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DETERMINANTS OF CANCER PREVENTION BEHAVIOURS AMONG FARMERS USING PESTICIDES IN LAIKIPIA COUNTY, KENYA

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ABSTRACT

Cancer is the second leading cause of death worldwide with an average of nine million deaths per year. Available studies have shown a rise in cancer cases from exposure to environmental agents such as pesticides and fertilizers. Despite multiple studies on cancer, empirical evidence on the role of personal protection against exposure to pesticides is lacking especially in the local context. To provide local evidence of personal protection among famers this study sought to establish determinants of cancer preventative behaviors among rural farmers in Laikipia County, Kenya. The objectives of the study were to assess the personal protection practices among farmers, establish demographic characteristics associated with and personal protection practices, determine the association between knowledge and personal protection practices and establish the association between attitude and personal protection practices. A descriptive analytical cross-sectional survey was used in this study. The study targeted small-scale farmers. A sample of 196 farmers was selected using Slovins' formula. The study employed simple random sampling to choose participants. The data was collected using a structured questionnaire that was administered by the researcher. The study instruments were pretested in Isiolo County, Kenya, for a preliminary evaluation. Data was analyzed using descriptive statistics such as frequencies and percentages. Chi-square tests were also carried out to determine the association between the variables. Logistic regression was also carried out to establish determinants of cancer preventative behaviors. Statistical Package for the Social Sciences version 28 was used for analysis. The results showed that majority of the respondents 88.3% (n=173) had poor personal protection practices. Slightly above half 67.3% (n=132) of the respondents were knowledgeable on personal protection. In addition, majority of the respondents 75% (n=147) had a negative attitude towards personal protection. Chi-square analysis showed that age ($p<0.01$), level of education ($p<0.01$), land size ($p<0.01$) and crops grown ($p<0.01$) were statistically significant. Age ($p < 0.001$), level of education ($p < 0.001$), land size ($p < 0.001$) and attitude ($p < 0.001$) were predictors in the regression analysis. The study concluded that personal protection practices among farmers using pesticide are poor. Personal protection practices associated with demographic characteristics, knowledge and attitude. The researcher recommended that the county government of Laikipia ought to provide farmers with access to personal protective equipment. In addition, there is a need for targeted education and awareness campaigns to improve knowledge of personal protection practices among farmers.

Key Words: *Attitude, Knowledge, Personal Protection, Cancer Prevention*

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INTRODUCTION

Cancer is the second greatest cause of death in the world after cardiovascular disease, and the third most common cause of mortality worldwide. (Wild, 2019). According to the World Health Organization (WHO) cancer leads as the second top cause of death worldwide with an average of 9 million deaths per year. In 2020, 10 million cancer deaths occurred globally, 550,000 in sub-Saharan Africa and 22,000 in Kenya (WHO, 2021). After infectious and cardiovascular diseases, cancer ranks third in causes of mortality in Kenya. The annual incidence and mortality is 47,000 and 33,000 respectively (Union for International Cancer Control (UICC), 2019).

Risk factors of cancer are broadly classified into lifestyle factors, family history, genetic disorders, viruses, and environmental exposures (Holick, 2020). Lifestyle factors such as poor diet, smoking, lack of using PPE during pesticide application and alcohol use as well as lack of exercises are known modifiable risk factors which have attributed to the prevalence of cancer today (Sabarwal et al. 2018). Available studies also show a rise in cancer cases from exposure to environmental agents such as pesticides and fertilizers. Concerns about pesticides being a carcinogen have been widespread among researchers and this hypothesis has been confirmed in animal studies. The mechanism by which pesticides cause cancer are unclear but researchers suspect that elements in pesticides are involved in DNA mutations which lead to cancerous cells (Melanda et al., 2022).

A study on determinants of personal protection during pesticide application among patients diagnosed with cancer is important for oncology nurses. An oncology nurse cares for and educates patients who have cancer including prevention and early detection (Von Ah, 2019). One of the responsibilities of an oncology nurse is to provide patient education and using results and recommendations made by the current study, the oncology nurse will be in a better position to provide relevant and up to date health education regarding cancer and the role of personal protection. A lot of studies have been conducted on personal protection among farmers. However, majority of these studies have been conducted in developed countries (Damalas et al., 2019; Mubushar et al., 2019; Yuantari et al., 2015), studies conducted in Sub-Saharan Africa, Kenya – Laikipia County in particular are scarce. Therefore, the purpose of this study was to explore the factors associated with cancer preventative behaviors among farmers in Laikipia County, Kenya.

Problem Statement

Anecdotal evidence from Nanyuki Teaching and Referral Hospital (NTRH) in Laikipia County indicates that there is an increased projection in cancer related cases among patients with the year 2017 reporting 155 cases, 2018 reporting 276 cases, and 308 cases reported in 2019 (NTRH, 2023). The reasons for this rise are unclear. However, Epidemiological studies such as Melanda et al. (2022) and VoPham et al. (2017) have found link between cancer and exposure to pesticides. This could be either by long exposure periods, lack of awareness, and improper or lack of use of protective wear while handling the chemicals. Because majority of the patients are employees or owners of commercial farms in the county where pesticides are largely used, there is a possibility that the rise in cancer cases is due to the use of the pesticides and lack of personal protection.

Various studies have been conducted on personal protection among farmers and found poor personal protection. However, these studies such as Damalas et al. (2019) and Sapbamrer and Thammachai (2020) were conducted outside Kenya and the results may not be wholly applicable to the Kenyan populace due to environment, cultural and genetic differences. Therefore, to provide local evidence of personal protection among famers this study sought to establish determinants of cancer preventative behaviors among rural farmers in Laikipia County, Kenya.

Research Objectives

To establish determinants of cancer preventative behaviors among farmers using pesticide in Laikipia County, Kenya. The study was guided by the following specific objectives:

- To assess the personal protection practices among farmers using pesticide in Laikipia County, Kenya.
- To establish demographic characteristics associated with and personal protection practices among farmers using pesticide in Laikipia County, Kenya.
- To evaluate the association between knowledge and personal protection practices among farmers using pesticide in Laikipia County, Kenya.
- To establish the association between attitude and personal protection practices among farmers using pesticide in Laikipia County, Kenya.

Conceptual Framework

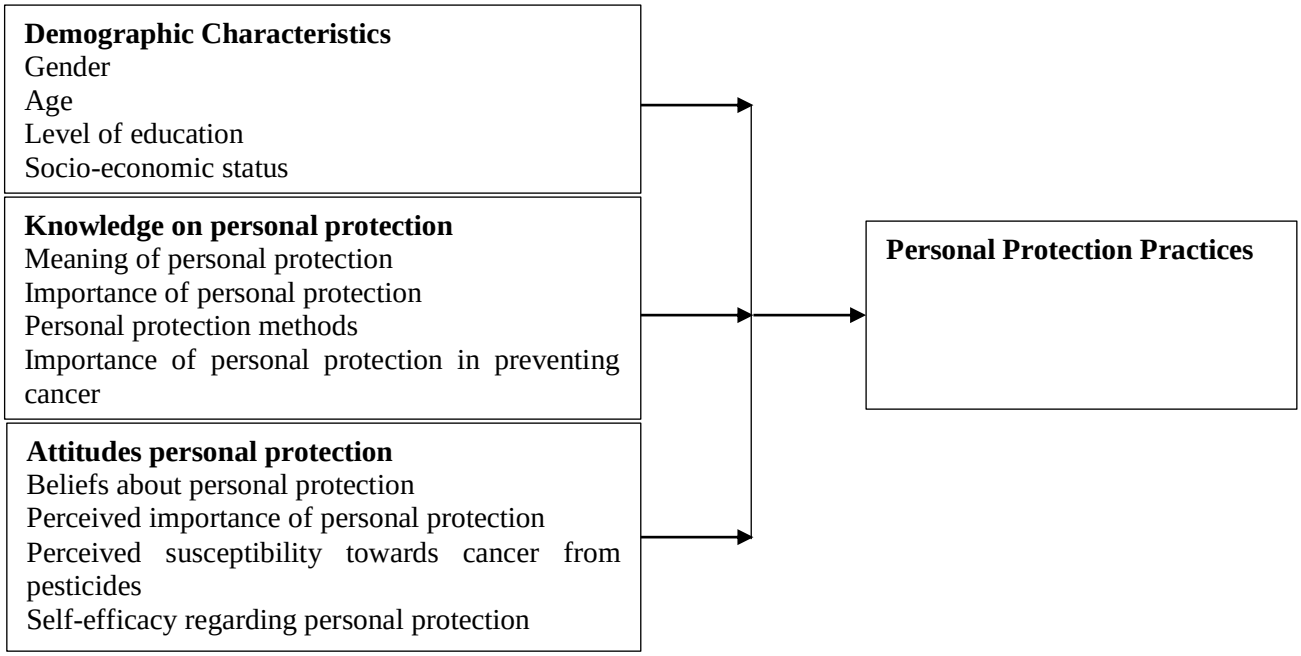

Figure 1: Conceptual Framework

LITERATURE REVIEW

Level of Knowledge on Personal Protection among Rural Farmers

Farmers' awareness of pesticide safety and biosafety was assessed by Mubushar et al. (2019) in a in Pakistan in order to keep farmers healthy through targeted extension programmes. Findings indicated that farmers in the study relied on advice from their neighbors, who lack a basic understanding of biosafety because of the low level of literacy in the study area. Various factors, such as level of education, ownership of land and total land area, have a major impact on farmers' awareness of safe pesticide use. The point of departure is that this study was carried out in Pakistan where the types of crops and pesticides used differ greatly to Kenya.

Negatu et al. (2016) surveyed Ethiopian farmers and farm labourers on their pesticide knowledge, attitudes, and practices. Except for a few farm employees who were applicators and largely hired by the LSGH, virtually few farmers and farm labourers questioned had received pesticide-related training. Non-chemical pest management strategies were only known by a tiny percentage of farmers and agricultural employees that participated in the research. Fewer than a quarter of SSIF staff frequently read pesticide labels, and none of them make use of scaled measuring equipment to assure precise dose readings. However, this study relied solely on self-report data. The current study used both self-report and observational data to generate more robust findings. Pesticide use methods, knowledge, and the health impacts of pesticides were studied in randomly chosen horticultural farmers in Meru by Marete et al. (2021). The majority of farmers were familiar

with proper pesticide handling techniques, such as reading package instructions and donning protective gear. However, personal protection practices were not assessed in this study necessitating the need for the current study.

Attitude towards Personal Protection among Rural Farmers

In a study carried out among farmers in Iran, Damalas et al. (2019) evaluated variables that influence farmers' perceptions of personal safety and safe conduct when using PPE for pesticide spraying. More over half of the farmers polled said pesticide spraying posed no risk to workers' health and safety. Increased personal safety concerns were found among young farmers with high educational levels and extensive farmland areas who had access to the internet, a seminar on pesticide usage and PPE, and an awareness of pesticide toxicity. The point of departure is that this study was carried out in Iran where the types of crops and pesticides used differ greatly to Kenya.

Iranian farmers' attitudes, knowledge, and practices about pesticide usage were examined in a research undertaken by Rostami et al. (2019). Personal protection equipment (PPE) was widely seen as a need by farmers. 37.5 percent of those surveyed said they had difficulty using personal protection equipment. The farmers' usage of personal protection equipment was connected with their knowledge and attitude about the equipment. The point of departure is that this study was carried out in Iran where the types of crops and pesticides used differ greatly to Kenya.

Personal Protection Practices among Rural Farmers

Regarding pesticide safety measures, the usage of PPE in agricultural pesticide handlers throughout the world has been studied by Sapbamrer and Thammachai (2020). Many studies have shown that pesticide handlers across the world often wear a shirt, pants and caps as their primary PPE. An apron, goggles, gloves, boots, and a mask were the most basic PPE. Farmers wore far more PPE than agricultural laborer. This was a systematic review of many studies from many countries. The current study presented empirical evidence for Kenya.

Using a questionnaire, Damalas et al. (2019) investigated the factors that influence farmers' perceptions of the significance of personal safety and safe behaviour when using PPE in pesticide spraying. Using long-sleeved shirts, long pants, chemical-resistant gloves, socks, and shoes as PPE is risky for most farmers. However, this study relied solely on self-report data. The current study used both self-report and observational data to generate more robust findings. Researchers Moradhaseli et al. (2017) conducted a study on the safety and protective behaviour of Iranian farmers in connection to the use of chemical pesticides in their farms. When spraying pesticides, the vast majority of people failed to properly wear their protective gear. Pesticide safety behaviour, employment experience, income level, and attitudes toward correct pesticide application all had a favourable link. The point of departure is that this study was carried out in Iran where the types of crops and pesticides used differ greatly to Kenya.

Melon growers in Central Java were studied in Indonesia by Yuantari et al. (2015), who surveyed their knowledge and attitudes towards pesticide use. On the ground, just 3.8 percent of the people were wearing glasses, and just 1.9 percent were wearing boots. It was merely a piece of their shirt knotted over their lips that served as the masks. Wearing long pants or shirts with sleeves was not a necessity for farmers; they also didn't wash their clothes after wearing them for more than one day at a time. Almost no farmers utilized conventional, comprehensive, and in good condition personal safety equipment. However, the association of knowledge and practice was not tested in this study.

In a study by Adesuyi et al. (2018), Nigerian vegetable farmers' knowledge, techniques, and exposure to pesticides were analyzed. More than 67% of farmers said they use PPE when handling, preparing, and spraying pesticides. A mere 11% of those who said they used PPE really did so in accordance with the manufacturer's recommendations. Quite a few people who took the survey said they didn't use respirators,

nasal masks, coveralls, or even glasses or goggles when they were working. Protective gloves, helmets, and booths were the most often worn PPE. However, only vegetable famers were included in this study. To fill this gap, the current study included farmers of various crops.

A research conducted by Soko (2020) aimed to identify the principal crops farmed in Kenya, the pests that damage them, and the agricultural chemicals that are used to manage them. Insecticides and rodenticides were the most commonly utilized agricultural pesticides among responders. Artificial pesticides were found to be both more effective and more popular than pesticides manufactured at home, according to the findings of this study. However, the personal protection practices of the famers in this study were not studied. To fill this gap, the study sought to establish determinants of cancer preventative behaviors among farmers using pesticide in Laikipia County, Kenya.

METHODOLOGY

This study employed an analytical cross-sectional design to establish determinants of cancer preventative behaviors among farmers in Laikipia County, Kenya. Laikipia County is selected for the study because of the presence of both large and small-scale farming of both subsistence and horticultural farming.

The study population comprised small-scale farmers in Laikipia county. This included famers doing farming in at least five acres of land. The estimated number of small-scale farmers in the county was estimated at 386 (County government of Laikipia, 2021).

Slovin's formula was used to calculate the sample size

$n = N / (1 + N e^2)$

where "n" represents the sample size, "N" represents the population while e is the margin of error

Therefore, in a population of 386 famers,

$n=386/(1+386*0.05^2) =196.43$

The study therefore used a sample of 196 small-scale farmers in Laikipia County. Simple random sampling was used to recruit respondents in the study.

The study used a structured researcher administered questionnaire and an observation checklist to collect data. To establish the reliability of the instruments in this study, data collected in the pre-test phase was analyzed using Cronbach alpha which was employed to check internal consistency. A pre-test was carried out in Isiolo County which borders Laikipia County to the north. A total of 20 small-scale farmers in Isiolo county which is 10% of the main sample was used.

Data collected was cleaned, sorted, coded and entered into a computer using SPSS version 25 for windows. Descriptive and chi-square analysis were used to analyze quantitative data. Descriptive analysis included frequencies, percentages, mean and standard deviation. Chi-square analysis was used to test the association between variables. All tests were conducted using Statistical Package for the Social Sciences (SPSS) version 28 for Windows at 95% confidence interval.

RESULTS

Results are in the form of descriptive, chi-square and regression statistics presented in tables. A total of 196 parctipants took part in the study representing a maximum (100%) response rate.

Participants' Personal Protection Practices

The study sought to assess the personal protection practices among farmers using pesticide in Laikipia County, Kenya. Respondents were asked to indicate their frequency of using nose and mouth masks, face masks, goggles, aprons, gloves, long-sleeved shirts, long pants, and helmets. The results show that 37.8% (*n*=

74) frequently used nose and mouth masks while 28.1% (*n*=55) and an equal number 28.1% (*n*=55) used them sometimes and rarely respectively. For face masks, 30.6% (*n*=60) of the respondents indicated that they used them frequently, while 35.7% (*n*=70) used them sometimes. With regards to goggles, 19.4% (*n*=38) of the respondents always used them while applying pesticides, while 29.1% (*n*=57) rarely used them. The results show that 41.8% (*n*=82) of the respondents used aprons frequently while 20.4% (*n*=40) always used them while applying pesticides. For gloves, 42.9% (*n*=84) of the respondents used them frequently and 4.6% (*n*=9) always. Slightly 50.5% *(n*=99) frequently used long sleeved shirts while for long pants, 36.2% (*n*=71) used them frequently and 23.5% (*n*=46) always used them always. Finally, for helmets, 65.8% (*n*=129) of the respondents never used them.

Table 1: Personal Protection Practices

	Always	Frequently	Sometimes	Rarely	Never
Nose and mouth mask	6.1%	37.8%	28.1%	28.1%	0.0%
Face mask	0.0%	30.6%	35.7%	27%	6.6%
Goggles	19.4%	13.8%	20.9%	29.1%	16.8%
Apron	20.4%	41.8%	26.5%	0.0%	11.2%
Gloves	4.6%	42.9%	31.6%	4.6%	16.3%
Long-sleeved shirts	13.8%	50.5%	16.8%	6.1%	12.8%
Long pants	23.5%	36.2%	23%	4.6%	12.8%
Helmet	0.0%	0.0%	10.7%	23.5%	65.8%

Respondents were observed whether they were wearing several personal protection equipment. Results in table 2 show that 49.5% (*n*=97) wore a nose and mouth mask, 36.2% (*n*=71) wore a face mask, 53.1% (*n*=104) wore goggles, 65.8% (n=129) wore an apron, 63.8% (*n*=125) wore gloves, 67.3% (*n*=132) wore long-sleeved shirts, and 82.7% (*n*=162) wore long pants. However, none of the respondents wore a helmet.

Table 2: Observation Results

	Yes	No
Nose and mouth mask	49.5%	50.5%
Face mask	36.2%	63.8%
Goggles	53.1%	46.9%
Apron	65.8%	34.2%
Gloves	63.8%	36.2%
Long-sleeved shirts	67.3%	32.7%
Long pants	82.7%	17.3%
Helmet	0.0%	100.0%

Respondents who were observed using 5 of the 8 items were deemed to have good practice. As shown in figure 2, majority of the respondents 88.3% (*n*=173) had poor personal protection practices.

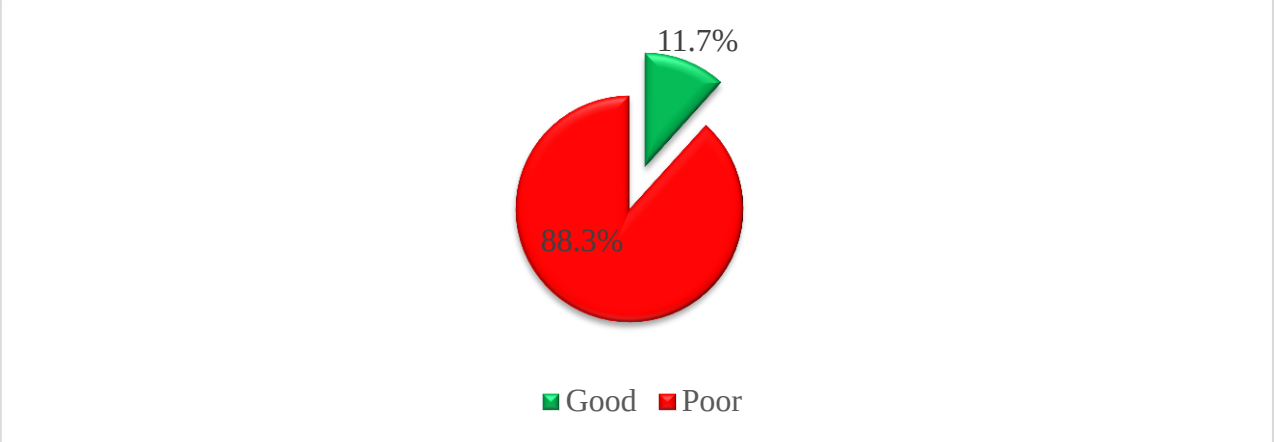

Figure 2: Personal Protection Practices

Barriers to Using Protective Wear

Respondents were also asked to indicate the reasons why they did not use the protective wear listed. For nose and mouth masks, 83.7% (*n*=164) of the respondents indicated that they found them uncomfortable, while 10.7% (*n*=21) indicated no reason for not using them. For face masks, 60.2% (*n*=118) of the respondents indicated heat stress for not using them, while 32.7% (*n*=64) found them uncomfortable. For goggles, the biggest reason for not using them was that they were costly, with 43.9% (*n*=86) of the respondents indicating so. For aprons, 41.3% (*n*=81) of the respondents had no reason for not using them. For gloves, the biggest reason for not using them was that they caused heat stress, with 40.3% (*n*=79) of the respondents indicating so. For long-sleeved shirts, the biggest reason for not using them was that they were uncomfortable, with 34.2% (*n*=67) of the respondents indicating so. For long pants, the biggest reason for not using them was that they were uncomfortable, with 57.1% (*n*=112) of the respondents indicating so. Finally, for helmets, the biggest reason for not using them was that they were costly, with 39.8% (*n*=78) of the respondents indicating so.

Table 3: Barriers to Using Protective Wear

	Costly	Uncomfortable	Heat stress	No reason
Nose and mouth mask	0.0%	83.7%	5.6%	10.7%
Face mask	0.0%	32.7%	60.2%	7.1%
Goggles	43.9%	28.1%	9.2%	18.9%
Apron	0.0%	27.0%	31.6%	41.3%
Gloves	5.6%	23.0%	40.3%	31.1%
Long-sleeved shirts	13.3%	34.2%	25.5%	27.0%
Long pants	0.0%	57.1%	23.0%	19.9%
Helmet	39.8%	21.4%	14.3%	24.5%

Mixing and Spraying During Windy Conditions

Regarding avoiding mixing and spraying during windy conditions, the majority of respondents reported that they rarely avoid it 58.7% (*n*=115), while 28.6% (*n*=56) indicated that they always avoid it. About 12.8% (*n*=25) of respondents reported that they never avoid mixing and spraying during windy conditions.

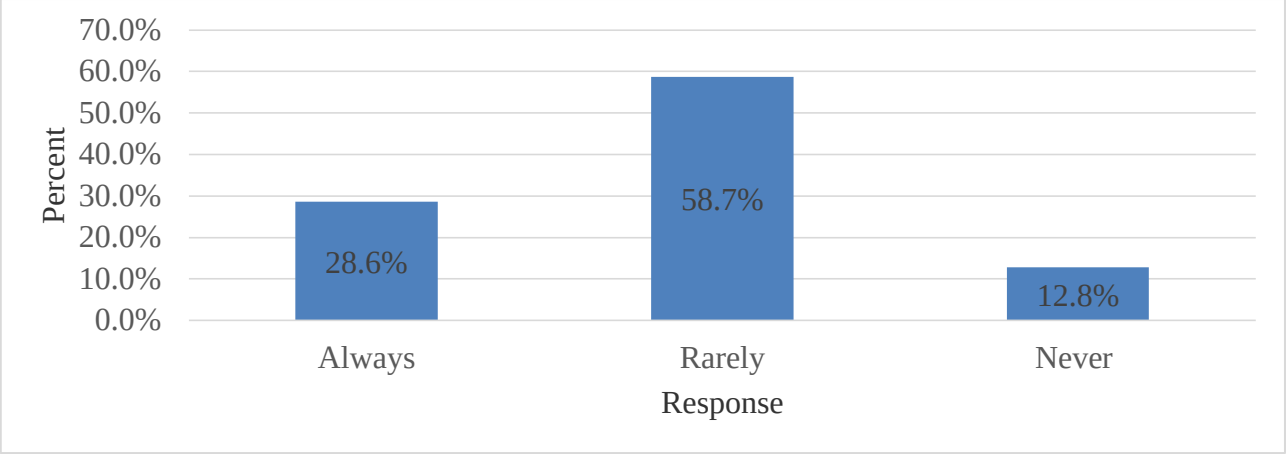

Figure 3: Mixing and Spraying During Windy Conditions

Regarding reasons for spraying during windy conditions, the highest proportion of respondents 40.6% (*n*=76) indicated that they had no reason for spraying when it is windy. 36.9% (*n*=69) reported that it is always windy in their area, while 22.5% (*n*=42) indicated that they find it uncomfortable working under the sun when it's calm. Nine respondents did not provide a valid response.

Table Error! No text of specified style in document.**: Reasons for Spraying on Windy Seasons**

	Frequency	Percent	Valid Percent
It is always windy in the area	69	35.2	36.9
It is uncomfortable working under the sun when it's calm	42	21.4	22.5
I have no reason for spraying when it is windy	76	38.8	40.6
Total	187	95.4	100.0

Washing Hands After Mixing

According to the survey results, 89.3% (*n*=175) of respondents reported that they always wash their hands after mixing, while 4.6% (*n*=9) reported that they rarely do, and 6.1% (*n*=12) reported that they never do.

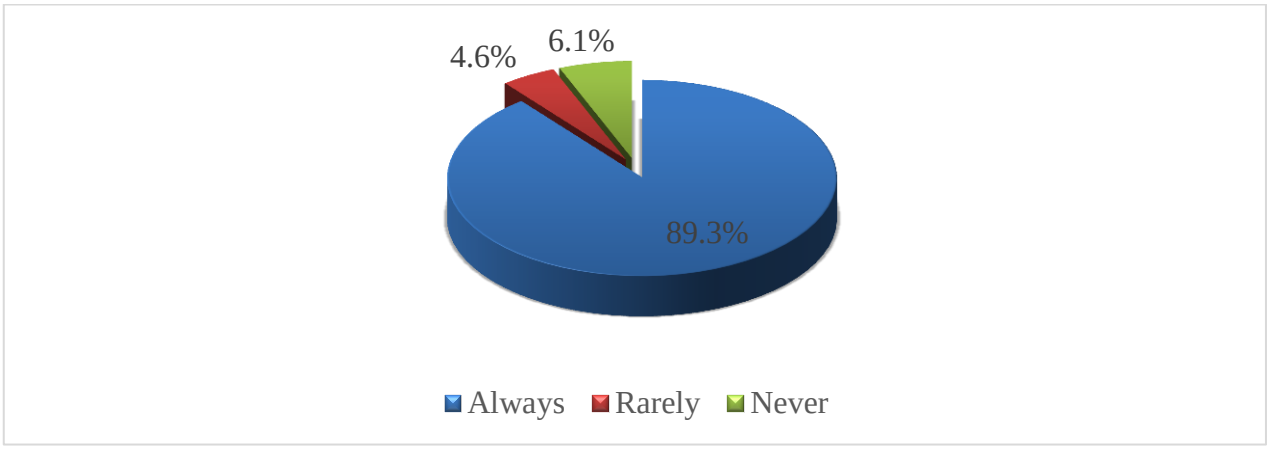

Figure Error! No text of specified style in document.**: Frequency of Washing Hands After Mixing**

Among the respondents who indicated reasons for not washing their hands after mixing, 10.7% (*n*=21) said there was not enough water, while 48% (*n*=94) had no reason for not washing their hands.

Table 5: Reasons for Not Washing Hands

		Frequency	Percent	Valid Percent
	There is not enough water	21	10.7	18.3
	No reason	94	48.0	81.7
	Total	115	58.7	100.0
Missing	System	81	41.3	
Total		196	100.0	

Smoking Cigarettes While Applying Pesticides

According to the survey results, 73.8% (*n*=138) of respondents never smoke cigarettes while applying pesticides to their crops. 13.9% (*n*=26) of respondents rarely smoke cigarettes while applying pesticides, and 12.3% (*n*=23) of respondents always smoke cigarettes while applying pesticides.

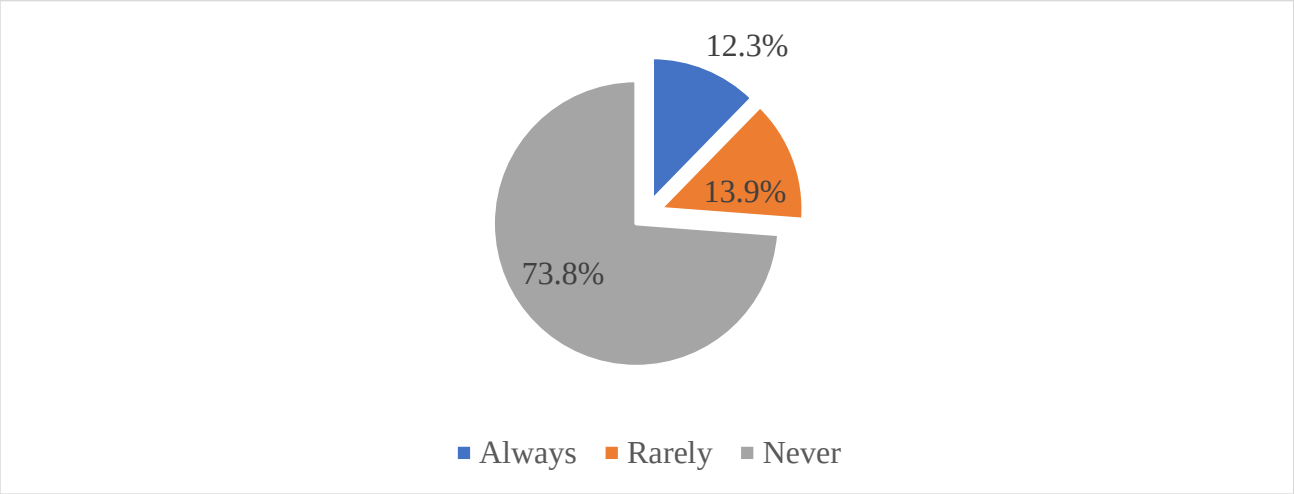

Figure 5: Frequency of Smoking Cigarettes While Applying Pesticides

Among the respondents indicated that they smoke cigarettes while spraying pesticides, with 59.7% (*n*=117) stating that there is no reason for doing so and 7.1% (*n*=14) indicating that they get an urge to smoke while spraying.

Table 3: Reasons for Smoking Cigarettes While Applying Pesticides

		Frequency	Percent	Valid Percent
Valid	Gets urge to smoke while spraying	14	7.1	10.7
	No reason	117	59.7	89.3
	Total	131	66.8	100.0
Missing	System	65	33.2	
Total		196	100.0	

Eating or Drinking While Applying Pesticides

Slightly above half 55.1% (*n*=108) of respondents reported eating or drinking rarely while applying pesticides to their crops, while 44.9% (*n*=88) reported never doing so.

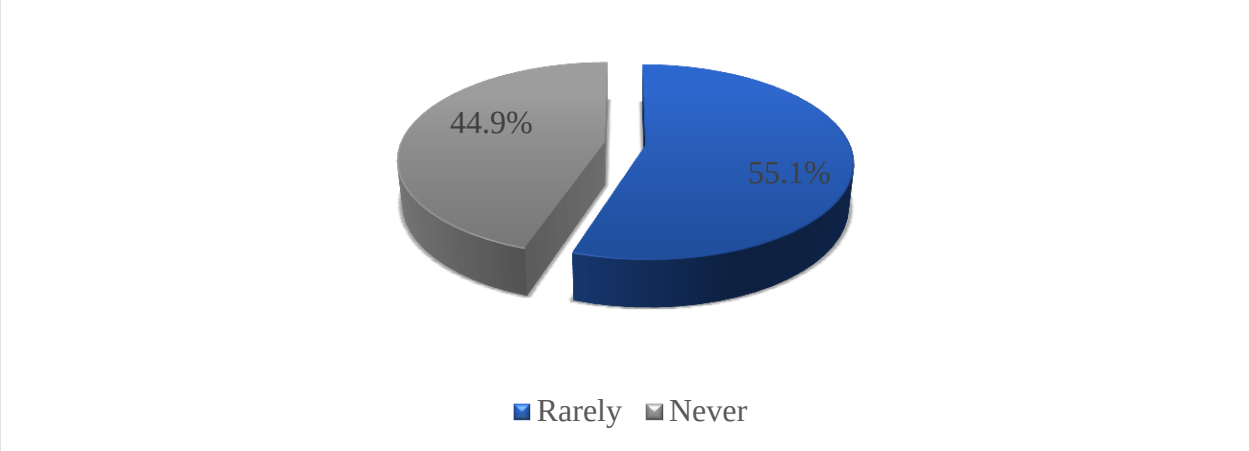

Figure 6: Frequency of Eating or Drinking While Applying Pesticides

Of those who did eat or drink, the most common reason was getting the urge to feed while spraying 19.3% (*n*=32) as shown in table 7.

Table 4: Reasons for Eating or Drinking While Applying Pesticides

		Frequency	Percent	Valid Percent
Valid	Gets urge to feed while spraying	32	16.3	19.3
	No reason	134	68.4	80.7
	Total	166	84.7	100.0
Missing	System	30	15.3	
Total		196	100.0	

Socio-Demographic Characteristics and Personal Protection Practices

The study sought to establish demographic characteristics associated with and personal protection practices among farmers using pesticide in Laikipia County, Kenya. Table 8 shows the socio-demographic characteristics of respondents. A total of 196 small-scale farmers participated in the study, comprising an equal number of males 50% (*n*=98) and females 50% (*n*=98). The majority of respondents were aged between 21 and 30 years 55.6% (*n*=109), followed by those aged 31-40 years 21.9% (*n*=43). The most common level of education completed was secondary education 43.9% (*n*=86) followed by college 39.8% (*n*=78). Most of respondents were married 54.1% (*n*=106), with the rest being either single 41.3% (*n*=81) or divorced/separated 4.6% (*n*=9). Christianity was the dominant religion 83.7% (*n*=164), with the rest being either Muslim 11.7% (*n*=23) or from other religions 4.6% (*n*=9).

In terms of land size, the most common size used for farming was 11-20 acres 55.1%, (*n*=108), followed by 5-10 acres 28.1% (*n*=55). Regarding the main crops produced, tomatoes were the most common 27.6% (*n*=54), followed by onions (26.5%, *n*=52) and potatoes 21.4% (*n*=42). Overall, the study found that the participants were equally divided between male and female, with the majority being between 21 and 40 years old and having completed college or secondary education. The majority of respondents were married and identified as Christians. In terms of farming practices, the most common land size used was 11-20 acres, and the most common crops produced were tomatoes, onions, and potatoes.

Table 5: Socio-Demographic Characteristics of Respondents

Characteristic		N	%
Gender	Male	98	50.0%
	Female	98	50.0%
Age	<20	21	10.7%
	21-30	109	55.6%
	31-40	43	21.9%
	41-50	13	6.6%
	>51	10	5.1%
Education	Primary	32	16.3%
	Secondary	86	43.9%
	College	78	39.8%
Marital status?	Single	81	41.3%
	Married	106	54.1%
	Divorced/separated	9	4.6%
Religion	Christian	164	83.7%
	Muslim	23	11.7%
	Others	9	4.6%
Land size	5-10	55	28.1%
	11-20	108	55.1%
	21-30	33	16.8%
Crops produced	Potatoes	42	21.4%
	Wheat	22	11.2%
	Tomatoes	54	27.6%
	Onions	52	26.5%
	Carrots	26	13.3%

To establish demographic characteristics associated with personal protection practices among farmers using pesticide in Laikipia County, Kenya, chi-square tests were conducted. Gender was not statistically significant ($\chi2 = 0.443$, df=1, p=0.506). Age was statistically significant ($\chi2 = 196.0$, df=4, p=0.000). The age group <20 had the highest proportion of farmers who reported good personal protection practices, while the age group 41-50 had the highest proportion of farmers who reported poor personal protection practices.

Education was also statistically significant ($\chi2 = 133.5$, df=2, p=0.000). Farmers with primary education had the highest proportion of poor personal protection practices, while farmers with college education had the highest proportion of good personal protection practices. However, religion was not statistically significant ($\chi2 = 5.084$, df=2, p=0.079).

Land size was statistically significant ($\chi2 = 32.865$, df=2, p=0.000). Farmers with land size between 5-10 acres had the highest proportion of poor personal protection practices, while farmers with land size between 11-20 acres had the highest proportion of good personal protection practices. Crops grown were statistically significant ($\chi2 = 48.043$, df=4, p=0.000). Farmers who grew wheat or tomatoes had the highest proportion of poor personal protection practices, while farmers who grew potatoes or onions had the highest proportion of good personal protection practices.

Table 6: Demographic Characteristics Associated with Personal Protection Practices

Demographic	Categories	Practice		Chi-square
		Good	Poor	
Gender	Male	88	10	$\chi2$ =0.443, df=1, p=0.506
	Female	85	13	
Age	<20	21	0	$\chi2$ =196.0, df=4, p=0.000
	21-30	109	0	
	31-40	43	0	
	41-50	0	13	
	>51	0	10	
Education	Primary	9	23	$\chi2$ =133.5, df=2, p=0.000
	Secondary	86	0	
	College	78	0	
Religion	Christian	141	23	$\chi2$ =5.084, df=2, p=0.079
	Muslim	23	0	
	Others	9	0	
Land size	5-10	42	13	$\chi2$ =32.865, df=2, p=0.000
	11-20	108	0	
	21-30	23	10	
Crops grown	Potatoes	42	0	$\chi2$ =48.043, df=4, p=0.000
	Wheat	12	10	
	Tomatoes	41	13	
	Onions	52	0	
	Carrots	26	0	

Knowledge and Personal Protection Practices

The sources of information on personal protective wear for applying pesticides include government agricultural extension workers 31.6% (*n*=62)), radio/TV stations 35.7% (*n*=70), internet 9.2% (*n*=18), and pamphlets attached to the pesticide containers (23.5% (*n*=46).

Table 10: Sources of Information on Personal Protective Wear

		Frequency	Percent
Valid	Government Agricultural extension workers	62	31.6
	Radio/TV stations	70	35.7
	Internet	18	9.2
	Pamphlets attached to the pesticides containers	46	23.5
	Total	196	100.0

The results show that the largest proportion of respondents 60.2% (*n*=118) agreed that pesticides cause cancer. Similarly, 45.9% (*n*=90) agreed that working in the farm exposes one to cancer, while 36.2% (*n*=71) did not know. In terms of protective clothing, a large majority 84.2% (*n*=165) agreed that wearing protective clothing while applying pesticides helps prevent cancer. Regarding the importance of reading first aid instructions on the pesticide label before use, 76% (*n*=149) of the respondents agreed that it is important. Finally, 60.7% (*n*=11) of the participants agreed that it is important to use personal protection during mixing and application of pesticides.

Table 7: Knowledge on Personal Protection Practices

	Strongly agree	Agree	Disagree	I don't know
Pesticides cause cancer	11.7%	60.2%	0.0%	28.1%
Working in the farm exposes one to cancer.	6.1%	45.9%	11.7%	36.2%
Wearing protective clothing while applying Pesticides help from causing cancer	0.0%	84.2%	4.6%	11.2%
It is important to read the first aid instructions on the label before using the pesticide	0.0%	76.0%	19.4%	4.6%
It is important to use personal protection during mixing and application of pesticides?	10.2%	60.7%	7.1%	21.9%

Items in table 11 were summed up. Respondents who scored 60% and above were deemed to knowledgeable. Slightly above half 67.3% (*n*=132) of the respondents were knowledgeable on personal protection as shown in figure 7.

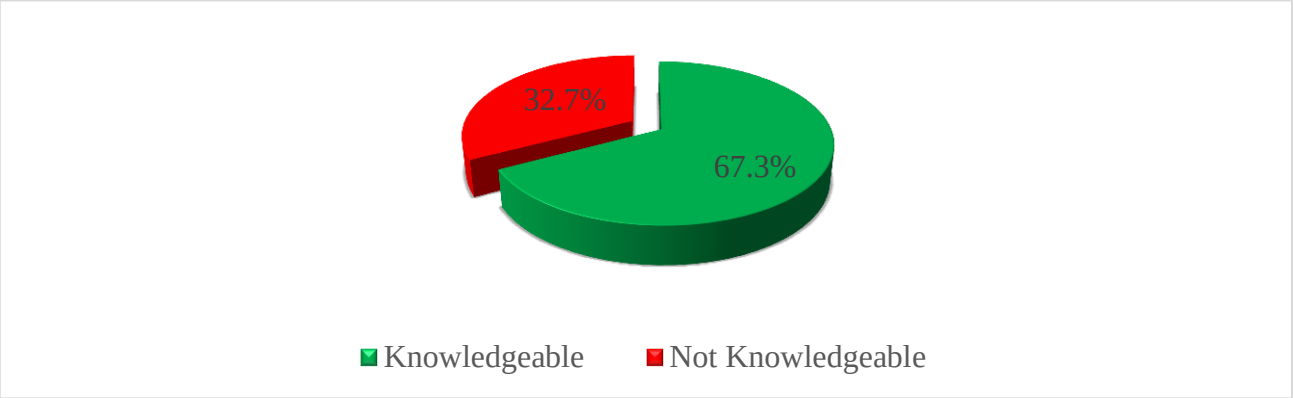

Figure 7: Knowledge on Personal Protection Practices

To determine the association between knowledge and personal protection practices, a chi-square test was conducted. Knowledge was statistically significant ($\chi 2$=6.751, df=1, *p*=0.009). The odds ratio for knowledge was 3.110, indicating that farmers with high knowledge were 3.1 times more likely to have good personal protection practices than those with low knowledge.

Table 8: Association Between Knowledge and Personal Protection Practices

		Practice		Chi-square
		Good	Poor	
Knowledge	Knowledgeable	122	10	$\chi 2$ =6.751, df=1, p=0.009
	Not knowledgeable	51	13	

Attitude towards Personal Protection

The largest percentage of respondents 87.2% (*n*=171) agreed that wearing gloves can reduce exposure to pesticides, with indicating agreement. Similarly, the majority agreed that wearing face masks 75.5% (*n*=148), glasses/goggles 61.2% (*n*=120), and overalls 65.3% (*n*=128) can reduce exposure to pesticides. Slightly above half 52% (*n*=102) of the respondents agreed that pesticides can affect the environment.

Table 9: Attitude towards Personal Protection

	Disagree	Uncertain	Agree	Strongly agree
Wearing gloves can reduce exposure to pesticides	6.1%	6.6%	87.2%	0.0%
Wearing face masks can reduce exposure to pesticides	6.1%	18.4%	75.5%	0.0%
Wearing glasses/goggles can reduce exposure to pesticides	12.2%	26.5%	61.2%	0.0%
Wearing overall can reduce exposure to pesticides	6.1%	28.6%	65.3%	0.0%
Pesticides can affect the environment	12.2%	31.1%	52.0%	4.6%

Items in table 13 were summed up. Respondents who scored 60% and above of the final score were deemed to have a positive attitude while the rest were classified as having a negative attitude. As shown in figure 8, majority of the respondents 75% (*n*=147) had a negative attitude towards personal protection

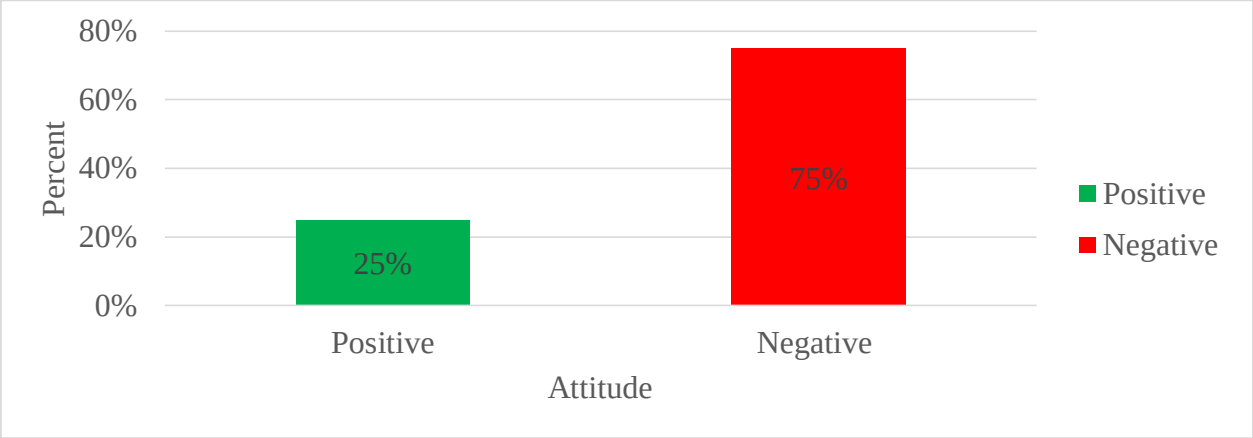

Figure 8: Attitude towards Personal Protection

A chi-square test was carried out between attitude and personal protection practices among farmers using pesticide. Attitude was statistically significant ($\chi 2$ = 13.809, df=1, p < .001). The risk estimate analysis showed that the odds of having poor personal protection practices were 3.9 times higher (95% CI = 1.827 to 8.326) among farmers with a negative attitude compared to those with a positive attitude, among those with poor personal protection practices.

Table 14: Association of attitude and personal protection practices

		Practice		Chi-square
		Good	Poor	
Attitude	Positive	36	13	$\chi 2$ =13.809, df=1, p=0.000
	Negative	137	10	

Regression Analysis

To establish determinants of cancer preventative behaviors among farmers using pesticide in Laikipia County, Kenya, regression analysis was carried out. Variables which were significant in the chi-square analysis were used. The results are presented in this section. Table 15 shows the model summary. The R value in the table represents the correlation coefficient, which shows the strength and direction of the relationship between the independent variables and the dependent variable. In this case, the R value of .883 indicates a strong positive relationship between the independent variables and the personal protection practices. The R Square value (.780) indicates that 78% of the variation in the personal protection practices can be explained by the independent variables in the model. The Adjusted R Square (.773) adjusts the R

Square value for the number of predictors in the model. The difference between R Square and Adjusted R Square is small, indicating that the model is not overfitting the data.

Table 10: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.883[a]	.780	.773	.154

The ANOVA table 16 shows that the regression model is statistically significant (F=111.944, p<0.001), meaning that the independent variables in the model are significantly associated with the dependent variable. The regression model accounts for a significant proportion of the variance in personal protection practices, as indicated by the R square value of 0.780, which suggests that approximately 78% of the variability in personal protection practices can be explained by the independent variables in the model.

Table 11: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.843	6	2.640	111.944	.000[b]
	Residual	4.458	189	.024		
	Total	20.301	195			

Table 17 show the coefficients of each variable. The results demonstrate that age (p < 0.001), level of education (p < 0.001), land size (p < 0.001) and attitude (p < 0.001) were statistically significant. The beta values of the significant variables in the regression model were as follows: Age (B = 0.222, p < 0.001), Level of education (B = -0.130, p < 0.001), Land size (B = 0.125, p < 0.001), and Attitude (B = -0.278, p < 0.001). The positive beta value for age indicates that older farmers were more likely to engage in cancer preventative behaviors using personal protective equipment. The negative beta value for level of education suggests that farmers with higher levels of education were less likely to engage in personal protection practices. The positive beta value for land size indicates that farmers with larger land sizes were more likely to use personal protective equipment. Lastly, the negative beta value for attitude suggests that farmers with a negative attitude towards personal protection practices were less likely to engage in cancer preventative behaviours.

Table 12: Coefficients

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.014	.084		12.065	.000
	Age	.222	.016	.651	13.770	.000
	Level of education	-.130	.025	-.288	-5.305	.000
	Land size	.125	.023	.257	5.436	.000
	Crops Produced	.020	.012	.082	1.599	.111
	Knowledge	.021	.023	.033	.909	.364
	Attitude	-.278	.038	-.374	-7.288	.000

SUMMARY

The study sought to assess the personal protection practices among farmers using pesticide in Laikipia County, Kenya. Majority of the respondents 88.3% (n=173) had poor personal protection practices. The study sought to establish demographic characteristics associated with and personal protection practices among farmers using pesticide in Laikipia County, Kenya. Education level, land size and crops grown were statistically significant. The study sought to determine the association between knowledge and personal protection practices among farmers using pesticide in Laikipia County, Kenya. Slightly above half of the

respondents were knowledgeable on personal protection. Chi-square test showed a that knowledge was statistically significant. The study also sought to establish the association between attitude and personal protection practices among farmers using pesticide in Laikipia County, Kenya. Majority of the respondents had a negative attitude towards personal protection. Attitude was statistically significant.

CONCLUSION AND RECOMMENDATIONS

Personal protection practices among farmers using pesticide in Laikipia County, Kenya are poor. There was a low utilization of nose and mouth mask, face mask and helmets. Discomfort was the main reason given for not using many of the Personal protection equipment. In addition, slightly above half of respondents reported eating or drinking rarely while applying pesticides to their crops.

Demographic characteristics are associated with and personal protection practices among farmers using pesticide in Laikipia County, Kenya. Specifically, age, level of education, land size and crops grown were statistically significant. Older farmers (above 40 years), those with below secondary education, those with small pieces of land (<10 acres) and those who grew wheat or tomatoes were more likely to have poor personal protection practices.

Knowledge was statistically significant. Farmers who are knowledgeable about personal protection practices are more likely to use PPE than those who are not knowledgeable. Attitude was also statistically significant. Farmers with a positive attitude regarding personal protection practices may be more likely to use PPE than those with a negative attitude.

There was a poor utilization of personal protection practices among farmers using pesticides. It is recommended that the county government of Laikipia ought to provide farmers with access personal protective equipment, as well as training and education on how to use them correctly.

Given the association between level of education and personal protection practices, there is a need for targeted education and awareness campaigns to improve knowledge of personal protection practices among farmers. This can be achieved through workshops, training programs, and the dissemination of educational materials on the safe handling and use of pesticides.

The study shows that a positive attitude towards personal protection practices can improve the utilization of PPE among farmers. Therefore, it is important to promote a positive attitude towards personal protection practices among farmers through community-based campaigns and sensitization programs.

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