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Knowledge, Attitudes, and Practices on Pesticide among Farmers in the Philippines

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ABSTRACT

Introduction. Pesticides are widely used in the agricultural sector to increase production by cutting down costs and improving the quality of produce. However, these chemicals come with serious health effects when an individual is exposed to large quantities at once, or low quantities over time.

Objectives. The objective of the study is to investigate the knowledge, attitude, and practices of farmers, as well as investigate the correlation among knowledge, attitude, and practice variables.

Methods. This research study used a cross-sectional design. Samples were drawn based on a multistage sampling of 387 agricultural workers. The target site was in Southern Philippines and the sample was selected using multi-stage sampling from the identified municipalities. Survey questionnaires were given to the respondents to measure knowledge, attitude, and practices (KAP) on pesticide exposure among farmers. The data were encoded using SPSS 13.0. The statistics used were both descriptive and inferential. Correlation analysis was used to study the relationship among knowledge, attitudes, and practices.

Results. The results showed that farmers used pesticides in their farms on an average of 2.31 days per week (SD 2.13). The respondents reported that they were exposed to pesticides for about 3.46 months per cropping season (SD: 2.76), as well as from 3.34 (SD 5.92) cropping seasons per year. The mean score of the respondents on the knowledge aspect of the questionnaire was 5.91 out of 10 items (SD 3.28). The average score on practices on pesticide use among respondents was 3.37 (SD 1.75) with 8 items to evaluate practices. Lastly, the mean score on attitude on pesticide use among respondents was 5.34 (SD 3.31) over 12 items. Analysis showed a moderate correlation between knowledge and attitude with Pearson's r = 0.651 (P <0.0001), also a moderate correlation between knowledge and practices at r = 0.521 (P <0.0001), and a moderate correlation between practices and attitudes at r = 0.443 (P <0.0001). Factor analysis revealed three components for items within practices and attitudes and two for items within knowledge.

Conclusion. Pesticide use in the Philippines continues to present various challenges in terms of its safety to humans and the environment. Farmers do not have adequate knowledge of pesticides and their proper management from use to disposal. They need to improve knowledge, encourage a healthy and safe attitude and correct practices on the hazards from pesticides, as well as its proper usage and handling. It is recommended that capacity building and training for farmers are initiated to address inadequacies in their knowledge, attitudes and practices.

Key Words: Knowledge, attitude, practices, farmers, pesticide use, pesticide handling

INTRODUCTION

Pesticides are widely used in the agricultural sector to increase production through cutting costs and improving the quality of produce. However, these chemicals come with serious health effects when an individual is exposed to large quantities at once or low quantities over time.[1] In addition to this, safe pesticide handling is not strictly enforced, most especially in developing countries. Developed countries have stricter regulations through banning dangerous pesticide

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products, however, these banned chemicals may still be sold in developing ones, increasing the health risk attached to the handling of pesticides within these countries. Many times, these farmers also do not comply with the safe dosages and mixing proportions of the pesticides used.[2]

In the Philippines, the agricultural industry amounts to a value of Php 429.7 billion (8.6B USD) with around 50% of this consisting of crops produce. However, crop production has been experiencing a decline, further contributing to the pressure faced by farmers to increase their production.[3] One of the remedies to this dilemma is the use of pesticides by farmers. An analysis of trends of the types of pesticides used in the Philippines found that the most common pesticide types were pyrethroids, organophosphates, and carbamates.[4] This is an alarming finding since these pesticide types are known to include pesticides ranging from the highest toxicity level to moderate ones.[5] The International Labour Organization urges countries to ensure safe and healthy workplaces[6] and achieving this requires efforts from the farmers, distributors, and government officials.

This study aims to investigate the knowledge, attitudes, and practices of farmers regarding pesticides. This will provide insight on misconceptions and gaps in their knowledge and practices that require clarifying to improve their safety on the farm. Farmers in developing countries are usually known for having poor knowledge and unsafe practices of pesticide usage on the farm. If these issues are not addressed, the misuse of pesticides will not only have health implications to the farmer but to the environment as well, manifesting in terms of pollution and public health.[7]

MATERIALS AND METHODS

This research study used a cross-sectional design. Samples were drawn based on a multistage sampling of agricultural farmers in 2018. The top agricultural municipalities were identified in North Cotabato in Southern Philippines, which is labeled as the fruit basket of Mindanao, producing several tropical fruits for the entire country.

The samples were randomly drawn based on a multistage sampling of farmers. Five municipalities were selected for the first stage of sampling. The sample of respondent farmers was obtained from agricultural areas in these municipalities (Figure 1).

The sample size was obtained using Daniel's Formula for sample size computation,

$$n = \frac{Z_{\frac{\alpha}{2}}^2 p(1-p)}{d^2}$$

where $Z_{\frac{\alpha}{2}}$ is the critical value of the normal distribution, α is the confidence level, p is the sample proportion, and d is the margin of error. Assuming a design effect of 1, infinite population size, confidence level at 95%, and setting the sample proportion at 50% to maximize the sample size,

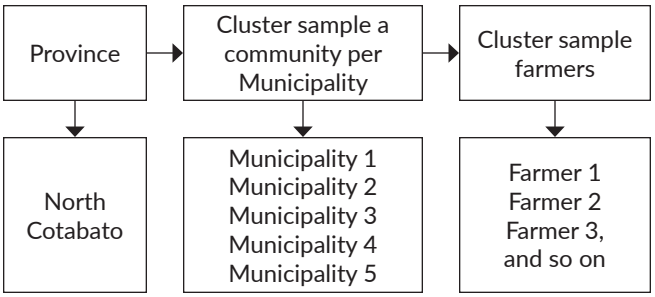

Figure 1. Multistage Sampling.

Table 1. Distribution of respondents by municipality (N=387)

Municipality	Frequency	Percent %
Municipality A	135	34.9
Municipality B	55	14.2
Municipality C	68	17.6
Municipality D	86	22.2
Municipality E	43	11.1

we got a sample size of 387. The distribution of farmers in the various municipalities is shown in Table 1.

The sampling frame is a list of agricultural areas in North Cotabato. When random samples of farms were selected, respondents were taken from willing participants within the agricultural area. For the inclusion criteria, respondents must: 1) be a resident of North Cotabato, 2) be an immigrant who currently resides in North Cotabato, 3) have been working in agriculture for at least a year at the time of the survey, and 4) may have other occupations (e.g., housewife) but still engaged in agriculture. This is because farming is a family-based economy where the majority of the household members are involved in any agricultural task or work. People residing outside North Cotabato, as well as people who have not worked at all in farming and agriculture (or worked in agriculture for less than a year), are excluded from the study.

Survey questionnaires were given to 387 farmer respondents, and the collection was through a self-administered interview facilitated by a field assistant. A field assistant facilitated a group consisting of five to ten farmers. Survey questionnaires were given to the respondents to measure knowledge, attitudes, and practices (KAP) on pesticide exposure among farmers. The data were encoded using SPSS 13.0. The statistics used were both descriptive and inferential. Correlation analysis was used to study the relationship among knowledge, attitudes, and practices. This study is part of a bigger project on pesticides and agriculture in the Philippines. The objective of the study is to investigate the knowledge, attitude, and practices (KAP) of farmers, as well as investigate the correlation among KAP variables. The significance of this study is to provide a basis for the content of the advocacy of the agricultural program.

Operationalization of KAP

Knowledge is defined as being able to understand information about a certain subject that is gained through education or by experiencing the event itself.[8] Jallow et al.[9] explored the knowledge and safety practice of farmworkers in Kuwait towards pesticides and defined the variable knowledge in the context of pesticide use as awareness in its exposure routes, effects on the environment, and human health, and awareness in the current legislation governing pesticide usage among farmers. Zyoud et al.[10] defined knowledge in the context of pesticide use as the extent of awareness regarding pesticides' effects on human health, livestock, and environment, as well as the routes of pesticide entry into one's body in their study among farmworkers in Palestine. Rostami et al.[11] explored the KAP on pesticides of agricultural workers in Iran and used the ways of the route of pesticide in the body, storage and destroying of pesticides, safety practices, recognition of dangerous pesticides, as well as the usage and acquirement of pesticides as indicators.

Attitude is a person's positive or negative feelings towards an object, person, or incident. A person's attitude is based on the predisposed knowledge or belief towards something.[12] In studies involving the use of pesticides, the definition of attitude focused on emotive predisposition on the safe use of pesticides such as the use of protective personal equipment. The study of Bagheri et al.[13] in Northern Iran explored the attitude of farmers relating to attitudes on the impact of pesticides to the environment, to the contamination of crops, contamination of water resources, effect on air pollution, and health problems.

Practice is the application of learned knowledge or beliefs into actual action.[14] In the context of pesticide usage, Kafle et al.[15] defined the variable practice as the methods or ideas utilized during purchase, utilization (mixing and spraying), storage, and disposal. Similarly in another study by Ndayambaje et al.,[16] the activities observed by the authors in terms of pesticide handling of the sampled population were used as variables for practice. These included the use of personal protective equipment during spraying, the method of pesticide mixing, as well as its storage. A study among farmers in Ethiopia also explored the practices of pesticides in terms of handling and storage.[17]

The questionnaire for knowledge is composed of 10 items with a 3-point scale – yes, no, and unknown- designed to assess the general knowledge of the respondents on pesticides. The respondent can only have knowledge, no knowledge, or unknown. The questionnaire for Practices is comprised of a mix of multiple-choice and multiple response questions designed to know the respondents' course of action on specific situations, and their habits on specific tasks, and consisted of 8 questions. The questionnaire for Attitudes is comprised of twelve questions on a four-point Likert scale: no opinion, disagree, neutral, and agree. The questions are designed to assess the opinion of respondents on specific topics.

Ethics clearance was secured before the data collection from the Ethics Board to ensure confidentiality, autonomy, informed consent, and respect to subjects. The study was funded by the Commission on Higher Education (CHED) in the Philippines, in collaboration with the University of Southern Mindanao for the extension service program to the area. The study was also approved by the Ethics Board of the said University.

There are limitations on the quality of data obtained from the survey. Since the survey was self-administered, questions that respondents skipped regardless of reason cannot be forced and will be reported as missing values. The respondents also can withdraw their participation at any time regardless of the reason as is stipulated in the Informed Consent.

RESULTS

Out of the 387 respondents, 62% were male and 33.9% were female. The majority were married (71.1%) and the mean age was 48 years. Almost half (44.2%) reached high school, attaining third year level on average (SD: ±0.95); 22.2% reached grade school, with a mean year level attainment at Grade 5 (SD: ±1.53); 19.4% reached college or tertiary level, with a mean year level attained at second year (SD: ±1.12); 4.9% reached vocational level, and only 1.6% reached the post-graduate level. The questionnaire for occupation allows for multiple responses. More than half (71.3%) were employed as agricultural workers, 44.8% as pesticide applicators, 29.8% as housewives, 22.4% as growers, 3% as pesticide distributors, and the remaining 6% were classified as having other occupations. (Table 2).

The farmers used pesticide in their farms on an average of 2.3 days per week (SD: ±2.13). The mean total spraying time was 3.07 hours (SD: ±14.76) per day. The average amount of pesticide used was 1.33 L of mixture per application (SD: ±6.53). The respondents reported that they were exposed to pesticides for about 3.46 months per cropping season (SD: ±2.76), as well as from 3.34 (SD: ± 5.92) cropping seasons per year (Table 3).

When knowledge, attitude and practices were measured through surveys among respondents, the total mean score of correct answers was low with knowledge at 5.91, attitude at 5.34, and the lowest is practice at 3.37 (Table 4).

Knowledge

An item analysis on the respondent's knowledge on pesticide use was done and the proportion of correct answers was also examined (Table 5). The question on pesticides' ability to produce fire gained the least correct answers (27.4%), majority of which fell under the unknown category. The question with the greater number of correct answers (73.6%) was the statement that farmers using pesticides should rest if not feeling well. Statements 2 and 5 maintained a proportion of correct answers above 70%, which tackled the safe use of pesticide. The mean score of the respondents

Table 2. Distribution of sociodemographic characteristics (N=387)

Sociodemographic Characteristics		Frequency	Percentage (%)
Sex	Male	240	62.0
	Female	131	33.9
	Missing	16	4.1
Marital Status	Single	18	4.7
	Married	275	71.1
	Widower	27	7.0
	Separated	5	1.3
	Missing	62	16.0
Educational Attainment	Grade school	86	22.2
	High school	171	44.2
	College	75	19.4
	Vocational	19	4.9
	Post-graduate	6	1.6
	Missing	30	7.8
Occupation (multi-response)	Agricultural Worker	261	71.3
	Pest Applicator	164	44.8
	Housewife	109	29.8
	Grower	82	22.4
	Pesticide Distributor	11	3.0
	Others	22	6.0
		Mean	Std. Deviation
Age		47.74	12.47

Table 3. Mean pesticide exposure among respondents in North Cotabato

Pesticide Usage in Farm	Mean	Standard Deviation
Amount of mixed pesticide (Liters) per application	1.33	6.53
Amount of time used to prepare dilution (minutes)	6.19	9.03
Total spraying time (hours) per day	3.07	2.16
Days of pesticide use in a week	2.31	2.13
Exposure to pesticide by months per cropping season	3.46	2.76
Exposure to pesticide by cropping season per year	3.34	5.92

Table 4. Mean total score for knowledge, beliefs, and practices (N=387)

	Mean Total Score of Respondents	Std. Deviation
Knowledge	5.91	3.28
Attitudes	5.34	3.31
Practices	3.77	1.75

on the knowledge aspect of the questionnaire with a perfect score of 10 items was 5.91 (SD 3.29).

Practice

About forty-three percent of the farmers said that they use alternative methods before using pesticides, and 44.4% uses pesticide in extreme conditions like heat. Majority of the farmers clean up leaked pesticide immediately (73.4%) by flushing it with water from a hose (40.3%). A minority use mop or absorbent material (9.8%). A high percentage of respondents practiced closing the sprayer nozzle when moving away from farm or crops (67.7%). However, only 46.3% mixed pesticides far from storage of pesticides, only 34.6% mixed pesticides more than 400 feet from canals and irrigations. It should also be noted that 17.3% of the respondents engaged in the habit of blowing the sprayer when clogged (Table 6).

Attitudes

Among twelve statements that aimed to evaluate the attitude of the farmers regarding pesticide, there were three statements that majority of the farmers answered

Table 5. Item analysis and proportion of correct answers on knowledge on pesticide use among respondents (N=387)

Statements	Yes/True Freq (%)	No/False Freq (%)	Unknown Freq (%)	Correct Answers (%)
1. Pesticides can produce spark resulting to fire.	106 (27.4)	80 (20.7)	123 (31.8)	27.4
2. Farmers should only drink and eat after washing hands.	274 (70.8)	29 (7.5)	12 (3.1)	70.8
3. Farmer who uses pesticide should rest if he is not feeling.	285 (73.6)	24 (6.2)	6 (1.6)	73.6
4. Pesticide accumulates in the body of humans or animals when one happens to smell, splash, or handle pesticide.	258 (66.7)	21 (5.4)	32 (8.3)	66.7
5. I understand the written directions on stickers of pesticides.	277 (71.6)	13 (3.4)	21 (5.4)	71.6
6. Leftover pesticides used in farms should be taken home and stored properly.	262 (67.7)	42 (10.9)	9 (2.3)	67.7
7. There's a chemical reaction when fertilizer and pesticide mixes that results to fire.	141 (36.4)	70 (18.1)	96 (24.8)	36.4
8. Pesticides are safe to travel nearby humans, food, and animals.	104 (26.9)	193 (49.9)	17 (4.4)	49.9
9. Examples of natural enemy of pest to crops are other insects, birds, frogs, ants, and spiders.	224 (57.9)	56 (14.5)	33 (8.5)	57.9
10. Pesticides can kill the natural enemy of pests to crops.	267 (69)	27 (7)	20 (5.2)	69.0

Table 6. Distribution of practices on pesticide use (n=387)

Practices	Frequency (%)
Does not use alternative ways before using pesticide	
No	168 (43.4)
Yes	153 (39.5)
Does not use pesticide in extreme conditions like heat	
No	133 (34.4)
Yes	190 (49.1)
Handling leaking pesticide	
Cleans Immediately	284 (73.4)
Asks/tasks others to clean	9 (2.3)
Let it dry	25 (6.5)
Cleaning methods of leaked pesticides	
Flushing with water or uses hose	156 (40.3)
Uses mop or absorbent material	38 (9.8)
Others	41 (10.6)
Closes nozzle when moving away from farm or crops	
Yes	262 (67.7)
No	31 (8.0)
Missing	94 (24.3)
Location to mixing or loading pesticides	
Inside, beside or near the storage of pesticide	96 (24.8)
Far from the storage of pesticide	179 (46.3)
Distance of mixing area to irrigations or canal	
More than 400 feet away	134 (34.6)
Less than 400 feet away	144 (37.2)
Missing	109 (28.2)
Blowing sprayer when clogged	
Never	120 (31.0)
Occasionally or sometimes	67 (17.3)
Almost every time	67 (17.3)
Every time	27 (7.0)
Missing	106 (27.4)

incorrectly. Majority of the farmers (58.7%) agreed that "Pesticide use yearns more crops than any other methods." (Item 6) compared to only 7.8% who correctly disagreed. Item number 8, "Pesticide use can be harmful to crops." was disagreed upon by majority of the farmers (32.0%) while 23.8% of the farmers only correctly agreed to the statement. Lastly, majority of the farmers (30.5%) agreed on item number 12, "Pesticides are necessary if one wants to feed the growing world population with quality good food." compared to 27.9% who correctly disagreed (Table 8).

There is significant correlation between all pairs for the total scores of attitudes, practices, and knowledge. There was moderate correlation in all variables, but the highest moderate correlation was between knowledge and attitudes (Pearson correlation coefficient = 0.651). This suggests that the higher the knowledge score is, the more positive the attitude. There was moderately strong correlation between knowledge and practices (r = *0*.521). between practices and attitudes, (r = 0.443) (Table 9).

Table 7. Item analysis and proportion of correct practices (N=387)

Practices	% of Correct
Use of alternative methods before using pesticide	43.40
Use of pesticide in extreme condition such as heat	49.10
Handling leaking pesticide	73.40
Cleaning practice on leaked pesticide	9.80
Closes nozzle	67.70
Location to mixing or loading pesticides	46.30
Distance of mixing area to irrigation	34.60
Blows sprayer when clogged	52.50

DISCUSSION

A farmer is defined in this study as someone involved in the agricultural production.[18] A housewife can be a farmer as women are often engaged in the farming sector in the Philippines. Moreover, there are also farmers who are pesticide distributors and/or pesticide applicators. This study focuses on the knowledge, attitudes, and practices of farmers towards pesticide use in the Philippines.

The average score attained by the respondents in this study on knowledge aspect was 5.91 (SD ± 3.28). A study done in Iran also observed poor knowledge on pesticide use among their respondents. In their study, the item that generated the lowest score concerned the proper disposal of pesticide containers.[11] However, in the present study, majority of respondents knew that leftover pesticides should be brought back and stored properly. Another study done in Turkey observed that their respondents knew how to read the label on pesticide containers. They also found that majority of their respondents knew that pesticides could cause harmful effects to the body which should increase cautious behavior among pesticide users.[19] In addition, increased knowledge on pesticides' negative health effects may further discourage farmers from using pesticides.[20] The lack of awareness of the harmful effects of pesticides contributes to the growing dilemma of pesticide mishandling, which puts users at significant health risks.[9] These were consistent with the findings in this study.

The farmers from this study reported several alarming practices that could increase the risk of experiencing harmful effects from exposure to pesticides. One-third (39.5%) of the farmers reported that they did not find alternative ways to protect their crops from pests andt resorted immediately to the application of pesticides. This practice may stem from the knowledge that pesticide use is the best method to kill the natural enemy of crops, as well as the misconception that the use of pesticides is necessary in producing quality

Table 8. Item analysis and proportion of favorable attitudes and perception (N=387)

Attitudes/Perception	No Opinion (%)	Disagree (%)	Neutral (%)	Agree (%)	Correct Answers %
1. Odor from pesticide is harmful.	5 (1.3)	28 (7.2)	21 (5.4)	269 (69.5)	69.5%
2. Pesticide can cause cancer.	43 (11.1)	29 (7.5)	45 (11.6)	199 (51.4)	51.4%
3. Natural pesticides are more effective than chemical pesticide.	37 (9.6)	86 (22.2)	72 (18.6)	124 (32)	32.0%
4. Farmers should only be allowed by the government to use pesticide when they had training on proper use of pesticide.	18 (4.7)	46 (11.9)	36 (9.3)	221 (57.1)	57.1%
5. Plant pests account for the largest yield loss.	8 (2.1)	12 (3.1)	25 (6.5)	274 (70.8)	70.8%
6. Pesticide use yearns more crops than any other methods	13 (3.4)	30 (7.8)	49 (12.7)	227 (58.7)	7.8%
7. Pesticide is not effective if the pests are returning.	17 (4.4)	51 (13.2)	49 (12.7)	203 (52.5)	52.5%
8. Pesticide use can be harmful to crops.	34 (8.8)	124 (32)	61 (15.8)	92 (23.8)	23.8%
9. It's not harmful to health to eat crops sprayed with pesticide.	20 (5.2)	177 (45.7)	41 (10.6)	80 (20.7)	45.7%
10. It's not harmful to eat food sprayed with pesticide.	20 (5.2)	156 (40.3)	51 (13.2)	69 (17.8)	40.3%
11. Pesticides are harmful to health of people living nearby spraying area.	16 (4.1)	32 (8.3)	18 (4.7)	213 (55)	55.0%
12. Pesticides are necessary if one wants to feed the growing world population with good quality food.	27 (7)	108 (27.9)	36 (9.3)	118 (30.5)	27.9%

Table 9. Correlation analysis of total score for knowledge, attitude, and practices

Variables Correlated	Pearson Correlation Coefficient	p-value
Knowledge and Attitude	.651	<.0001
Knowledge and Practices	.521	<.0001
Attitude and Practices	.443	<.0001

foods. This is in contrast with the study by Bagheri et al.[20] among Iranian farmers who report that they only sometimes consider using eco-friendly and low-toxicity pesticides.

Another concerning observation in this study was the farmers' practice of handling leftover pesticides and handling water mixed with pesticides. Disposal of pesticides should never be done in any area of the farm field.[21] Incorrect disposal practices have also been observed among farmers in Iran,[11,20] Tanzania,[22] Ethiopia,[23] and Kuwait.[11] In a particular study done in Ethiopia[23] they found that a considerable number of farmers interviewed would store left over pesticides at home within the commonly used areas. Most farmers also disposed of their pesticide containers by discarding these in the field or nearby sources of water, burning, or burying these.[23] These practices of storage and disposal by farmers increase the risk of exposure to pesticide among farmers and bystanders.

The practice that gained the least number of correct answers (9.8%) was the cleaning practice on leaked pesticide. This meant that the farmers in this study did not properly clean pesticide containers and equipment with leaks. This is very concerning since the risk for direct contact with the chemical is very high, as well as the chances of this chemical being transferred to other exposed surfaces. Spills and leaks are frequent problems encountered by farmers during preparation, mixing, and application of pesticides. Such was the case among farmers in Ghana who reported that spills and leakage commonly occurred due to poor equipment as well as during mixing.[24]

Of all the practices mentioned, the practice that presented the greatest risk among farmers was blowing the sprayer when clogged. This occurs when the farmer uses his mouth to blow the nozzle of the sprayer to release a blockage during pesticide application. This practice should be avoided at all costs as the risk for ingestion is extremely high. The same practice was observed among farmers in Iran and Uganda.[11] An association was also found between blowing on the nozzle and the occurrence of potentially acute pesticide poisoning within the previous year.[25] Pesticides enter the body through dermal contact, ingestion, or inhalation. However, when the application medium consists of gas particles, exposure can occur through all three routes. Dermal contact may be the most common cause of pesticide poisoning but ingestion produces the most potentially fatal outcomes.[26]

The attitudes of farmers regarding pesticide use garnered an average score of 5.34 (SD ±3.31) over 12 items, suggesting that attitude level is negative. The most prevalent misconception among the farmers was that pesticide use is a necessary technique to produce more crops. Only 7.8% of farmers disagreed with this statement while 58.7% agreed with it. Their response to this statement may also be linked to their other misconception that chemical pesticides are more effective in preventing pests. Majority of farmers (32.0%) also disagreed that the pesticides used were harmful to crops, while only a few agreed (23.8%). This is important to note because studies with similar findings have observed that farmers who believed pesticides to be a necessary and plant-safe method of increased crop production were prone to use more of these chemicals.[27-29] A study among Southeast Asian countries specifically noticed that farmers who were

aware of biopesticides and insect handpicking used less pesticides by almost 31% in their crops. They also observed that for the countries of Cambodia and Laos (using more synthetic pesticides), farmers reported more symptoms than those from Vietnam (using less synthetic pesticide and more alternatives). It was suggested by Schreinemachers et al. that one of the ways to reduce synthetic pesticide use is to increase awareness and accessibility of biopesticides and other pesticide alternatives.[29] Likewise, the farmers in this study showed inadequate knowledge and practices in relation to mixing and loading of pesticides, which may have implications in spillage factor as shown in the cumulative exposure level study in Indonesia.[30]

The attitudes of farmers reveal that they are aware that pesticides are potentially harmful to the bodies of humans. This is shown by their disagreement with the statements that crops sprayed with pesticides are not harmful to eat. Majority of farmers (55.0%) also agreed with the statement that pesticides are harmful to the health of individuals living near spray areas. However, being aware of pesticide's harmful potential is not enough for them to restrict its use. The same observation was found in other studies and was justified through the attitudes that the gains from pesticide use is greater than the risks.[27,29,31] The reason why farmers believe the gains to be greater than risks is due to insufficient knowledge on the actual risk of pesticide and its long-term implications. This is because various studies who have found farmers to decrease pesticide use did so after undergoing a form of training on proper pesticide management and safe handling.[27,28,31] Bhandari et al. found that perceived barriers to a farmer's production lead to negative pesticide safety practices while perceived benefits produced the opposite.[27] In this study, the farmers can be focused more on the increase in loss if they reduce pesticide use, rather than the health benefits of using safer alternatives, hence the necessity of pesticide training among farmers.

It is important to first improve knowledge on proper pesticide use among farmers as knowledge can influence attitudes and in turn their perception as shown in the results of this study among farmers in the Philippines. Correlation analysis showed that knowledge positively influences both attitude and practice, with the highest positive correlation evident between knowledge and attitudes ($P < 0.0001$). Similarly, attitude positively influences practices as well ($P < 0.0001$). This is consistent in the study of Bagheri et al.[13] among Iranian farmers. They observed that knowledge, attitudes, and perceptions all played influencing roles in the behaviors of farmers with regards to the use of pesticides. Of the three, knowledge had the greatest variability measure. They also found that knowledge produced a significant measure of variability on the attitude of farmers, which subsequently produce variability in their perception.[13] In Ethiopia, those with good knowledge and attitude were more likely to have better practice on pesticide use in terms of handling and storing.[17] In Iran, it was found that farmers that have good knowledge and attitude towards corresponded with their use of protective equipment when using pesticides.[11]

Knowing these, improving the attitudes and practices of farmers first begins with increasing their knowledge and awareness on pesticides and its harmful effects on the body, most especially since the respondents exhibited low knowledge on proper pesticide use. The implementation of a training program on safe pesticide use may be useful in increasing knowledge as exhibited in a study done in Nepal by Vaidya et al.[32] They found that those who underwent training exhibited higher knowledge scores than a control group who did not. In addition to this, after the training, the number of symptoms from pesticide use reported from this group decreased, while the opposite was observed for those in the control group.[32] Bagheri et al.'s study among Iranian farmers emphasized the dangers to health when there is poor knowledge on pesticides.[20] They observed that the farmers rarely seek professional help when experiencing symptoms of pesticide poisoning because most believed that the symptoms were natural occurrences from the use of pesticides rather than the occurrence of poisoning.[20]

CONCLUSION

Pesticide use in the Philippines remains challenging in terms of its safety to humans and the environment. Results from this study showed that most farmers did not have adequate knowledge on pesticides nor the proper attitude and practices in several items relating to pesticide. There is a correlation between knowledge, attitude, and practices that suggests that information dissemination is needed to correct attitude and unsafe and unhealthy practices.

It is recommended that capability building and training for farmers are initiated to address inadequacies in their KAP of pesticides. It would also be beneficial to provide knowledge on safer alternatives for toxic pesticides, and provide access to these as it may encourage a reduction in the use of harmful pesticides.

Statement of Authorship

The author conceptualized the work; acquired and analyzed the data; drafted and revised; and approved the final version to be published.

Author Disclosure

The author declared no conflicts of interest.

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