Original Research Article

DETERMINANTS OF COMPLIANCE TO SAFETY MEASURES IN THE USE OF PESTICIDES AMONG SMALL SCALEFARMERS IN MIIRYA SUBCOUNTY, MASINDI DISTRICT

ABSTRACT

There is a global challenge mainly manifested in developing economies where compliance to safety measures in the use of pesticide especially by farmers is very low resulting in health challenges. This study therefore aimed at assessing the determinants of compliance to safety measures in the use of pesticide among local farmers in Miirya Sub County of Masindi District, Uganda.
The objectives of the study were to identify the individual and institutional determinants related to compliance, then establish the level of compliance and finally determine the association between the different factors and compliance to safety measures in the use of pesticides among small scale farmers.

Systematic random sampling was used to select the respondents, and a research-administered questionnaire was used to collect data. Data was analysed using both descriptive and inferential statistics, at 95% level of significance. Chi square analysis and binary logistic regression analysis were used to test for significance.

The study found out that the level of compliance to safe measures in the use of pesticides among farmers was low (30.2%). Findings also showed that the majority of the respondents were 40 years and above (66.7%), primary graduates (61.8%), married (84.0%), high knowledge level (94.8%), negative attitudes towards safe use of pesticides (70.8%), high risk perception (91.7%), no influence of peers (57.9%), using pesticide toxicity classes II and III (66.7%), never been trained on PPEs (53.2%), never received inspection in the past year (70.5%), and SOPs in place (81.4%).The bivariate logistic regression analysis indicated that farmer's attitude; risk perception and SOPs in place were significantly associated with compliance to safe measures in the use of pesticides among farmers ($p < 0.05$).

The study recommends that there is need for local farmers to be made aware of the risks attached to improper use of pesticides and the reinforcement of provisionsand adherence tostandard operating procedures by the relevant authorities.

KEY WORDS: Compliance to use of pesticides, small scale farmers, agricultural pesticides

INTRODUCTIONAND BACKGROUND

Globally, the use of pesticide is growing day by day, but the adequate compliance to safety measures of pesticide use in developing economies is still low and farmers are directly exposed to chemicals which have a negative impact on their health (FAO 2022). It is estimated that every year there is a 50 – fold increase in global pesticide consumption; and 2.5 million tons of pesticides are used each year; out of which about 69% is used in Europe and the US alone(Alvanja M. C. 2009. UNEP 2022, Directorate General for External Policies 2021).However, Miller &Spoolman (2011) reported earlier that every year the pesticides used by farmers are 10 - 100 times more toxic than those used in the previous year. They further noted that over 80% of farmers worldwide do not comply to the safety measures of handling these pesticides(Miller &Spoolman 2012). These statistics are however assumed to be even higher in developing countries. In addition, in developing countries, concerns about the adverse effects of pesticide on health are increasing, especially because of low educational level and unfavourable working conditions. A study in Kuwait revealed that over 70% of the farmers were not compliant to the standard safety measures of pesticide use, for example, they did not read or follow pesticide label instructions (Jallow *et. al.,* 2017). In Vietnam, non-compliance to safe pesticide measures was found to be 67% (Kien, 2015). Countries like Nepal, despite the fact that pesticide consumption is increasing by about 10%–20% per year adherence levels to safe measures of pesticide use is very low at 15% (Khanal & Singh, 2016).

In Africa, despite the popularity and extensive use of pesticides, there are noted serious concerns about health risks arising from the exposure of farmers when mixing and applying pesticides or working in treated fields and from residues on food and in drinking water for the general population(Damals*et. al.,* 2011). Problems caused by pesticides are as a result of excessive, unscientific, and ineffective applications, which have resulted in residue on agricultural products, increased production costs, and environmental pollution (Tudi *et. al.,* 2021). In a number of African countries, pesticide use has been noted with attached health impacts on the farmers, attributed to non-compliance to safety measures of pesticide handling (Kwame Osei Boateng *et. al.,* 2023). For example, in Ghana, Afari-Sefa *et. al.,* (2015) in highlight from their study that farmers experienced health impacts of pesticides after application; and these farmers were found not taking into consideration health protection when applying the pesticides. According to this scholar, the level of adherence to safety measures of pesticide use was found to be as low as 11%. Similarly, Kwadzo*et. al.,* (2015) also noted that farmers in Nigeria were exposed to health risk factors of skin/eye irritation due to inadequate knowledge on personal protective equipment use during pesticide application; while those who had some training and education on pesticide usage had low levels of health effects.

In East Africa, the problem of compliance to safety measures of pesticide handling is almost the same. For example, in Tanzania, it was establishedthat about one-third of the farmers applied pesticides in mixtures of various doses, and about 68% of the farmers reported having felt sick after routine pesticides application(Cox Peter 1985, Massomo 2019). While in Rwanda, it is noted that over 95% of farmers do not comply with minimum standards for safe pesticide use and 80% of farmers store pesticides in their

homes without personal protection measures(Areco Rwanda Nziza2020; Louise Wipfler and Mechteld ter Horst 2018).

Several factors have been identified in previous investigations associated with farmers' pesticide exposure. Some of these factors include the lack use of appropriate equipment along with taking protective activities that are needed during pesticide handling, insufficient knowledge of the law, and lack of training (Afshari *et. al.,* 2021). Other scholars like Khanal & Singh (2016) identified institutional determinants like pesticide toxicity class, training of farmers on PPE, inspections by agricultural officers, standard operational procedures in place and accessibility to PPE as among those factors associated with compliance to safe measures of pesticide use.

In Uganda, unlike the practice in several other developing countries, small-scale farmers do not use the most hazardous pesticides of WHO class 1a and 1b. However, the use of WHO class II pesticides and those of lower toxicity is seen in combination with inadequate knowledge and practices in safe use of pesticides among the farmers(WHO 2020; Sekimpi*et. al.,* 2021)). These pose a danger of acute intoxications, chronic health problems and environmental pollution. Therefore, training of farmers in IPM methods, the practicing of proper hygiene and the use of personal protective equipment (PPE) when handling pesticides should be promoted (Oesterlund *et al*., 2014). Unfortunately, no study has been done to document the level of compliance to safe measures of pesticide use in this part of Uganda. It was therefore necessary to conduct a study on the compliance to safe measures in use of pesticides among farmers.

Statement of the Problem

Pesticides have become an integral part of present-day farming, and play a major role in increasing agricultural productivity(Tudi *et. al.,* 2021). However, the indiscriminate and extensive use of pesticides represents one of the major environmental and public health problems all over the world, and this is due to noncompliance to safe use of pesticides. Despite the vast interventions put in place by the government of Uganda through the ministry of agriculture, including training of farmers at local level about safe measure of pesticide use this problem has remained existing in the region In Uganda, compliance to safe measures of pesticide use is still very challenging,while compliance to safe measure of pesticides in Uganda is up to 48%. (PROBICOU, 2013). In Masindi including Miiryasub county, compliance level is far below at 9% (Sekimpi et al., 2021). Inappropriate application of pesticides can have negative effects on human health (Öztaş et al., 2018). Despite the vast interventions put in place by the government of Uganda through the ministry of agriculture, including training of farmers at local level about safe measures of pesticide use, this problem has remained existing in the region (PROBICOU 2013; Semalulu*et. al.,* 2005). It is therefore not clear whether pesticide knowledge, attitude, level of education riskperception among the farmers has a resultant effect on farmers compliance to safe measures in the use of pesticides among the farmers, thus a need for research.

The aim of thisstudy was to assess the determinants of compliance to safe measures in the use of pesticides among farmers in Miirya Sub County, Masindi District, Uganda. Specifically, the study

- identified the different factors related to compliance to safe measures in the use of pesticides among farmers in the sub-county;
- established the level of compliance to safety measures in the use of pesticides among farmers in thesub-county;
- determined the association between the different factors and compliance to safe measures in the use of pesticides among farmers.

Theoretical and Conceptual Framework

The study wasguided by the Health Belief Model (HBM) (Cater *et. al.*, 2006). This is a psychological model that attempts to explain why people would or would not use available services to prevent anticipated future complications arising because of neglected services prior to the complication.
Although HBM is considered for this study of compliance to safe measures in the use of pesticides, the model does not address certain individual and institutional factors. Using this theoretical frame work, however, a conceptual framework was developed underpinning this study.

The logic underlying the dependent variable in this analysis is that safety practices is a function of set of independent variables. A conceptual model is developed on the basis of their relationship between compliance variables and safety measure practices.Compliance factors as reflected in the conceptual framework, that is: individual factor such as age, level of education, knowledge of pesticides, attitude, peer influence and risk perception such as trainings, pesticide toxicity class and government policy which focuses on guidelines and enforcements. These in the ideal situation can affect the level of compliance to safe measures in the use of pesticides thus exposure of farmers to risks associated with unsafe use of pesticides.
There are also institutional factors such as pesticide toxicity class, training of farmers on PPE, inspections by agricultural officers, standard operational procedures in place, and accessibility to PPEs.

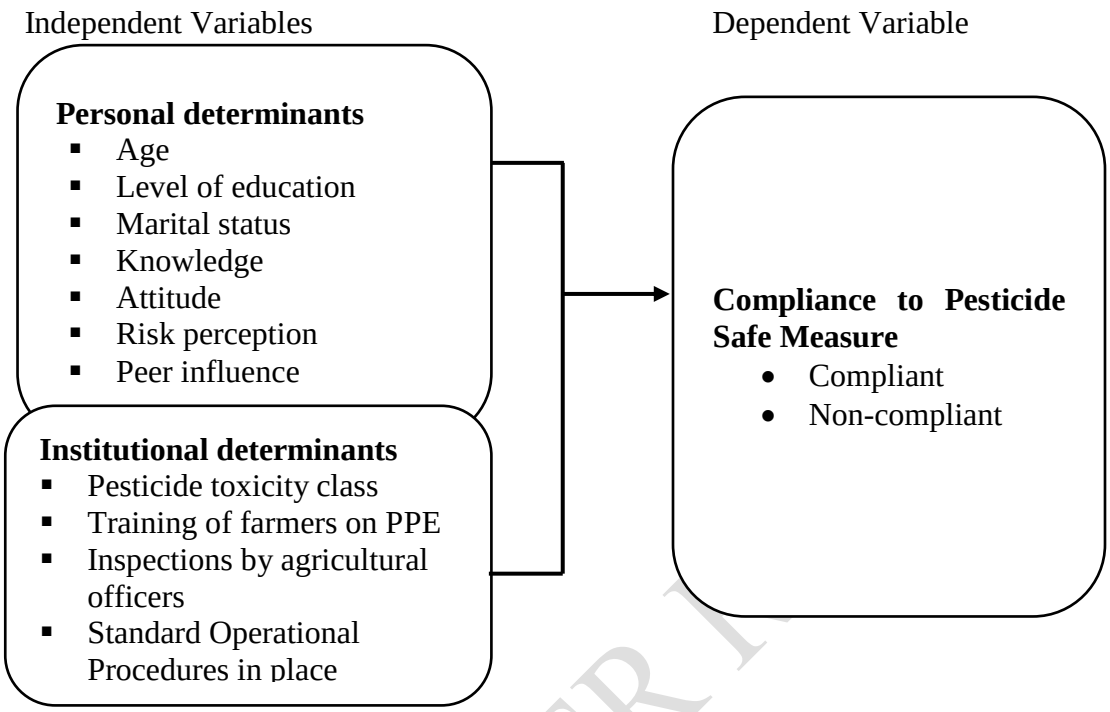

Figure 1: Conceptual Framework.

Brief Literature review and Identified Gaps

The literature was reviewed regarding a number of variables related to compliance to safe measures of pesticide use among farmers. The variables that guided the review included age of respondent, level of education, marital status of respondent, knowledge, attitude, risk perception, pesticide toxicity class, training of farmers on PPE, inspections by agricultural officers, standard operational procedures in place and accessibility to PPE. A number of gaps were identified in the review, as summarised below.

A recent scholar used the theory of planned behaviour which does not address the time frame between "intent" and "behavioural action" (Wang & Chu, 2017). The current study hence adopted health belief model, to cater for the influence of institutional factorsand the individual behaviour issue solved.

Regarding sample size determination, some scholars used the expected frequency of 50% to determine the sample size (Despotović *et. at.,* 2023), being that the target population was unknown, and current study usedCochran formulato determine the sample size since the target population is known/ definite. Some scholars used a significance level of 1%

(Thapa *et al.,* 2021), hence a need to do another study adopting a significance level of 5%.

When looking at study subjects, some scholars only focused on rice growers (Ndayambaje *et al.,* 2019), only arable crop farmers (Abegunrin *et. al.,* 2020), some only focused on maize farmers (Yalley, 2019), some only considered on farm workers on the palm oil plantations (Khan *et. al.,* 2019), some focused on vegetable farmers only(Bilaliib *et. al.,* 2022), some conducted the studies among pesticide retail firms (Lekei *et. al.,* 2014) other than the farmers who are the primary users of these pesticides. The current study included all farmers regardless of what they specialized in growing/ farming.

On the data collection processes, some scholars used in-depth interviews and observations on-farm to collect the data from the farmers (Abegunrin *et. al.,* 2020; Jallow *et. al.,* 2017), and left out the quantitative data which would have been used to obtain statistical evidences of the intriguing factors associated with compliance to safe measures of pesticide use; and some scholars used focused group discussions and pre-test surveys, to collect data from the respondents (Jianjun *et. al.,* 2016), which could only be appropriate in gathering qualitative data but not quantitative data.

In reference to data analysis, some scholars used correlation analyses to establish the existing relationships occurring between the response and explanatory variables (Öztaş *et. al.,* 2018); some scholars used correlation analyses (Miyittah *et. al.,* 2020) to establish the existing relationships occurring between the response and explanatory variables. Some scholars analysed the data in the study using only descriptive analyses (Ndayambaje *et. al.,* 2019), which could not clearly establish the statistical significance existing between the different independent variables and safe measures of pesticide use. Since the current study has only categorical variables, it hence used chi square analysis/ Fisher's exact test and binary logistic regression model.

The current study therefore focused at bridging the identified gaps above, to assess the determinants of compliance to safe measures in the use of pesticide among farmers in Miirya Sub County, Masindi District.

METHODS

The researchers used a community based cross-sectional research design with a quantitative approach earlier described by Levin (2006) and Setia (2016), and a quantitative study approach (Apuke (2017) using a semi-structured questionnaire.

The study was carried out in Miirya sub-county, Masindi District, located in western part of Uganda. The sub-county is found in Buruli County, and it is made up of three parishes, and 36 villages. The parishes in Miirya sub-county are Bigando, Isimba and Kigulya, and the sub-county is bordered by Kimengo sub-county in the south, Nyangahya sub-county in the south west, Karujjubu sub-county in the North West, Masindi central in the west, Pakanyi sub-county in the north, and Kiryandongo district in the east. The sub-county and the entire district is made of people whose main occupation is substance farming, mainly on small scale. Since the study focuses on farmers, it was done in Mirya where the major activity is farming(Masindi District Local Government, 2020) Many of these farmers have been enrolled on the sub county extension services that were introduced in the region by the National Agricultural Advisory Services (NAADS) and Operation Wealth Creation (OWC) in the recent past (Masindi District Local Government, 2020), which was aimed at commercialization of agriculture in the region.

According to Masindi District socio-economic report of 2020, Miirya sub-county has a total population of 4408 people (Masindi District Local Government, 2020). This includes farmers as well as other people doing other form of work other than farming.

Target Population and Sample size

The target population are the farmers in Miirya sub-county in the three parishes of Bigando, Isimba and Kigulya parishes and they are 3562 farmers (Masindi District Local Government, 2020). The majority of these farmers are carrying out substance farming on a small scale.

The Sample Sizeof 387 was determined using Cochran formula, which allows calculating ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population.

The sample from each parish was determined based on the proportionate sampling allocation criterion by Kothari (2004).

Table 1: Sampling Frame

Parish	Total population	Population of farmers	Sample size	Households
Bigando	1651	1255	136	1439
Isimba	989	788	86	756
Kigulya	1768	1519	165	1482
Total	4,408	3,562	387	3,677

Sampling Procedure

In this study, systematic random sampling technique was employed to select study participants. This selected technique ensured that all respondents have an equal chance (probability) to participate in the study.

The selection of the farmers was done on household level. A sampling interval (z) was obtained by dividing the total number of farmers in Miirya sub-county by the sample size. For this study, a sampling interval of z = 9 was used. This implies that after obtaining the starting respondent from the first household, every farmer found on the 9^{th} household was selected for inclusion into the study in each of the parishes, until when the required sample size is obtained.

For households that were found having more than one respondent, asimple random sampling using raffle method was used to select only one respondent. While for cases where a household was found with no eligible respondent, the next neighbouring household was considered.

The study used a questionnaire survey method for data collection and it had both closed and open-ended questions. Measures to ensure quality included validity and reliability checks.

On top of getting relevant the institutional review board (IRB) authorization, all the required Covid 19 PPE and standard operating procedures were dully followed.

RESULTS AND DISCUSSION

A total of 387 participants were targeted and all of them responded providing 100% response rate.

PERSONAL DETERMINANTS

The personal determinants related to compliance to safety measures in the use of pesticides among farmers included age, education level, marital status, knowledge, attitude, risk perception and peer influence. Descriptive statistics were employed to analyse the data presented in Table 2 below.

Table 2: Personal Determinants Influencing Compliance to Safety Measures in the Use of Pesticides Among Farmers

Variables	Categories	Frequency	Percentage
Age group	<30years	28	7.2
45.0±11.1 year	30-39years	101	26.1
	40-49years	129	33.3
	≥50years	129	33.3
Education Level	None	35	9.0
	Primary	239	61.8
	Secondary	98	25.3
	Tertiary/University	15	3.9
Marital Status	Married	325	84.0
	Unmarried	62	16.0
Knowledge Level	Low	20	5.2
	High	367	94.8
Attitude	Negative	274	70.8
	Positive	113	29.2
Risk Perception	Low Risk	32	8.3
	High Risk	355	91.7
Peer Influence	No	224	57.9
	Yes	163	42.1

The majority (66.7%) of the study respondents were aged 40 years and above, implying that most of the farmers who participated in the study were of older age. In contrast to study findings above, findings from another study (Kien (2016), highlighted that slightly above average proportion of the farmers in the study (52.9%) were of average age bracket between 31 to 40 years. Whereas, in a similar way, a study done in Nepal about

knowledge on pesticide management practices and factors associated with adoption of PPEs among farmers, revealed that the mean age of farmers who participated in the study was found to be 39.52 years, and most of the respondents were belonging to the age bracket of 36 – 50 years (41.17%) (Thapa *et al.*, 2021).

The results in Table 2further show that the majority (61.8%) of the farmers were primary school graduates. This implies that most of the farmers in the study had low education levels. This can be attributed to the general belief in the area where it is usually assumed that individuals with higher levels of education tend to do white collar jobs, and leave farming for only those individuals with lower levels of education. Similar to study findings above, a related study in the central region of Ghana(Miyittah *et. al.*, (2020)found that the majority (50.7%) of farmers were primary graduates. This different from studies in Turkey (Öztaş *et. al.*, (2018)where the majority of the farmers (53.3%) were high school graduates.

The majority (84.0%) of the respondents were married. This is related to the fact that most of the farmers were of older age.Earlier studies (Kien*et. al.*, (2016); Yalley 2019) in Vietnam and Ghana respectively, also showed that majority(78.2% and 72%) of the farmers were married.

Most (94.8%) of the farmers have high knowledge levels regarding safe measures of pesticide use. This is because the farmers in the region were given training at local level about safe measures of pesticide use. This was the same case in Ghana as reported by Miyittah *et. al.*, (2020), but in Vietnam the levels of knowledge were reported to be lower (37.6%)(Despotovic *et. al.*, 2023; Kiene *et. al.*, 2016).

Concerning attitude, most (70.8%) of the farmers have a negative attitude towards safe measures of pesticides use. This implies that most of the farmers are not very concerned about following guidelines of safe use of pesticides, like reading the precautions on pesticide labels and use of PPEs. Other earlier studies in Nigeria and China (Abegunrin *et. al.*, 2020). Wang and Chu (2017) reported major limitations of safety practices due to poor attitude towards implementation of the safety practices.

However, a large majority (91.7%) of the farmers had a perception that there is a very high risk while using pesticides. This implies that most of the farmers had fear of acquiring the negative effects of pesticides when using them. This could have been caused by the knowledge the farmers acquired from the local trainings they received, where the trainers cautioned them against the negative effects of pesticides if improperly used.This inevitably created a high-risk perception among the farmers. These findings are similar to those earlier reported by Wang and Chu (2017) in China.
It has been earlier strongly advised (Tago *et. al.*, (2014) that pesticide policies need to specifically clarify the motivation for regulation and the role of risk perceptions as far as benefitcost analysis is concerned.

Finally on peer influence, the results (Table2 above) show that the majority (57.9%) of the respondents are not influenced by their peers on the use of safe measures of

pesticides. This could because these farmers had received knowledge of pesticide use from earlier trainings, and hence it is assumed they depend on the influence of acquired knowledge from the trainings rather than influence of peers. Studies undertaken earlier in China (Jianjun *et. al.*, 2016), agree with the results of this study.

INSTITUTIONAL DETERMINANTS

The study also focused on the institutional factors related to compliance to safe measures in the use of pesticides among farmers. These included pesticide toxicity class, training on personal protective equipment, receipt of inspection in the past year and SOPs in place and these are presented in Table 3 below.

Table 3: Institutional Determinants Influencing Compliance to Safe Measures in the Use of Pesticides Among Farmers

Variable	Categories	Frequency	Percentage
Pesticide Toxicity Class I	Class I: Bright Red, Skull-bones	86	22.2
	ClassII: Bright Yellow	133	34.4
	ClassIII: Bright Blue	125	32.3
	ClassIV: Bright Green	29	7.5
	ClassV: Flammable	14	3.6
Training on PPEs	No	206	53.2
	Yes	181	46.8
Received inspection in the past year	No	273	70.5
	Yes	114	29.5
SOPs in Place	No	72	18.6
	Yes	315	81.4

Table 3 results show that a higher proportion (88.9%) of the farmers were using Classes I, II or III toxicity levels. This implies that most of these farmers were using relatively high hazardous pesticides. This is closely related to reports given by previous researchers in Ghana and Tanzania (Yalley 2019; and Lekei *et. al.*, 2014) respectively.

The results also show that a bigger proportion (53.2%) of the farmers had never received any training on the use of personal protective equipment (PPEs). This finding may explain why the farmers in the study had negative attitudes towards safe measures of pesticides use, since they are assumed not to know the significance of wearing PPEs and how to wear them. On the other hand, it is also likely that the negative attitudes towards safe use of pesticides might have discouraged these farmers against attending the PPE

trainings. The above results are also similar to anearlier study in Malaysia by Khan *et. al.*, (2019).

In the past year, the majority (70.5%) of the farmers had never received any kind of inspection on pesticide use. This implies that most of these farmers were using the pesticides without any monitoring/ inspection on whether they are following the right procedures. This also explains why most of the farmers had negative attitudes towards safe use of pesticides, since there was a gap in monitoring of compliance.

These results are in agreement with studies byBilaliib *et. al.*, (2022)and Lekei*et. al.*, (2014) undertaken in Tanzania. They further recommended that relevant inspection personnel and policy makers should put in place programs focused towards sensitizing farmers on correct usage of pesticide and strengthen the enforcement mechanisms to improve compliance to safe pesticide management.

The majority (81.4%) of the farmers reported that they had the relevant SOPs in place (Table 3 above) for safe pesticide use and were using them. However earlier studies undertaken in Rwanda and Saudi Arabia(Ndayambaje *et. al.*, 2019; Abdollahzadeh & Sharif 2021) reported despite farmers having the SOPs most of the farmers were not complying with the minimum requirements of use of SOPs and in the later case they even failed to access the PPE.

Level of Compliance to Safe Measures in the Use of Pesticides

On the general level of compliance to safe measures in the use of pesticide by farmers it was established only 30.2% were complying and the majority were not. Thes results are agreement with earlier study done in Uganda by Nalwanga &Ssempebwa (2011). Other studies also undertaken in Vietnam and China (Hoi et. al., 2016; Jianjun *et. al.*, 2016) also revealed that many farmers rate safety measures application relatively low and may even fail to disposal left over pesticide properly.

Association Between Personal and Institutional Determinants of Compliance to Safe Measures in the Use of Pesticides

To show this association, both chi square and bivariate logistic regression analyses were conducted at 95% level of significance.

The chi square analysis results on personal determinants are shown in Table 4 below while the institutional determinants are in Table 5.

Personal Determinants

The results in Table 4 below show that four personal determinants, that is, education level ($p = 0.000$), knowledge level ($p = 0.012$), attitude ($p = 0.000$) and risk perception ($p = 0.000$) had significant association with compliance to safe measures in the use of pesticides among farmers in the study ($p < 0.05$). Other individual factors including age group, marital status and peer influence were not significantly associated with compliance to safe measures in the use of pesticides among farmers in the study ($p > 0.05$).

Table 4: Chi Square Analysis of Personal Determinants Associated with Compliance to Safe Measures in the Use of Pesticides among Farmers

Variable	Categories	Compliance to Measures		chi-square	Df	p-value
		No	Yes			
Personal Determinants						
Age group 45.0±11.1 year	<30years	19(67.9)	9(32.1)	5.017	3	0.171
	30-39years	63(62.4)	38(37.6)			
	40-49years	90(69.8)	39(30.2)			
	≥50years	98(76.0)	31(24.0)			
Education Level	None	31(88.6)	4(11.4)	29.168	3	0.000**
	Primary	181(75.7)	58(24.3)			
	Secondary	52(53.1)	46(46.9)			
	Tertiary/University	6(40.0)	9(60.0)			
Marital Status	Married	225(69.2)	100(30.8)	0.277	1	0.599
	Unmarried	45(72.6)	17(27.4)			
Knowledge Level	Low	19(95.0)	1(5.0)	6.366	1	0.012*
	High	251(68.4)	116(31.6)			
Attitude	Negative	213(77.7)	61(22.3)	28.259	1	0.000**
	Positive	57(50.4)	56(49.6)			
Risk Perception	Low Risk	31(96.9)	1(3.1)	12.153	1	0.000**
	High Risk	239(67.3)	116(32.7)			
Peer Influence	No	197(70.1)	67(29.9)	0.026	1	0.872
	Yes	113(69.3)	50(30.7)			

Institutional Determinants

Among the 4 institutional determinants only one was not significant (Table 5 below).

Table 5: Chi Square Analysis of Institutional Determinants Associated with Compliance to Safe Measures in the Use of Pesticides among Farmers

Variable	Categories	Compliance to Measures		chi-square	df	p-value
		No	Yes			
Pesticide Toxicity	ClassI: Bright Red, Skull-bones	69(80.2)	17(19.8)	11.330	4	0.023*
	ClassII: Bright Yellow	86(64.7)	47(35.3)			
	ClassIII: Bright Blue	91(72.8)	34(27.2)			
	ClassIV: Bright Green	15(51.7)	14(48.3)			
	ClassV: Flammable	9(64.3)	5(35.7)			
Training on PPEs	No	164(79.6)	42(20.4)	20.236	1	0.000**
	Yes	106(58.6)	75(41.4)			
Received inspection in the past year	No	188(68.9)	85(31.1)	0.358	1	0.549
	Yes	82(71.9)	32(28.1)			
SOPs in Place	No	70(97.2)	2(2.8)	31.611	1	0.000**
	Yes	200(63.5)	115(36.5)			

The three institutional determinants which were established to be significantly associated with compliance to safe measures were pesticide toxicity ($p = 0.023$), training on PPEs ($p = 0.000$), and standard operating procedures in place ($p = 0.000$) at $p < 0.05$.

One institutional determinant, received inspection in the past year, was not significantly associated with compliance to safe measures in the use of pesticides among farmers in the study ($p > 0.05$).

The multivariate logistic regression analysis of both the institutional and individual determinants associated with compliance to safe measures in the use of pesticides among farmers was done and the results are given in Table 6 below.

Table 6: Multivariate Logistic Regression Analysis of Determinants Associated with Compliance to Safe Measures in the Use of Pesticides among Farmers

Variable	Compliance to Measures		COR [95% CI]	p-value	AOR [95% CI]	p-value
	No	Yes				
Age group, 45.0±11.1 year						
<30years	19(67.9)	9(32.1)	1	1	1	1
30-39years	63(62.4)	38(37.6)	1.415[0.477-4.198]	0.532	1.392[0.470-4.119]	0.551
40-49years	90(69.8)	39(30.2)	0.810[0.269-2.435]	0.707	0.797[0.265-2.396]	0.686
≥50years	98(76.0)	31(24.0)	0.572[0.180-1.824]	0.345	0.561[0.177-1.781]	0.033
Education Level						
None	31(88.6)	4(11.4)	1	1	1	1
Primary	181(75.7)	58(24.3)	0.863[0.231-3.232]	0.827	0.814[0.220-3.017]	0.758
Secondary	52(53.1)	46(46.9)	1.984[0.476-8.266]	0.347	1.940[0.472-7.977]	0.358
Tertiary/University	6(40.0)	9(60.0)	2.665[0.397-17.870]	0.313	2.567[0.382-17.266]	0.332
Knowledge Level						
Low	19(95.0)	1(5.0)	1	1	1	1
High	251(68.4)	116(31.6)	6.789[0.462-99.843]	0.163	7.916[0.534-117.301]	0.133
Attitude						
Negative	213(77.7)	61(22.3)	1	1	1	1
Positive	57(50.4)	56(49.6)	6.057 [3.201 - 11.462]	0.000	5.247 [2.663 - 10.340]	0.000**
Risk Perception						
Low Risk	31(96.9)	1(3.1)	1	1	1	1
High Risk	239(67.3)	116(32.7)	31.271 [3.593 - 272.149]	0.002	31.507 [3.551 - 279.565]	0.002**
Pesticide Toxicity						
Class I: Bright Red, Skull-bones	69(80.2)	17(19.8)	1	1	1	1
Class II: Bright Yellow	86(64.7)	47(35.3)	1.705[0.803-3.623]	0.165	1.716[0.814-3.620]	0.156
Class III: Bright Blue	91(72.8)	34(27.2)	1.078[0.472-2.462]	0.859	1.085[0.477-2.469]	0.845
Class IV: Bright Green	15(51.7)	14(48.3)	3.082[1.003-9.472]	0.049	2.999[0.974-9.237]	0.056
Class V: Flammable	9(64.3)	5(35.7)	3.963[0.481-32.664]	0.201	4.572[0.550-37.986]	0.159
Training on PPEs						
No	164(79.6)	42(20.4)	1	1	1	1
Yes	106(58.6)	75(41.4)	1.187[0.646-2.179]	0.581	1.485[0.726-3.038]	0.279
SOPs in Place						
No	70(97.2)	2(2.8)	1	1	1	1
Yes	200(63.5)	115(36.5)	27.200 [5.288 - 139.915]	0.000	25.773 [5.001 - 132.798]	0.000**

The results (Table 6) show that only three determinants were significantly associated with compliance to safe use of pesticides. These are: Positive Attitude, High Risk Perception and Adhering to SOPs.

The results show that there was a strong statistically significant association between farmer's attitude and compliance to safe measures in the use of pesticides among farmers. The crude odds ratio [COR = 6.057, (CI 95% = 3.201 - 11.462)], implied that the odds of complying to safe measures of pesticide use among farmers who had positive attitude were about 6 times higher compared to those farmers who had negative attitudes towards safety measures of pesticide use. Whereas on carrying out multivariate analysis, adjusted odds ratio [AOR = 5.247, (CI 95% = 2.663 - 10.340, p = 0.000] implied that the odds of complying to safe measures of pesticide use among farmers who had positive attitude towards safety measures were about 5 times higher compared to those farmers who had negative attitudes. This suggests that having a positive attitude towards safe use of pesticides increases the likelihoods of complying to safe measures of pesticides use. Therefore, the farmers' attitudes need to be improved as this would motivate them to comply to safe measures of pesticides use.
The above results are in agreement with previous studies in several countries including Nigeria and China (Abegunrin *et. al.,* 2020; Wang and Chu 2017; and Afshari*et. al.,* 2021)who also reported that having a positive attitude is significant in improving compliance to safe use of pesticides.

The results (Table 6) also show that risk perception had a strong statistically significant association with compliance to safe measures in the use of pesticides among farmers. The crude odds ratio [COR = 31.271, (CI 95% = 3.593 - 272.149)], implied that the odds of complying to safe measures of pesticide use among farmers who had a high-risk perception of pesticide use were about 31 times higher compared to those farmers who had a low-risk perception of pesticide use. Whereas on carrying out multivariate analysis, adjusted odds ratio [AOR = 31.507, (CI 95% = 3.551 - 279.565, p = 0.002] implied that the odds of complying to safe measures of pesticide use among farmers who had a high-risk perception of pesticide use were about 32 times higher compared to those farmers with low-risk perception.
The above results are similar to earlier findings in Greece, China and Malaysia (Damalas and Hashemi 2010; Jianjun *et.al.,* 2016; and Khan *et.al.,* 2019)which reported that farmers with higher risk perception were more concerned about their health and hence paid more attention to compliance to safety measures when using pesticides.

The results (Table 6) finally also show that the presence of SOPs had a strong statistically significant association with compliance to safe measures in the use of pesticides among farmers. The crude odds ratio [COR = 27.200, (CI 95% = 5.288 - 139.915)], implied that the odds of complying to safe measures of pesticide use among farmers who reported having standard operating procedures (SOPs) in place were about 27 times higher compared to those farmers who reported not having the SOPs. Whereas on carrying out multivariate analysis, adjusted odds ratio [AOR = 25.773, (CI 95% = 5.001 - 132.798, p = 0.000] implied that the odds of complying to safe measures of pesticide use among farmers who reported having SOPs in place were about 26 times higher compared to those farmers who reported not having the SOPs. This indicates that having SOPs in place increases the likelihood of the individual to comply to safe measures of pesticides use.

Therefore, there is need to have SOPs available as this would enable more farmers to comply with the safety measures while using pesticides.
Ndayambaje *et. al.*,(2019), Strong *et.al.,* (2008) and Abdollahzadeh & Sharif (2021) who carried out related studies in Rwanda, the US and Saudi Arabia respectively reported that presence of standard operating procedures had a significant association with the compliance to safe measures of pesticide use among the farmers and farm workers in the communities.

CONCLUSION AND RECOMMENDATION

In conclusion the level of compliance to safe measures in the use of pesticides among farmers was low. Among the personal determinants, attitude and risk perception were significant factors influencing compliance to safe measures in the use of pesticides among farmers. While among the institutional determinants, standard operational procedures in place were also significantly associated with compliance to safe measures in the use of pesticides among farmers.

Therefore, there is need to work on improving farmers' attitudes, sensitizing them about the risks attached to use of pesticides, and provision of SOPs for pesticide use on their farms.

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