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OCCUPATIONAL HEALTH AND SAFETY MEASURES ADOPTED BY FRESH PRODUCE FARMERS USING AGROCHEMICALS IN NAKURU COUNTY, KENYA

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ABSTRACT

Purpose: The study sought to identify the occupational health and safety (OHS) measures adopted by fresh produce farmers using agrochemicals in Nakuru County, Kenya.

Methodology: The study used a cross-sectional analytic and descriptive design targeting 388 farmers, with data collected through surveys, interviews, observations, and FGDs. Quantitative data were analyzed descriptively, while qualitative data underwent thematic analysis.

Results: The study revealed that while 97% of farmers reported practicing handwashing after agrochemical application, only 69.1% consistently used personal protective equipment (PPE), with focus group discussions indicating actual usage was as low as 2% in some areas due to cost and limited awareness. Additionally, 68% of respondents had not received formal training on agrochemical safety, 57% conducted safety inspections irregularly, and 98% did not monitor their health after exposure. Although 93.3% claimed to follow product label instructions, qualitative findings showed that most farmers selectively read only dosage guidelines and often increased concentrations beyond recommended levels.

Unique contribution to theory, policy and practice: The study recommends structured capacity building, subsidized access to PPEs, regular health monitoring, and stronger institutional support to enhance compliance with OHS standards.

Keywords: *Occupational Health and Safety measures, Agrochemicals, Fresh Produce Farmers, Nakuru County*

INTRODUCTION

According to the World Health Organization (WHO), agrochemical use is widespread and can have negative consequences for public health (Orlando et al., 2023). Over the past decades, the use of agrochemicals, including but not limited to pesticides, herbicides, insecticides, and fungicides in crop production has become more widespread, particularly in developing countries, as a modern approach to protect agricultural investments. Agrochemicals have high levels of acute as well as chronic hazards to human health and the environment. In many instances, agrochemicals have been shown to cause severe or irreversible harm under conditions of use (Heinrich Böll Stiftung, 2023).

Ahmed et al. (2021) in their systematic review of contamination levels and associated health risks of pesticides in vegetable production in Bangladesh, showed a plausible relationship between agrochemical use dependency and worsening climatic conditions. More agrochemical volumes are required over time due to crop and pest resistance, erratic weather conditions, and climate change. Despite this, agrochemical use reduction as a solution to the climate crisis has largely been ignored. On the contrary, agrochemical use as a climate mitigation strategy has been fronted as a strategy for intensifying food production through continuous use to guarantee global food security, ignoring the resulting deleterious effects.

The rapid increase in the world population has resulted in a boost to the demand for food supply and agricultural food products, coupled with an intensification of agrochemical applications. At the global level, agrochemical applications have increased by more than 50% between 1990 and 2010. The total agrochemicals trade was estimated to be around 5.9 million tons in 2019, which accounts for around 35.5 billion US dollars. Thus, agrochemicals use is expected to double in the next 10 years in developing countries. This increase is expected to raise the alarm over the dangers of agrochemicals and the need to address agrochemical safety in developing countries. The widespread use of agrochemicals in agricultural and domestic settings is a serious threat to the environment and public health. The effects of excessive and inappropriate uses of agrochemicals on the environment and human health are recognized worldwide. Due to their persistent nature, agrochemicals remain in the environment for a long period and gradually enter food systems. Exposure to agrochemicals occurs via different environmental media such as air, water, soil, and food and can result in both acute and chronic effects (Tudi et al., 2022).

Problem Statement

According to Luke Montrose (2021), in an epidemiological review, they contend that exposure to synthetic agrochemicals may be associated with adverse health outcomes. Agricultural workers are among the most vulnerable working populations due to social and cultural risk factors frequently associated with their ethnicity, immigration status, social class, and rural location, as well as disparities related to language barriers and lack of access to healthcare (Luke Montrose, 2021). In addition, these potential risk factors can be exacerbated by occupational hazards associated with agricultural work, including exposure to environmental hazards such as synthetic pesticides and fertilizers, diesel exhaust, ultraviolet radiation, biologically active dusts, and zoonotic viruses and bacteria, all of which may put farm working populations at an increased risk for a variety of adverse health effects. Agrochemical exposure among agricultural workers has been linked to certain cancers, DNA damage, oxidative stress, neurological disorders, as well as respiratory, metabolic, and thyroid effects (Luke Montrose, 2021).

The use of agrochemicals among Fresh Produce Farmers has been associated with negative health effects. Existing data link agrochemical exposure to endocrine disruption, genetic mutations, neurological dysfunction, and other metabolic disorders, apart from the myriad of acute effects. Despite the risks, farmers continue to use agrochemicals due to various factors such as lack of knowledge, inadequate protective equipment, and limited access to alternative pest control methods (Anaduaka et al., 2023). The evaluation of climate change, agrochemical use and health effects among Fresh Produce Farmers is crucial to identify the factors that motivate or compel farmers to use agrochemicals, assess the safety challenges of agrochemicals and their impacts on climate change and human health, and ascertain the determinants of farmers' decisions on agrochemical use in Fresh Produce Farming. This research is necessary to develop strategies to promote the adoption of safe agrochemical use practices, to safeguard food quality, mitigate negative health effects, and promote climate change resilient fresh produce farming practices.

The effect of climate change on agrochemical usage in Kenya and its impacts on the health of Fresh Produce Farmers is dire. The impacts of climate change on agrochemical use and their effects on the health of Fresh Produce Farmers in Nakuru County have not been adequately studied. This research is therefore important because it will seek to generate new information on climate change effects on agrochemical use and the resulting health effects among Fresh

Produce Farmers in Nakuru County and contribute to the body of knowledge on the phenomenon (KARLO, 2021).

According to the National Cancer Institute of Kenya (NIC-Kenya) report released in 2023, the most common cancer types reported in the National Cancer Registry for the period 2021/2022 were breast (15.9%), cervix (13.3%), and esophagus (11.8%). The report showed that the Central and Eastern regions of Kenya demonstrated a higher rate of cancer cases reported on the National Cancer Registry. Nakuru County was reported as the second among the top ten counties, accounting for 63% and 62% of the total cancer burden among females and males, respectively, after Nairobi County (Okumu Lynet, 2023). This study sought to identify the occupational health and safety measures adopted by Fresh Produce Farmers using agrochemicals in Nakuru County, Kenya.

LITERATURE REVIEW

This literature review examines existing research on occupational health and safety in agrochemical use among smallholder farmers. It highlights global and local challenges, including exposure risks, unsafe practices, and limited training. Emphasis is placed on safety behaviors, policy gaps, and the need for effective interventions.

Empirical Review

Working conditions in agriculture are hazardous. Exposure to pesticides is a major occupational hazard for farmers and farmworkers; it is of major importance for farmers' health, and has been extensively studied, although occupational exposure and residential exposure to pesticides also deserve attention. Farming is acknowledged to be a dangerous occupation that poses risks for farmers, farm employees, and family members (Shammi et al., 2020). Information on the health impacts of pesticides is quite limited in many developing countries, with many surveys relying solely on farmer self-assessments of their health status. Exposure to pesticides in agriculture occurs during loading, mixing, application of pesticides, and manual activities in treated crops.

Agrochemical use and handling are a global issue because they affect human health. Estimates cited by the Food and Agriculture Organization (European Union, 2021) showed that approximately 3 million people are poisoned and 200,000 die from pesticide poisoning every year. The largest number of poisonings and deaths occurred in developing countries, with an average projection of 220,000 fatalities per year. In Sri Lanka, studies showed that approximately 1000 fatalities occurred due to unsafe handling of pesticides, while in Kenya, 350,000 cases of pesticide poisoning per year were estimated (Marete et al., 2021). Frequent

exposure to pesticides results in ill health, both in the short term and long term. Rising numbers of cases of non-communicable diseases such as cancer have been linked to air pollution in large cities and pesticide exposure in commercial large-scale farming rural areas (Glasgow, 2019; Ahmed et al., 2021). In global terms, therefore, in trying to find solutions to minimize incidences of ill health, it is important to determine whether farmers and farm workers, who are predisposed to pesticide exposure, take precautions in pesticide handling and adhere to pesticide use regulations. Proper use and handling of pesticides is also significant as it involves adopting good agricultural practices such as the use of IPM, including, selection of pesticides which have less impact on the environment (Gómez-ramírez et al., 2019).

Agrochemicals also have significant implications in global food trade, in which developing countries have to meet stringent regulations on residue limits in foods before their export produce is accepted into the international markets, such as the EU (FAO/WHO, 2008; Marete et al., 2020). Therefore, there is a call for education and awareness on pesticide use and handling for agricultural extension workers, farmers, and farm workers in developing countries.

The safety measures taken by fresh produce farmers in agrochemical use include: Education- It is important to educate all farm workers about the dangers of agrochemical use. Personal Protective Equipment (PPE); Farmers should be trained and encouraged to wear appropriate PPE, such as chemical-proof goggles, rubber gloves, and a heavy-duty long-sleeved shirt, to avoid exposure to hazardous chemicals. First Aid: Clean water should be provided for first aid in case of chemical exposure. If a farmer comes into contact with a chemical, first aid must be administered immediately, and plenty of water should be on hand to flush out the chemical after contact. Storage and Handling: Chemicals and cleaning supplies should be stored in a locked storage cabinet or separate shed away from fresh produce handling areas to prevent contamination from occurring. Proper Application: Farmers should apply agrochemicals in a way that is safe and follows recommended practices to avoid accidents and exposure. These measures are essential to ensure the safe use of agrochemicals and to minimize the risks to human health and the environment (Demi & Sicchia, 2021).

Hoque et al. (2022) found that among winter rice, potato, bean, eggplant, cabbage, sugarcane, and mango farmers in Bangladesh, over 47% of the farmers were overusing pesticides. With only 4% of farmers formally trained in pesticide use or handling and over 87% of farmers openly admitting to using little or no protective measures while applying pesticides, overuse is a potentially threatening problem to farmer health as well as to the environment. As end users

and distributors, farmers and retailers of pesticides are directly exposed to pesticides, and their behaviors for the safe use of pesticides play an important role in reducing point and non-point sources of pollution, hazards, and acute or chronic intoxication to pesticides in agricultural regions. The levels of knowledge and risk awareness and the practices of farmers and retailers are essential elements for increasing the efficiency of devising to protect these stakeholders. (Ataei et al., 2021) reported that almost half of the farmers (49.5%) from the study area of Zanjan, Iran, had shown unsafe behavior in the use of PPE, and significant proportions of the farmers showed potentially unsafe behavior in the use of pesticides (42.2%). In public policy initiatives, agriculture and health have often been pursued in an unconnected manner; evidence across the world, however, shows that there are multiple links between the practice and products of agriculture and environmental health risks (Zinyemba et al., 2021). In recent years, the interest in health and safety in the workplace has increased. Agriculture is one of the human work activities with the highest risk indexes. Studies on risk perception of agricultural workers are often referred to as specific risk factors, especially for agrochemicals, but the risk perception plays an important role in preventing every kind of accident and occupational disease (Shammi et al., 2020). Given the potential risk of pesticides to public health, the use of agrochemicals in agriculture should be subjected to constant monitoring. Given the limited or poor literacy skills of Fresh Produce Farmers and widespread use of agrochemicals, it is predictable that occupational exposure to agrochemicals is likely to be high, cumulating the vulnerability to acute and chronic poisoning to human health and the environment. Thus, the objective of this study is to determine the levels of agrochemicals and behavior of farmers regarding the usage of agrochemicals and to evaluate the driving factors related to environmental, human health risks, and hazards.

Theoretical Review

The Social Cognitive Theory (SCT) was proposed by Albert Bandura (1986) to predict how social and cognitive factors influence health behavior (Luszczynska & Schwarzer, 2015). In principle, Bandura postulated that observations of the social norms had a significant impact on learning and that learning, ultimately, influenced the health behaviors that were practiced by individuals. The SCT is underscored by a three-dimensional relationship among cognitive, environmental, and supportive behavior factors. These three factors were postulated as determinants of health promotion and disease prevention (Martin & Guerrero, 2020), which makes the SCT an appropriate theory to support the investigation of the relationship between

individual characteristics of farmers, agriculture practices/behaviors, and potential health outcomes.

The relationship between the personal cognitive factors, socioeconomic or environmental factors, and supportive behavior is referred to as reciprocal determinism, emphasizing the interplay between the components of the theory and the effect on health outcome (Martin & Guerrero, 2020). In relation to cognitive influences on behavior, the constructs of the SCT are self-efficacy (belief that one can perform a behavior that will lead to a particular outcome), outcome expectation (assessment of the consequences of an action), and knowledge (information about how to act and the risks and benefits (Glasgow, 2019).

In relation to environmental influences on health, the constructs of the theory include observational learning (learning behaviors through cultural norms in a society), normative belief (belief about the normalcy and acceptability of a cultural norms), social support (support that is provided through interaction with peers, colleagues, family and other members of the society), and barriers and opportunities (external factors that facilitate or hinder a behavior) (Martin & Guerrero, 2020). With regard to supporting behaviors, the constructs of the SCT are behavioral skills (personal capacity to perform a behavior), intentions (considerations about adding or modifying behaviors), and reinforcement and punishment (providing or removing incentives for acting).

RESEARCH METHODOLOGY

The study design was a community based cross-sectional analytic and descriptive study, and target population included fresh produce farmers living in rural areas who are routinely exposed to agrochemicals in their daily occupational activities. A sample size of 388 participants was accessed. Data was collected using structured questionnaires, Interview schedules, Focused Group Discussion (FGD) guide and an Observation guide. Data analysis was conducted using descriptive statistics including frequency and percentages. Qualitative data was analyzed using thematic analysis.

RESULTS

To identify the Occupational Health and Safety measures adopted by Fresh Produce Farmers using agrochemicals in Nakuru County, Kenya

Hand washing behavior and changing of clothes

97% of the respondents practice hand washing after applying agrochemicals use with only 1% not washing or changing clothes.

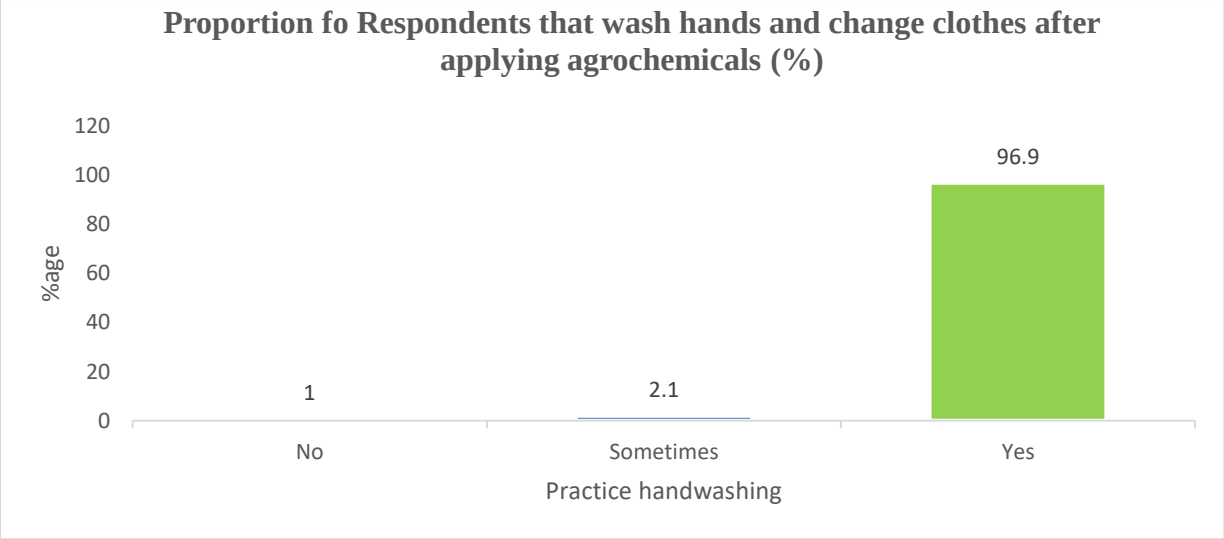

Figure 1: Proportion Of Respondents Who Wash Their Hands And Change Clothes After Applying Agrochemicals

However, from the focus group discussions, Farmers have mixed practices when it comes to hand washing and changing clothes after spraying agrochemicals. Many acknowledge the importance of washing hands but admit that they often do it quickly, sometimes out of urgency or hunger. Changing clothes, however, is not always a priority. Some farmers wear the same clothes they used for spraying the next day, while others delay changing until they bathe in the evening.

"It depends how hungry one is, washing hands we do, but changing the clothes immediately is rare… we wash hands in a hurry." A farmer from Bahati

"She is saying she won't get off the clothes she had on the farm, and the following day, you will still see her in the same clothes." A farmer from Bahati

In some areas, farmers insist that removing contaminated clothes is a must, recognizing the health risks. However, others continue working in the same clothes after spraying, even if chemicals have spilled on them. This prolonged exposure raises concerns about long-term health effects, especially given the potency of some chemicals. For example, a chemical called "Thunder" was mentioned as being so strong that it kills pests instantly—even birds that eat affected pests can die.

"After spraying, you will continue doing other activities on the farm, and remember that some chemicals have spilled on you. That is why people now have a lot of chemicals in their bodies. There is a very strong chemical that we used called thunder. When you spray it on the farm,

even the pests that were in the soil will come out dead. If a bird eats that pest, it will also die." A farmer from Mau Narok

Use of PPE

Majority, 69.1% of the respondents, use PPEs when handling agrochemicals, with only 5.2% of them never using any PPEs.

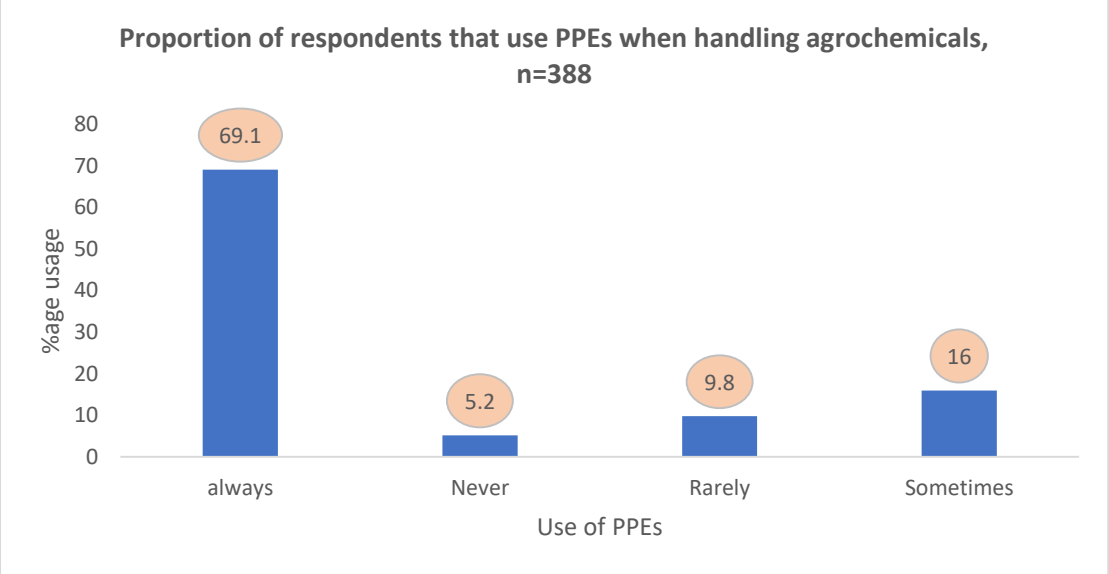

Figure 2: Distribution of Respondents By Use Of PPEs

This is contrary to the focus group discussion findings, where farmers have widely acknowledged that the use of personal protective equipment (PPE) when spraying agrochemicals is extremely low. Many simply do not have protective gear, and those who do often find it difficult to use regularly. In some areas, farmers say that only about 2%—or even less—wear full protective clothing. The most commonly used item is a simple mask, often left over from COVID-19, while gloves, aprons, and goggles are rarely seen.

"We don't have them, they are minimal, we don't have maybe masks, those for 10 shillings, masks of which they came during COVID, at least that's what most people use. Let us say maybe 95% are not covered. It is not 95, maybe 98, only 2% use it. Only 2%" A farmer from Bahati

The reasons for not using PPE vary. Some farmers believe that since they have always sprayed chemicals without protection, they can continue doing so. Others admit that the cost of proper gear is too high, making it a low priority. Even those who own protective equipment, often for other businesses like fumigation, rarely use it for farming.

"The reason most farmers haven't bought the protective gear is that they are expensive. So before a farmer could afford it, they feel it is a waste of money, and yet they can spray their farms without the protective gear." A farmer from Mau Narok

There is also a clear lack of knowledge about the risks. Many farm workers spray chemicals without knowing what they are handling or how to protect themselves. Some don't check if their equipment is leaking, and after spraying, they continue their day as usual—eating, drinking, and interacting with others—without changing clothes or washing properly. The few who are aware of the risks say that if PPE were more affordable, more farmers would use it.

"That person will carry that pump on their back without knowing the condition of the pump, whether it has a leakage, they don't know which chemical they are going to spray, they don't even know what they are supposed to do after spraying, maybe he will get into some place take alcohol and after that go and eat in some hotel and maybe he hasn't covered his hands. So there is a lack of knowledge when it comes to the usage of these chemicals, and the gowns are costly, but those who know their importance do buy them. In terms of preparedness, they are not prepared because you will find someone going to spray at 2 pm."

Training on safe handling and application of agrochemicals

68% of the respondents have not been trained on safe handling and use of agrochemicals, while 22% have been trained, and 10% partially trained.

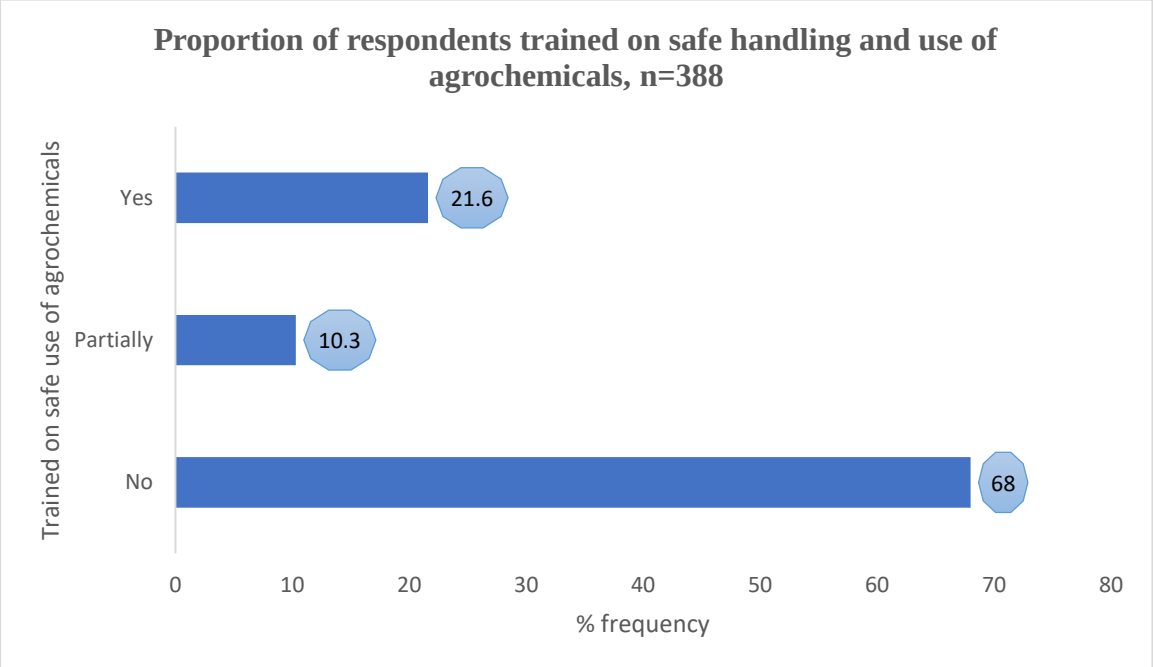

Figure 3: Distribution of respondents by training on safe handling and use of agrochemicals

Contrary to the Focus Group discussions, farmers in Mau Narok and Njoro acknowledged receiving training on agrochemical use from OSHO. However, they felt that the lack of follow-ups rendered the training ineffective, as it did not lead to improved production or effectively control pests. As a result, they did not fully appreciate the training. Instead, all participants agreed that they rely on learning from fellow farmers who achieve high yields and from sprayers who have hands-on experience with agrochemicals.

"Most farmers emulate those farmers who have become rich through farming. You learn from those successful farmers. If they used a certain agrochemical, next time you will use that chemical on your farm." A farmer from Mau Narok

"The problem is also that those who come to train these farmers don't make any follow-ups to know how these farmers are faring. In other areas, they use a model farm so that other farmers can see how you use the agro chemicals." A farmer from Njoro.

Adherence to Instructions on Agrochemical Product Labels

Majority of the respondents always read and follow instructions on agrochemical product labels regarding proper use, handling, and storage.

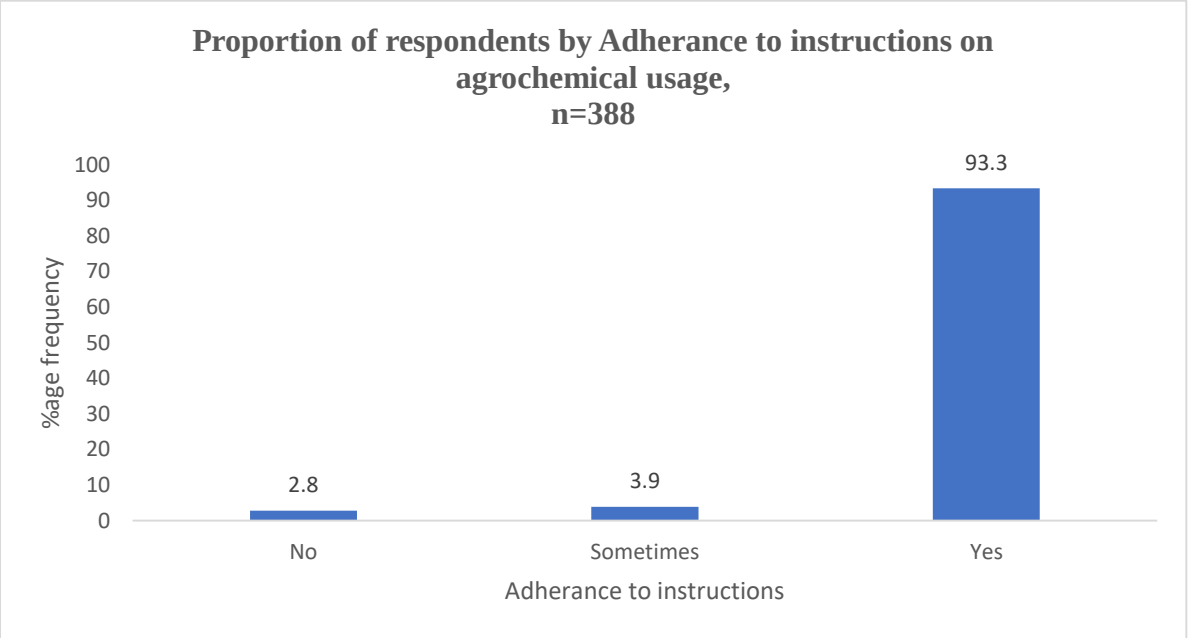

Figure 4: Distribution of respondents by adherence to instructions on agrochemical usage

From the focus group discussions, farmers are aware that agrochemical packaging comes with instructions on proper usage, and some even recognize the pictograms meant to make

understanding easier. However, despite this awareness, most farmers do not strictly follow these guidelines. While they acknowledge that reading instructions is important, many only pay attention to specific details such as the amount of chemical to mix with water and the expiry date. Other critical information, such as how long the chemical remains active on crops or the necessary safety precautions, is often ignored.

"The area that we are keen on is the amount to be used… the time, we don't read the rest, we don't even look at the duration that it will take on the farm, that it will end after days or weeks, we don't look at that." A farmer from Bahati.

One of the biggest reasons farmers overlook these instructions is time. With so many tasks to handle on the farm, taking a moment to carefully read labels is not a priority. Some farmers also struggle with the tiny print sizes on chemical containers, making it difficult to read even if they wanted to. Instead of relying on what is written, many prefer to follow advice from fellow farmers or sprayers, believing that practical experience is more useful than written guidelines.

"The problem also is that those writings are so tiny that you can't even see well, and that is where a lot of information is hidden because they know you can't see that easily. They should write well about how it is supposed to be about those chemicals and their side effects." A farmer from Mau Narok

Another issue is trust—or rather, the lack of it. Many farmers feel that the recommended chemical dosages are too weak to be effective. Over time, they have developed the habit of increasing concentrations, believing that using a stronger mix will give better results. This tendency is further fueled by the widespread belief that some agrochemicals sold in the market are either fake or expired. Farmers have witnessed cases where chemicals fail to work as expected, leading them to assume that higher doses are the only solution.

"We also have another weakness, for example, if the instructions say 200 grams, we tend to add more to make it concentrated, though that is not farmers' fault. it is because we have used them with the amount they have, and it doesn't work, so you opt to make it more concentrated for it to work." A farmer from Bahati

Frequency of safety inspections of farms

In the study, 57% of the respondents conducted safety inspections on an irregular basis, while 42% did weekly inspections. Only 1% of the respondents conducted monthly inspections as part of compliance with OHS standards.

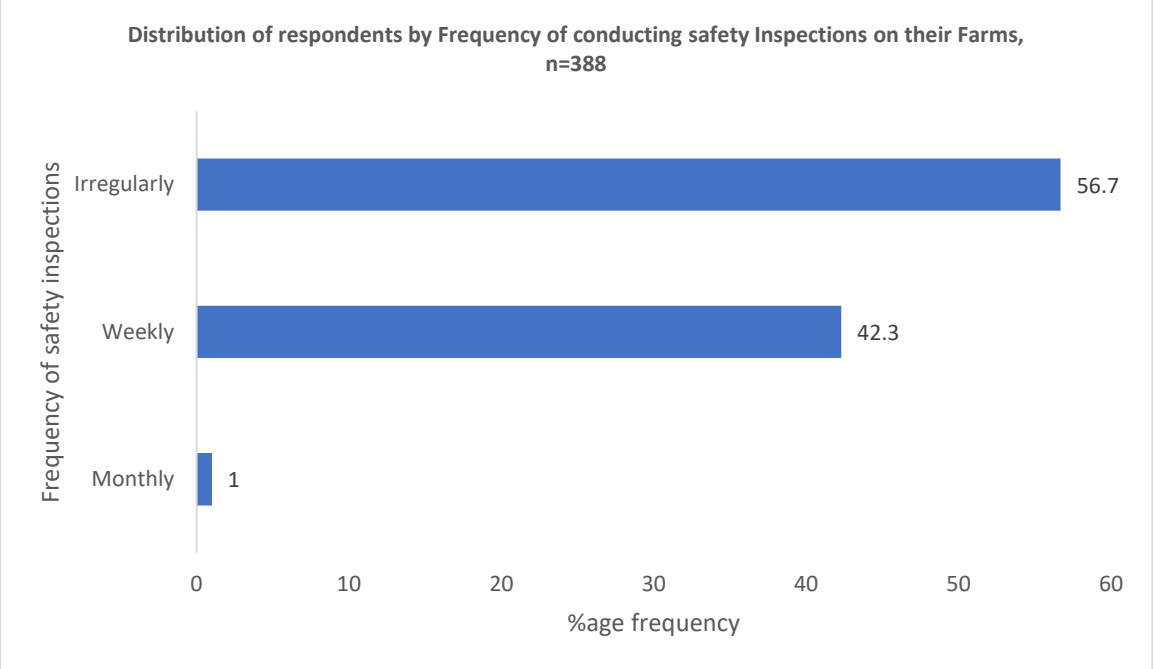

Figure 5: Distribution of respondents by frequency of safety inspection of farms

Regular Monitoring of Health

In the study, 98% of the respondents did not monitor their health regularly because of exposure to agrochemicals, while only 2% did monitor their health.

DISCUSSION

The findings of the study showed that 97% of the respondents practice hand washing after applying agrochemicals, 2% use it sometimes, and 1% do not wash or change clothes after applying agrochemicals. According to Tudi and others, an important source of exposure to pesticides is through dermal contact with contaminated clothing (Tudi et al., 2022). This makes it a priority for fresh produce farmers to wash their clothing and hands after application of agrochemicals (Aksüt & Eren, 2023).

In the study findings, there was acceptable use of PPEs seen; 69.1% of the respondents always use PPEs when handling agrochemicals, 16% of them use PPEs sometimes while 9.8% rarely use, and 5.2% of them never use any PPEs. Inadequate use of PPEs among fresh produce farmers is an issue in Kenya, which has also been identified in other studies, including (Marete et al., 2021b). In the qualitative data collected in the FGDs, the majority of the respondents reported that they did not use PPEs, which aligns with another study in Kenya by Kinyua and others showing that few applicants of agrochemicals used PPEs when applying agrochemicals (Kinyua et al., 2023).

The study revealed that 68% of the respondents have not been trained on safe handling and use of agrochemicals, while 22% have been trained, and 10% partially trained. Lack of training is a notable challenge in the implementation of occupational health and safety precautions that play a role in the use of PPEs and adherence to instructions on agrochemical use (Kinyua et al., 2023). More so, the availability of training courses is a significant factor influencing the use of agrochemicals (Owemigisha et al., 2024). From the study, 93.3% of the respondents always read and followed instructions on agrochemical product labels regarding proper use, handling, and storage, 3.9% followed sometimes, and 2.8% did not adhere to instructions. The findings are contrary to Rother 2018, who argues that most agrochemical end-users in LMICs are unable to comprehend and follow instructions on the agrochemicals (Rother, 2018; Utyasheva et al., 2024).

The study showed that 57% of the respondents conducted safety inspections on an irregular basis, while 42% did weekly inspections. Only 1% of the respondents conducted monthly inspections as part of compliance with OHS standards. The study revealed that 98% of the respondents did not monitor their health regularly because of exposure to agrochemicals, while only 2% did monitor their health. Fresh produce farmers' perception about climate change plays a role in determining their adaptation strategies (Balasha et al., 2023). Farmers' knowledge about extreme weather patterns, including floods, drought, and rising temperatures, will affect the methods of application they use to manage risks by implementing appropriate strategies (Amani et al., 2022).

CONCLUSION

The study concludes that while freshest produce farmers in Nakuru County practice basic safety measures like handwashing, actual adherence to comprehensive occupational health and safety practices is inconsistent. PPE use is low despite self-reported compliance, largely due to cost and limited awareness. Most farmers lack formal training and rarely conduct safety inspections or health monitoring. Label instructions are often ignored or misunderstood. Enhanced training, access to PPE, and regular inspections are critical for safer agrochemical use.

RECOMMENDATIONS

The study recommends targeted capacity building through continuous training and sensitization to strengthen farmers' commitment to occupational health and safety practices, particularly the consistent use of PPEs and safe agrochemical handling. It further urges the Ministry of Agriculture to support fresh produce farmers by addressing resource gaps,

including mobilizing County-level partnerships to supply PPEs and enforce OHS compliance through structured health and safety interventions.

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