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Knowledge and Practice Associated with Handling Pesticides Among the Farmers of Kwanza Sub County

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Exposure, Handling, Knowledge, Pesticide, Practice, Threshold, Toxicity

ABSTRACT

Kenya as a country relies on agriculture to sustain its economy. Agriculture contributes up to 24% GDP. The quality and quantity of agricultural produce is dependent on the use of different pest controlling mechanisms such as pesticides. The use of pesticides exposes farm- ers to health complications resulting from contact with chemicals through the application and handling. The main objective of this study was to examine pesticide exposure among farmers of Kwanza sub-county in Trans-Nzoia County. The specific objective was; to assess the level of knowledge and practice associated with handling pesticides among the farmers, and to determine the health effects of exposure to pesticides among the farmers. To achieve its specific objectives, the study employed a descriptive cross-sectional study design. The study used purposive sampling to select participants from Kwanza sub-county and strati- fied random sampling was employed to pick the participants from within the four elective wards. The study involved 323 participants who filled semi-structured questionnaires as a data collection tool. In addition to the use of semi-structured questionnaires, FGDs and observation checklist was also used to collect data. Data was analyzed using SPSS version 22. Qualitative data was analyzed and presented thematically according to the study ob- jectives. Knowledge and practice were below the $P<0.05$ indicating significance. The study established that farmers in Kwanza sub-county in Trans-Nzoia County employed standard practices when handling pesticides. The study found out that farmers' knowledge of pesti- cides increased with high education level and training. On practice, the study established that training offered and level of education of individuals is effective in reducing exposure. The study concluded that farmers of Kwanza subcounty in Trans-Nzoia County had basic knowledge on the best practices to handle pesticides but lacked the necessary finances to implement. Thus, it is recommended that farmers in Kwanza sub-county needed to explore financial platforms to help on financial constraints.

INTRODUCTION

Pesticides are a large spectrum of substances ranging from herbicides, insecticides, and fungicides all with the aim of preventing destroying or repelling pests from animals or cultivated crops [1]. The largest group of pesticides used all over the globe are mostly organophosphate pesticides which includes the classes of fungicides, herbicides, nematicides, acaricides and molluscicides. This class of pesticides has been in use since the early 1940s to control pests with impact on agricultural production and public health [2],[21]. Benefits reaped from the use of pesticides are protecting the crops from pests that are otherwise a nuisance to the farmer, increasing the yield of the crop and fighting potential disease-causing vectors to both plants and humans [1]. Despite the benefits of pesticides, they also have the potential to cause adverse health effects upon exposure to humans [10]. Due of their high levels of toxicity and widespread use, pesticides present a serious threat to the populations in agricultural communities. Other than children, farmers in low-income countries are largely affected by exposure to pesticides due to poor practices in pesticide handling [19]. People in agricultural communities are deemed to experience higher doses of exposure to pesticides[3].
Pesticides have different mechanisms of toxicity. Acute toxicity causes respiratory, GIT, skin, eye and nonspecific symptoms like headaches. Neurotoxicity is most of the times a chronic effect except in cases like acute and high dose organophosphate poisoning which cause paralysis and peripheral neuropathy[10]. Neurotoxicity happens by disrupting the ion channel function or blocking the normal acetylcholine breakdown [10]. Herbicides have a tendency of affecting both target and non-target organisms. Other factors like the site of exposure usually determine the effects experienced after an exposure has occurred [22]. Other factors that affect toxicity are the type of toxicant, dose, and route of exposure like ingestion, dermal absorption and inhalation [24]. Duration of exposure and age of individuals also affect toxicity [1]. The effects might be acute or chronic in nature [10]. Majority of pesticides have been noted to have the ability to inhibit acetylcholinesterase from breaking down acetylcholine. Sub chronic exposure could result in muscle weakness, muscle twitching, motor function impairment, and sensory disturbances as a result of overstimulation of the nerves and muscles[20].

These effects are acute and occur as a result of exposure to high doses of pesticides and within 24 hours[8]. Long term exposure leads to chronic effects and which may lacksymptoms from the onset. Such effects could be mental activity deterioration and learning disability [10]. Some pesticides have the potency to bio-accumulate in the body of an organism and cause severe health effects once the threshold dose has been passed [13]. Metabolic syndrome and certain types of cancers have been associated with long term exposure to certain types of defoliant pesticides like Agent Orange which was used in the American Vietnamese war [23]. Dichlorodiphenyltrichloroethane (DDT) which has been banned in many developed countries also has a high capability to bio-accumulate and impact negatively on the health of humans. When an individual is within the environment where pesticides are being applied, it counts as exposure regardless of the amount of dose exposed to an individual [5]. Exposure is also determined by an individual's knowledge, practice, and perception towards the use of pesticides [4]. Globally, 5.5 billion pounds of pesticides are produced each year and exposes over 1.8 billion workers in farming to pesticide poisoning each year [15]. Additionally, Africa uses 20% of the 5.5 billion pounds of pesticides produced annually, yet it costs Africa's health bill excess of $90 billion dollars each year as a result of pesticide use [13].

In Kenya, 60% of the 7,000 metric tons imported is classified as bad actor pesticides and harmful to human health [7]. With the increasing rate of agriculture, pesticide exposure is expected to increase overtime. Therefore, there is need to study the knowledge and practice of the farmers. Kwanza Sub County, which solely depends on agriculture as a source of economic sustenance raises the question of finding out if pesticides are of great use in this region. The Kenya Farmers Association of Kwanza sub county are objective in improving lives by growing agriculture in the region by increasing production of the crops. This gives the calculated assumption that pesticides are being employed in large quantities in order to achieve maximum production of food crops since pesticides are important in protecting crops from damage and boosting production [6]. This study targeted farmers since they are in direct contact with pesticides as part of their economic activity.

Materials and Methods

2.1 Research Design

A descriptive cross-sectional study design was utilized in this study. This research design allowed for the description and reporting of matters as they were at that point in time, therefore, giving the actual situation of an event within study population. This study design was preferred since it permits the researcher to look into numerous characteristics at once in a population [12]. This applied to this study because the socio demographic factors were looked at in a bid to find the significant ones in relation to pesticide exposure. Additionally, the study design enabled the researcher to look at the prevailing characteristics in the study population like behavior in terms of practice and knowledge towards pesticides among the farmers of Kwanza sub county.

2.2 Study Variables

The independent variables of the study were socio demographic factors, knowledge, and practice of a farmer. The dependent variable was pesticide exposure. The independent variables were evaluated to ascertain how they impacted on the dependent variable.

2.3 Study Area

This study was carried out in Kwanza Sub County. This is one of the five sub-counties of Trans-Nzoia County. This county is found on the western region of Kenya with a population of 1.3 million people and measures 2,483 square kilometers. Kwanza Sub County has a population of 193,087 people and measures approximately 466.9 square kilometer. Kwanza Sub County is located in the coordinates 1.01910N, 35.00230E. This study area was purposively chosen because it has 16650 households from

2.4 Study Population and Target Population

The target population for this study were the inhabitants of Kwanza Sub County located in Trans-Nzoia County. The study population were the farmers selected to participate in the study and the agricultural extensional farmers and the practitioners working in the agrovets.

2.5 Inclusion and exclusion criteria

Individuals included in this study were the residents of kwanza Sub County, who carried out their farming activities within Kwanza and who gave consent to participate. Those excluded from this study were those living and practicing farming outside Kwanza, anyone below the legal age of 18 and those declared mentally unfit to give consent including those who refused to give consent

2.6 Sampling Technique

The researcher referred to the Trans-Nzoia county database on farmers [9] and the Kenya Farmers Association [9] to purposively select the population of farmers with the most similar characteristics, which is the use of pesticides in this constituency. Stratified random sampling was utilized to randomly pick their serial identification numbers from the register of Kenya Farmers association and form strata which were the four wards of Kwanza constituency. The wards are Kapomboi, Kwanza, Keiyo, and Bidii. Random samples were then selected from these strata. Equal proportions of the total desired sample size were calculated. Finally, simple random sampling was used to select respondents from each ward.

2.7 Sample Size Determination

The Sample size determination was done in line with [7] formula of sample size determination since the number of registered farmers in the association from kwanza Sub County is 25,000.

2.8 Data Collection Tools & Technique

Questions focused on knowledge and practice were applied through the questionnaires. The questionnaires were interview admitted to all the farmers handling pesticides in kwanza sub county. The questions used to evaluate knowledge and practice were measure

using a 5-point Likert scale whereby 1 point represents poor knowledge and practice while 5 points represents excellent conduct in knowledge and practice. In assessing the extent to which knowledge, practice and behavior influences the use of pesticides among the farmers of Kwanza, a complete observer checklist was employed. FGDs as a technique was also employed in understanding knowledge and practice.

2.9 Pilot and pretesting

The pretesting of research tools was carried out in Saboti Sub County, Trans-Nzoia County using 10% of the sample size. This Sub County has similar characteristics as compared to kwanza Sub County in relation to farming activities. The questionnaires were checked for any unquantified questions. Appropriate and accurate instruments for data collection were reviewed by the supervisors to ensure that tools for data collection were up to standard. The observation checklist was also checked to ascertain that it indeed fits the study design and objectives of the study.

2.10 Data Analysis

Statistical analysis of the data was done using the Statistical Package for Social Sciences version 22 of 2018. Descriptive statistics was used to present data from the Likert scale analysis. For the farmer's knowledge and practice, the mean and standard deviation were calculated and a chi square test with a cut-off value of $P< 0.05$ used to carry out the statistical significance test. The qualitative data collected from the FGDs was analyzed through thematic context analysis. The themes used in analysis in relation to the FGD's were (Exposure via interaction, consequences of use, exposure and poisoning, additional education when buying). This was done by the qualitative coding software (Delve) to come up with narratives in relation to the FGD's questions

Results

3.1 Knowledge and practice associated with pesticide handling among farmers.

On understanding the label on pesticides (46.4%) strongly agreed that it is necessary for farmers. Conversely, on the importance of applying pesticides to plants, 200 (61.9%). farmers strongly disagreed. Majority of the farmers 160 (49.5%) strongly agreed that pesticide is harmful to health. On matters of getting exposed to pesticides when being applied in close proximity 180 (55.7%) farmers strongly agreed that close handling of pesticides exposes them. On the question of applying pesticides to crop all the time 150 (46.4%) strongly disagreed and disagreed 139 (43%) respectively. On the importance of attending training, 127(39.3%) farmers strongly agreed and 149 (46.1%) agreed on thematter respectively.

Table 1: knowledge and pesticide handling response

Knowledge	*Category*	*Number*	*Percentage (%)*
Understand Label written	Disagree	10	3.1
	Undecided	43	13.3
	Agree	120	37.2
	Strongly agree	150	46.4
Total		323	100
Applying to plants important?	agree	122	37.8
	Undecided	1	0.3
	Strongly disagree	200	61.9
Total		323	100
Harmful to health			
	Undecided	12	3.7
	Agree	151	46.7
	Strongly agree	160	49.5
Total		323	100
Close proximity exposure	Disagree	16	5.0
	Undecided	30	9.3
	Agree	97	30.0
	Strongly agree	180	55.7
		323	100
Pesticide all time good for crops?	Disagree	139	43.0
	Undecided	14	4.3
	Agree	20	6.2
	Strongly disagree	150	46.4
Total		323	100
Importance on attend-	Disagree	12	3.7

ing training	Undecided Agree Strongly agree	35 149 127	10.8 46.1 39.3
Total		323	100

Table 2: chi square values for responses

Knowledge	***value***	***Df***	***P value***
Understand label written	242.22	9	.000
Applying to plants important?	150.89	6	.000
Harmful to health	182.76	6	.000
Close proximity exposure	199.23	9	.000
Pesticide all time good for crops?	43.65	9	.000

3.2 Knowledge on Handling, Use and Storage of Pesticides

The results indicated that the majority of the farmers 157 (48.6%) agreed that PPE's were critical when handling pesticides. Additionally, concerning application of pesticides on a windy day the majority 198 (61.3%) strongly agreed that it was wrong to do that. The majority 168 (52%) strongly agreed and 132(40.8%) agreed that it was important to clean both tools and body after using pesticides. Results also indicated that (83%) of respondents both strongly agreed and agreed that is important to store pesticides away from house. On mixing pesticides, 139(43%) farmers strongly disagreed and 143(44.2%) disagreed respectively. Majority of farmers 161(49.8%) strongly agreed and 96(29.7%) agreed respectively that it was important to take note of both indoor and outdoor pesticides.

Table 3: practice and pesticide handling responses

Practice	***Strongly agree***	***Agree***	***Disagree***	***Strongly disagree***	***Undecided***
PPE use	157(48.6%)	129(40%)	9(2.78%)	0	28(8.62%)
Apply on wind	198(61.3%)		123	0	2
Body tool cleaning	168(52%)	132(40.8%)	11(2.2%)	0	16(5%)
Storing pesticides	154(47.6%)	119(36.8%)	29(9%)	0	21(6.6%)
Mixing pesticides	0	16(5.1%)	143(44.2%)	139(43%)	25(7.7%)
Indoor/outdoor noting	161(49.8%)	96(29.7%)	9(2.9%)	0	57(17.6%)

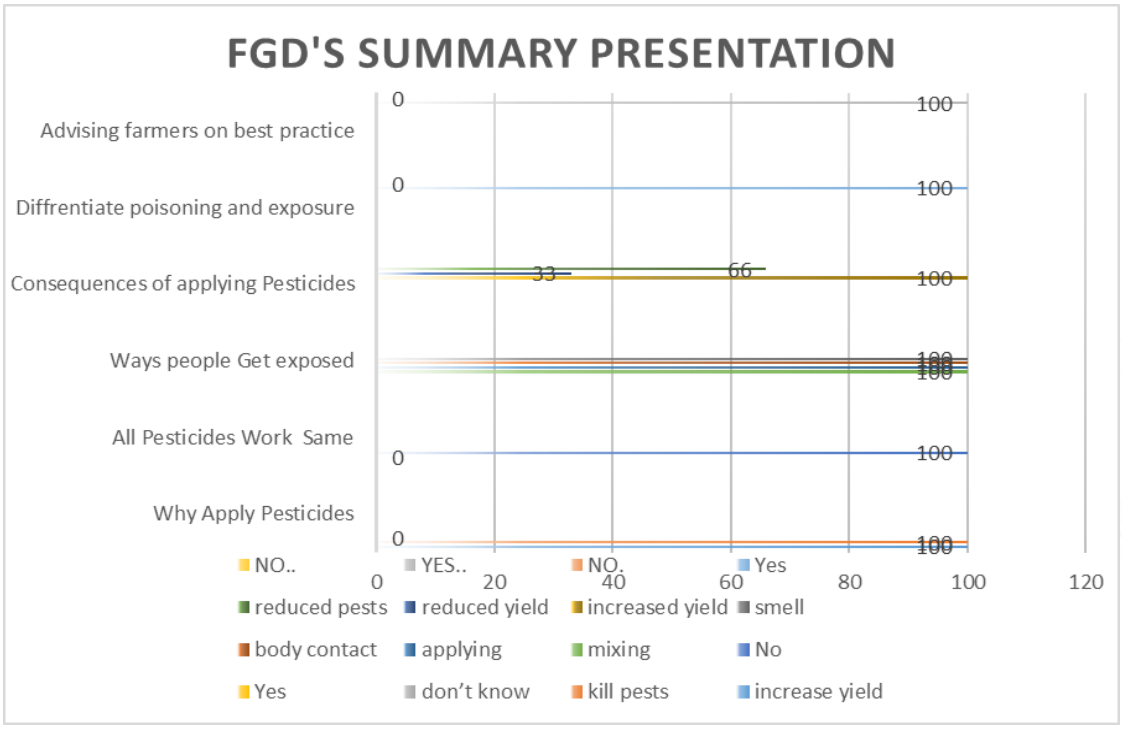
Table 4: chi square values for practice and handling pesticide responses

Practice	***value***	***Df***	***P value***
Apply on wind	240.56	8	.000
Body tool cleaning	153.59	6	.000
Storing pesticides	172.75	6	.000
Mixing pesticides	189.56	7	.000
Indoor/outdoor	42.68	9	.000
PPE use	196.47	6	.000

3.3 Focused Group Discussion on knowledge & Practice

The results are based on the findings of the three groups. The 3 groups unanimously agreed that farmers apply pesticides to increase their farm produce and reduce pests. On the question of whether all pesticides work the same, all the 3 groups came to a conclusion that pesticides work differently. All the three groups concluded that individuals get exposed to pesticides when mixing chemicals, applying pesticides, when the chemicals come in contact with their bodies, and through smell. On the consequences of using pesticides in the farm, the 3 groups unanimously agreed that it increases yield, 2 were of the view that it reduced pests, and 1 group concluded that application of pesticides reduced yield. The 3 groups agreed to the question on whether farmers could differentiate exposure and poisoning. Also, the discussion revealed that pesticides vendors advised farmers on the best practices when buying.

Figure 1: FGD summary representation



Discussions

4.1 Knowledge of farmers

The findings of this study indicated that the farmers were knowledgeable on matters of pesticide exposure in relation to their indicator scores. With a P<0.005) it indicated that there was enough statistical evidence to show that their knowledge was above the set cut off point. High level of knowledge in the study area can be attributed to the fact that the majority of participants had secondary education and above. The Kenyan curriculum is well known to articulate matters of farming as early as at the primary school level for the beneficiaries of the (8-4-4 system) Additionally, the findings of this study were consistent with a study [5], [16], in that higher education levels means that the level of knowledge on pesticides shall also be high. The knowledge indicators sought to understand the level of farmer's understanding of pesticide aspects such the labels, and the mode of application and their effects on the user. A clear demonstration of understanding of these concepts indicated that farmers were better positioned to stand less exposed to pesticides [14]. Focus group discussion was also used to understanding the farmer's knowledge of pesticides and the application. There were 8 questions designed to guide the discussions among the 3 groups. The results from the discussion revealed that a majority of farmers came to terms with the standard guidelines regarding the pesticide handling and use. It was evident to from the discussion that farmers applied pesticides to increase their farm produce by reducing the pesticides in their farms. This was common knowledge as reflected in all the three groups.

4.2: practice of farmers

The findings of this study established that the practices of farmers in relation to handling pesticide was concluded as safe. This is due to the fact that a cut off of (P< 0.05) was used and all the practice indicators turned out to be below the cut off. Safe practices in the study area can be attributed to the fact that prior exposure to knowledge and training inspires safer practices when it comes to handling pesticides. Additionally, safer handling of pesticides cannot be only attached to high level of education among the farmers. The FGD's have also indicated that farmers in Kwanza Sub County have been exposed to prior trainings from their head representatives in

the KFA. The findings of this study is consistent with another study [7], [17] in that being exposed to trainings ensures that the practices carried out by the farmers are safer as compared to those who have no prior trainings. Additionally, from the FGD's it was noted that the participants understood that all pesticides don't work for the same function revealed that farmers from Trans-Nzoia County understood and differentiated the pesticides according to their specific use and this enhances the farm produce. The study established that farmers understood ways of exposing themselves to the pesticides, an indication that they were better placed to avoid the dangers of pesticide exposure. The discussion sessions were critical because they assisted in drawing major conclusions about farmers. The fact that they came to a similar conclusion means that they were open minded, with the capacity to negotiate and reach a conclusion.

Conclusion

This study's findings indicate that the level of knowledge and practice associated with pesticide exposure and handling in Kwanza Sub-County is high and practices were also safe. High level of education, prior trainings on pesticide handling led to the reasons of high knowledge and safe handling of pesticides. The study also established that the level of income plays a major role in neutralizing the efforts of the high knowledge and safe practices. That is due to the fact that even someone with high knowledge can still get exposed since they do not have finances to purchase PPE's and implement safe practices.

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