injuries	The risk of occupational injury is higher in farmers with high stress levels, despite safety training.
21	Najafi et al., 2025	Iran	Field survey of rice farmers (n = 151): processing habits, storage, use of PPE	55% wore PPE; 35% experienced neurological symptoms, 34% respiratory distress; post-spray behaviors such as showering and changing clothes were significantly impacted.

Occupational Safety Practices in the Agricultural Sector

Based on a review of 21 research articles, occupational safety practices in the agricultural sector show significant variation across countries and regions. Factors such as worker education levels, access to personal protective equipment (PPE), and the effectiveness of safety training and regulations significantly influence implementation.

The use of PPE such as masks, gloves, eye protection, protective clothing, and boots is the most common safety practice. However, the level of use is highly dependent on risk perception and facility availability. Studies in Indonesia, Tanzania, and Nigeria (Susanna, 2017; Kurniawan et al., 2018; Abubakar et al., 2015; Kapeleka et al., 2025) indicated that PPE use remains low or inconsistent, often due to limited access and quality. On the other hand, studies in Greece and Iran (Tsakiris et al., 2024; Sookhtanlou & Allahyari, 2021; Najafi et al., 2025) indicated that high-risk perception correlates with increased PPE use.

Safety training is a key element in reducing the risk of workplace accidents and exposure to chemicals such as pesticides. Educational interventions are effective in increasing PPE use and reducing

symptoms of acute poisoning, as demonstrated in studies in Uganda and Indonesia (Solomon & Nazziwa, 2024; Ginting et al., 2019). However, some countries still face limitations in implementing comprehensive and sustainable training (Farahmandfard & Khanjani, 2023; Kurniawan et al., 2018).

Occupational safety regulations and oversight also play a crucial role. A global study by the ILO (2020) and data from the United States (Gorucu et al., 2022; Arora et al., 2020; Bai et al., 2023) showed that strict regulations and robust reporting systems can reduce workplace accident rates, although work stress and non-fatal injuries still occur. Conversely, the lack of field oversight in some regions, such as Iran and Colombia, has resulted in uncontrolled pesticide exposure and long-term health risks such as neurological and respiratory disorders (Mohammadi et al., 2025; Díaz-Criollo et al., 2020; Corral et al., 2023).

Overall, occupational safety practices in the agricultural sector still face various structural and social challenges. A cross-sectoral approach encompassing education, strengthened regulations, and increased access to quality PPE is needed to ensure optimal protection for agricultural workers across the country.

Health Impacts of Chemical Exposure and Workplace Accidents

Exposure to hazardous chemicals such as pesticides, insecticides, herbicides, and synthetic chemical fertilizers continues to pose a serious threat to the health of workers in the agricultural sector, particularly in developing countries. Recent primary studies have shown that persistent pesticide exposure, especially without adequate personal protective equipment (PPE), is associated with an increased risk of respiratory disorders, neurological disorders, heart disease, and endocrine disorders. In Indonesia, exposure to pesticides and other chemicals is also a significant problem. Susanna (2017) reported that farmers who do not use adequate personal protective equipment during pesticide spraying are at increased risk of developing chronic diseases. This problem is exacerbated by minimal government oversight of the use of hazardous chemicals in the agricultural sector and farmers' low awareness of the dangers of pesticides.

In general, recent studies indicate that exposure to hazardous chemicals in the agricultural sector remains a serious threat to the health of farmers, especially in developing countries. Although the use of personal protective equipment (PPE) and occupational safety training has increased over the past decade, many farmers still face health risks due to weak field supervision and limited early detection of poisoning symptoms. Pesticide poisoning is the most commonly reported impact. Acute symptoms such as headache, nausea, runny nose, and skin irritation are still common among farmers in various countries (Forouzan Rezapur-Shahkolai et al., 2017; Kapeleka et al., 2025). In Iran, approximately 60% of farmers experience acute symptoms from pesticides, and approximately 35% experience neurological and respiratory disorders (Najafi et al., 2025; Sookhtanlou & Allahyari, 2021). Similarly, studies in Colombia reported decreased lung function and an increased risk of asthma and rhinitis due to exposure to mixed pesticides (Díaz-Criollo et al., 2020; Corral et al., 2023).

Long-term exposure to pesticides has also been linked to chronic diseases such as ischemic heart disease, endocrine disorders, and possibly cancer (Mohammadi et al., 2025; Tsakiris et al., 2024). Some studies even link pesticide exposure to high work stress and a greater risk of injury (Arora et al., 2020; Bai et al., 2023).

In Iran, studies by Najafi et al. (2025) and Sookhtanlou & Allahyari (2021) found that despite using some form of PPE, most farmers still experienced neurological symptoms and respiratory distress from pesticides such as paraquat and chlorpyrifos. Mohammadi et al. (2025) even linked long-term exposure to an increased risk of ischemic heart disease based on cohort data.

Meanwhile, in Colombia, studies by Díaz-Criollo et al. (2020) and Corral et al. (2023) confirmed decreased lung function, asthma, and allergic rhinitis in farmers exposed to a mixture of

organophosphate and pyrethroid pesticides. Measurement of biomarkers such as the AChE enzyme provided strong evidence of chronic exposure. In Indonesia, although awareness of PPE is increasing (Ban, Inayah & Azizah, 2025), implementation in the field remains weak, and health problems often go undetected due to limited access to health services and low symptom reporting (Susanna, 2017; Ginting et al., 2019).

Exposure to chemicals, particularly pesticides, in the agricultural sector, has a significant impact on farmers' health. Pesticide use in Indonesia is very common, but it has serious implications for the health of agricultural workers. According to Kando et al. (2018), long-term pesticide use can trigger various health problems, including pancreatic cancer, prostate cancer, and reproductive health problems in women, such as spontaneous abortion and liver dysfunction. This is in line with research conducted by Mahawati et al. (2017), which showed that pesticide exposure risks affect farmers' health in various ways, including increasing cases of Chronic Obstructive Pulmonary Disease (COPD).

The impact of pesticide exposure is not limited to chronic diseases but can also cause acute poisoning. Akbar (2019) showed that workers involved in pest control are at high risk of pesticide exposure, with poisoning symptoms including vomiting, diarrhoea, and difficulty breathing. This emphasizes the need for adequate knowledge and the use of personal protective equipment (PPE) to reduce health risks. Research by Sahuri and Sahna (2021) also highlighted the importance of PPE use in reducing health risks from pesticide exposure.

Furthermore, efforts to improve farmer safety are crucial. Extension programs focused on the use of PPE play a role in raising farmer awareness of the risks of pesticide use. Sahuri and Sahna (2021) also emphasized that extension can minimize health risks by equipping farmers with the correct knowledge of pesticide use. Data shows that the use of PPE can reduce health complications among farmers, as discussed in research by Ahyanti et al. (2022).

However, despite numerous studies showing negative impacts, there is potential for mitigation through training and implementation of best practices in pesticide use. Yuantari et al. (2015) emphasized the need for special attention to unsafe behaviors frequently engaged in by farmers, such as not following usage instructions, which accelerate pesticide exposure. Therefore, effective pedagogy on the risks and safe practices of pesticide use can help reduce negative health impacts in the agricultural sector.

In Indonesia, although training and outreach have been conducted (Kurniawan et al., 2018; Ginting et al., 2019), implementation in the field is often inconsistent. Economic factors and the availability of quality PPE are major obstacles. Ban, Inayah & Azizah (2025) showed that long work hours and incomplete use of PPE significantly increase the risk of health problems. Therefore, a comprehensive approach is needed that involves community-based education, increased access to health services in agricultural areas, pesticide policy reform, and strengthening regulations and field inspections to minimise long-term impacts on the health of agricultural workers. Long-term impacts on mental health and the nervous system are also a concern. Several studies have shown that pesticide exposure has the potential to damage the central nervous system, causing cognitive impairment, memory loss, tremors, and even Parkinson's disease (London et al., 2012; Baldi et al., 2003). In India, research by Bhattacherjee et al. (2013) reported an increase in cases of depression and anxiety disorders among workers routinely exposed to agricultural chemicals. These psychological impacts often go undiagnosed, especially in rural areas of developing countries, where access to mental health services is very limited.

In addition to chemical exposure, occupational accidents caused by the use of heavy equipment are also a serious problem in the agricultural sector, particularly in developing countries. A recent study in the United States showed that non-fatal injuries such as broken bones, open wounds, and head injuries caused by the use of tractors and agricultural machinery remain common (Gorucu et al., 2022).

Research by Bai et al. (2023) also revealed that high levels of work stress can increase the risk of accidents and physical injuries, especially among farmers who lack occupational safety training.

Ergonomic issues also contribute to musculoskeletal disorders among agricultural workers. Inappropriate tool use and poor working posture lead to lower back, neck, and shoulder pain, as found in a study by Arora et al. (2020) that highlighted the physical and psychological burdens among farmers in the US Midwest.

Respiratory disease is one of the long-term health impacts that has also received attention in recent studies. In Colombia, Corral et al. (2023) and Díaz-Criollo et al. (2020) found that farmers exposed to a mixture of organophosphate and pyrethroid pesticides experienced decreased lung function, night cough, and increased incidence of asthma and chronic bronchitis. In Indonesia, studies by Ban, Inayah & Azizah (2025) and Ginting et al. (2019) showed that pesticide exposure for more than 4 hours per day without adequate PPE significantly increased the risk of respiratory disorders.

Skin diseases also remain a frequently overlooked health threat. A study by Sookhtanlou and Allahyari (2021) in Iran noted that farmers who used pesticides such as paraquat and chlorpyrifos without skin protection experienced dermatitis, irritation, and mild to moderate burns. A similar finding was reported by Najafi et al. (2025) in a study of rice farmers in Iran.

Overall, the latest research confirms that health risks from chemical exposure and the use of unsafe agricultural equipment remain high. This problem is exacerbated by a lack of safety training, limited health facilities in rural areas, and weak implementation of occupational safety regulations. Therefore, comprehensive interventions that include education, field inspections, and access to adequate PPE are needed to protect the health of agricultural workers across the world.

Effectiveness of Safety Interventions

A review of 21 recent studies shows that occupational safety interventions, particularly training, outreach, and the provision of personal protective equipment (PPE), are generally effective in reducing the risk of pesticide exposure and occupational accidents in the agricultural sector. In developed countries like the United States, the implementation of structured training and strict supervision has been shown to contribute to a decrease in non-fatal injuries and increased worker awareness of occupational hazards (Gorucu et al., 2022; Arora et al., 2020; Bai et al., 2023).

Meanwhile, in developing countries like Indonesia, although training and outreach have been conducted (Kurniawan et al., 2018; Ginting et al., 2019; Ban, Inayah & Azizah, 2025), their implementation in the field still faces challenges such as limited access to adequate PPE and inconsistencies in changing worker behaviour. Studies from Uganda (Solomon & Nazziwa, 2024) and Greece (Tsakiris et al., 2024) also strengthen evidence that a combination of practical training and behavior-based interventions can significantly improve PPE use.

The effectiveness of occupational safety interventions in the agricultural sector, particularly through training, outreach, and the provision of personal protective equipment (PPE), has been proven significant in reducing the risk of pesticide exposure and the incidence of workplace accidents. Research shows that the implementation of occupational health and safety (OHS) programs are directly correlated with a substantial reduction in workplace accident rates. For example, in a study conducted by Semnasti et al. (2023), the implementation of an OHS program successfully reduced workplace accidents by 83.3%, indicating that worker safety awareness significantly impacts the work environment.

Training and outreach provided to workers also serve to increase knowledge about the proper use of PPE. For example, Tallo et al. (2022) showed that pesticide use without proper PPE practices can increase the risk of farmers experiencing health problems due to pesticide use. In this context,

consistent outreach is crucial to ensure workers understand the importance of safety, especially when dealing directly with hazardous chemicals.

Furthermore, providing adequate PPE can help minimise the risk of workplace accidents. Research conducted by Ridyasmara et al. (2024) showed that implementing structured methods, including the provision of protective equipment and the adoption of Kaizen methods, can create a better safety culture in the workplace. This reflects the importance of managing the entire work process to reduce the likelihood of accidents.

Furthermore, effective safety management not only reduces the risk of accidents but can also contribute to increased productivity. Herlina (2022) noted that implementing effective safety management can support work productivity, with employees feeling safer and more comfortable in carrying out their tasks. Therefore, training, outreach, and the provision of PPE should be considered strategic investments in occupational safety in the agricultural sector.

However, several studies have shown that even with adequate training and PPE, long-term health risks such as respiratory and neurological disorders and chronic diseases remain high due to uncontrolled pesticide exposure (Mohammadi et al., 2025; Díaz-Criollo et al., 2020; Sookhtanlou & Allahyari, 2021). Therefore, the effectiveness of interventions depends heavily on program sustainability, the local socioeconomic context, and strong regulatory support and field oversight.

Discussion

This research shows that despite the implementation of various occupational safety practices in the agricultural sector, significant challenges remain, particularly in developing countries. Lack of access to personal protective equipment, inadequate safety training, and weak regulatory oversight are major barriers to improving worker health. Furthermore, the long-term health impacts of pesticide exposure remain a major concern and require further intervention by authorities.

More comprehensive interventions, such as increased access to PPE, stricter regulations on pesticide use, and ongoing education campaigns, are needed to reduce the health risks of agricultural workers. In Indonesia, existing policies must be strengthened through increased field monitoring and stricter law enforcement.

CONCLUSIONS

Conclusions

This research concluded that occupational safety practices in the agricultural sector still face significant challenges, particularly in developing countries. Exposure to pesticides and other chemicals, as well as accidents involving heavy equipment, are two major health threats to agricultural workers. Many workers exposed to pesticides over a long period experience serious illnesses, including neurological disorders, cancer, and respiratory diseases. Physical injuries resulting from workplace accidents remain a significant problem, particularly in countries with weak occupational safety regulations.

Safety interventions, such as occupational safety training, provision of Personal Protective Equipment (PPE), and enforcement of regulations and regular safety inspections, have proven effective in reducing the risk of accidents and health impacts from chemical exposure. However, challenges in implementing these safety programs, particularly in developing countries, such as limited resources, access to PPE, and lack of supervision and education, reduce their effectiveness. In many cases, despite increasing awareness of the importance of occupational safety, implementation of safety practices in the field often remains low.

Suggestions

1. Improving Occupational Safety Education and Training.
   It is crucial to increase the frequency and quality of occupational safety training for agricultural workers. Structured, comprehensive, and ongoing training is needed to ensure workers understand the health risks they face and how to protect themselves from chemical exposure and workplace accidents. Governments and international health organisations can play an active role in supporting more intensive educational programs.
2. Wider and More Affordable Distribution of PPE.
   Access to quality Personal Protective Equipment (PPE) remains a major challenge in many developing countries. Therefore, government subsidies or assistance programs are needed to provide more affordable PPE and ensure equitable distribution across all regions, especially remote rural areas. Furthermore, stricter oversight of its use needs to ensure consistent use by workers.
3. Stricter Enforcement of Safety Regulations and Inspections.
   The government needs to strengthen occupational safety regulations in the agricultural sector and ensure their proper implementation in the field. Regular safety inspections and strict enforcement of safety violations can help reduce workplace accidents and chemical exposure. Collaboration between the government, private sector, and non-governmental organizations is crucial to creating a safer working environment for agricultural workers.
4. Improving Access to Health Services for Agricultural Workers.
   Agricultural workers often struggle to access adequate health care, especially in rural areas. Governments and health institutions need to provide more accessible health services, including facilities for the diagnosis and treatment of chemical poisoning and physical injuries. These services should also be complemented by programs for early detection of chronic health problems caused by long-term exposure.
5. Development of Safe and Ergonomic Agricultural Technology.
   In the long term, developing safer and more ergonomic technologies in the agricultural sector must be a priority. Safer heavy equipment with additional safety features, along with more environmentally friendly agricultural innovations that minimize pesticide use, will help reduce risks for agricultural workers.

With these steps, it is hoped that the occupational safety and health of agricultural workers can be better protected, especially in developing countries, which still face major challenges in implementing effective occupational safety systems.

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