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Synthetic Pesticides and Farmer Health Awareness in Alegria, Surigao del Norte, Philippines

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ABSTRACT

Purpose: *This study aims to evaluate the effects of pesticide use on the health of farmers and raise awareness and knowledge of the proper use, handling, application, and waste disposal of pesticides to prevent detrimental effects on their health.*

Research Method: *The study used a close-ended structured survey questionnaire and employed non-probability sampling based on convenience in selecting 100 farmers. The survey gathered data on the socio-demographic characteristics of the participants, pesticide use, mixing and application of pesticides, after-spraying practices, and farmers' health. Descriptive statistics were used to analyze the collected data.*

Findings: *The study found that over half of the participants perceived symptoms of pesticide poisoning (68%). The most prevalent complaints felt by farmers right after applying pesticides were skin irritation (50%), dry throat (35%), headache (16%), eye irritation (11%), nose irritation (9%), dizziness (4%), blurring of eyes (2%), and weakness or fatigue (1%). These symptoms were attributed to the longevity of pesticide exposure, unsafe storage practices, improper disposal of empty pesticide containers, and the lack of use of personal protective devices.*

Research Limitations: *The study is limited by the non-probability sampling method used in selecting the participants, which may limit the generalizability of the results. Moreover, self-reporting and recall bias may have also affected the accuracy of the data collected.*

Originality/ Value: *According to the research, farmers must be educated on pesticide usage, handling, application, and disposal to avoid health problems. The report also calls for legislative initiatives to address pesticide abuse and safety in agriculture, especially in rural regions.*

Keywords: *Agricultural practices, Farmer health, Hazardous chemicals Pesticide toxicity, Rural populations, Sustainable agriculture.*

INTRODUCTION

Pesticides have significantly increased food production, with an estimated 3.2 million tons of pesticides used annually. However, pesticides are highly toxic and pose significant risks to humans, animals, and the environment (DOH, 2010). Wildlife can be adversely affected by pesticide drift, secondary poisoning, and runoff into water bodies. In contrast, pesticide exposure has been linked to various health issues, including cancer, reproductive effects, and neurotoxicity (Adel and Akefiwad, 2020). Pesticides can also contaminate soil, water, and vegetation, causing harm to non-target organisms (de Paiva Ferreira and Mendes, 2021).

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Farmers, who handle, dilute, mix, and apply pesticides, face significant occupational risks from exposure to these chemicals (Damalas and Eleftherohorinos, 2011; Rani *et al.*, 2021). Pesticides can enter the body through the skin, lungs, or ingestion, with skin absorption being the most common route of exposure (Pease *et al.*, 2005; Blackburn *et al.*, 2015). A single exposure incident can have severe consequences, including respiratory tract irritation, allergic sensitization, and even death (Ballantyne, 2005; Arbak *et al.*, 2014).

With an estimated 1.3 billion workers engaged in agricultural production worldwide, including 41 percent of the labor force in the Philippines, pesticide poisoning is a significant public health concern (Boedeker *et al.*, 2020). Previous studies have shown that farmers in the Philippines exhibit symptoms of pesticide poisoning attributed to improper storage, disposal, and application of pesticides (Perez *et al.*, 2015). Farmers must have adequate knowledge of pesticide hazards, use personal protective equipment, and follow safe application practices to ensure their safety, the environment, and the general public (Mequanint *et al.*, 2019).

This study, conducted among farmers in Alegria, Surigao del Norte, Philippines, intends to examine and evaluate the knowledge and practices of farmers in managing pesticides as well as the effects of different methods on their health in order to address these concerns. In order to avoid adverse effects on farmers' health, the study's findings will increase awareness and encourage correct pesticide usage, handling, and application techniques.

MATERIALS AND METHODS

Research Locale

The study was conducted in the Alegria, Surigao del Norte, in the Caraga region of Northeastern Mindanao, Philippines, from September to December 2021 upon the approval by the college research ethics and review committee of Surigao del Norte State University. The Municipalities of Mainit and Tubod bound Alegria to the north, the Municipality of Bacuag to the east, Lake Mainit to the west, and the Municipality of Kitcharao to the south. Alegria has a rolling terrain with an average elevation of 480 meters above sea level and a maximum elevation of 975 meters of the Kinabutan range (Figure 1). Nearly 50% of the area is highly suitable for agricultural production, contributing to the overall socio-economic development of Alegria (Municipality of Alegria, 2021).

Participants

This study involved Alegria local farmers who use synthetic pesticides on their farms, including rice, vegetable, and mango farms. Non-probability sampling was used to select participants from each barangay in the municipality. Farmers who use pesticides were eligible to participate, regardless of gender, age, education, or ability to pay. The study selected 100 farmers using non-probability sampling for convenience.

Data Collection

The descriptive study used a survey questionnaire to collect data from participants. The survey questionnaire was a modified version of Perez *et al.* (2015) and Okafoagu *et al.* (2017), with additional information from CCOHS (CCOHS, 2017). The questionnaire was divided into six sections: (1) Sociodemographic characteristics; (2) Pesticide use; (3) Pesticide mixing practices; (4) Pesticide application; (5) After spraying habits; and (6) Farmer's health. The questionnaire was delivered individually to participants, and the researcher acted as a facilitator to aid respondents with any queries or confusion. Photographs and documentation were taken with the participant's consent during the distribution of the questionnaires.

Data Analysis

We did a content analysis for this study by gathering data from a sample of farmers via survey questionnaires. The data were then organized, divided, and coded for analysis purposes. We calculated proportions and percentages to illustrate the study's findings. The number of farmers who agreed with each question/option was used to calculate proportions, while percentages were based on the proportion of the total number of participants. These descriptive statistics shed light on the data's patterns and trends, allowing us to form inferences and make recommendations based on the results.

RESULTS AND DISCUSSION

Farmers' Socio-Demographic Characteristics

This study involved 100 rice farmers and one farmer each producing cacao, sweet potato, and maize, with all 101 farmers using pesticides. Among these populations, 98 farmers were active in other agricultural operations, such as seed and land preparation, weed control, fertilizer application, and post-harvest management (Table 1). Men comprised

Figure 1: Map of the research locale.

the majority of pesticide applicators (98%), with only a minor proportion of women (2%). This reflects the male gender's dominance in farming in the studied area. Most female farmers did not apply pesticides, as they actively participated in other farming operations due to the weight of the knapsack sprayer (Perez *et al.*, 2015). Most participants (71%) worked on a farm of 1-3 hectares, with 35% owning a farm, half of the participants being tenants, and the remaining 15% being laborers/caretakers.

Regarding age, 77% were 31 and older, indicating a predominantly adult population (Figure 2). Agricultural employment may be unappealing to younger generations due to the hard labor frequently associated with farming (Perez *et al.*, 2015). Most of these farmers (87%) worked on farms for more than ten years, which is a long time of pesticide exposure that could harm their health depending on pesticide handling and application procedures.

All participants went to school, with more than half-finishing or achieving elementary (60%) and secondary (33%) education, and some even attending higher levels (7%). Most participants (85%) were married with children, whereas 13% were single, and two farmers (2%) were widows. Only Thirteen (13) farmers lived close to the farm/field, implying that 13% of the population had their homes/families exposed to farm pesticides. On their farms, all volunteers planted twice a year and used exclusively manual spraying methods (use of Knapsack sprayer).

Pesticides Used

All participants (100%) had been using pesticides for more than a year, and the majority of the research population (87%) had been using pesticides for more than ten years. These data indicate that those farmers have been exposed to pesticides for a long time, making them more susceptible to the chemicals' adverse health consequences. Exposure to pesticides over an extended period and regularly could impair farmers' health and, consequently, their output (Rola and Pingali, 1993; Rahmat *et al.*, 2018).

In addition to synthetic pesticides, organic pesticides were reported to be used by 43 farmers (43%) for pest management. Most of their reasons for abandoning this alternative control are that organic pesticides are very time-consuming (28%)—eighty-five percent of the people independently choose which pesticide to use. Most individuals can read and comprehend the pesticide's label (91%), and more than half of the population follow the label's instructions (61%). Since the majority of these farmers were educated, this was expected. According to previous research (Leungo *et al.*, 2012; Perez *et al.*, 2015), all farmers who were questioned for this study read pesticide labels. In addition, important information provided by pesticide manufacturers was added to assist farmers in adequately handling and using pesticides. Pesticide use by farmers is characterized by the use of 49 synthetic chemicals, as indicated in Table 2.

Table 1: Farmers' Socio-demographic Characteristics (N=100) in Alegria, Surigao del Norte

	Characteristics	N	(%)
Sex	Male	98	98
	Female	2	2
Age	1-20	1	1
	21-30	6	6
	31-40	16	16
	41-50	15	15
	51-60	38	38
	>60	24	24
Educational attainment	No schooling	0	0
	Elementary	60	60
	High school	33	33
	College	7	7
Marital status	Single	13	13
	Married	85	85
	Widow	2	2
Farmer's home located near the field	Yes	13	13
	No	87	87
Number of years working as a farmer	1-3 years	4	4
	4-5 years	5	5
	6-10 years	4	4
	>10 years	87	87
Owned a farm	Yes	35	35
	No	65	65
If not owned a farm	Caretaker	5	5
	Laborer	10	10
	Rent the land (tenant)	50	50
	Lease	0	0
Area of the farm (hectares)	<1	23	23
	1-3	71	71
	4-6	3	3
	7-9	1	1
	10->10	2	2
Responsible for farming activities (planting, harvesting, spraying, etc.)	Yes	98	98
	No	2	2
Type of crop planted	Rice	100	100
	Cacao	1	1
	Sweet potato	1	1
	Corn	1	1
Times of planting in a year	1	0	0
	2	100	100
Method of farming	Manual	100	100
	Mechanized	0	0

Rogue, Brodan, and Machete are the most widely used insecticides, while nearly half of the participants use 2.4-d and Endrin. Rogue is primarily used to eliminate weeds and is applied once every cropping cycle by 73.3% of users.Most Rogue users (20.54%) use 1-2 sardine cans per spraying container. Brodan is used by 59% of farmers and is typically applied 4-6 times every cropping cycle. Most users (38.99%) use 1-2 medication cups per spraying container. Most Machete herbicide users (25.45%) use 1-2 sardine cans per spraying container and apply the herbicide once every cropping cycle (98.18%). Additionally, most users spray 2.4-d herbicide once every cropping cycle (77.14%) and use 1-2 medication cups per spraying container (22.81%). While Endrin is typically sprayed 4-6 times each crop cycle, most users apply 1-2

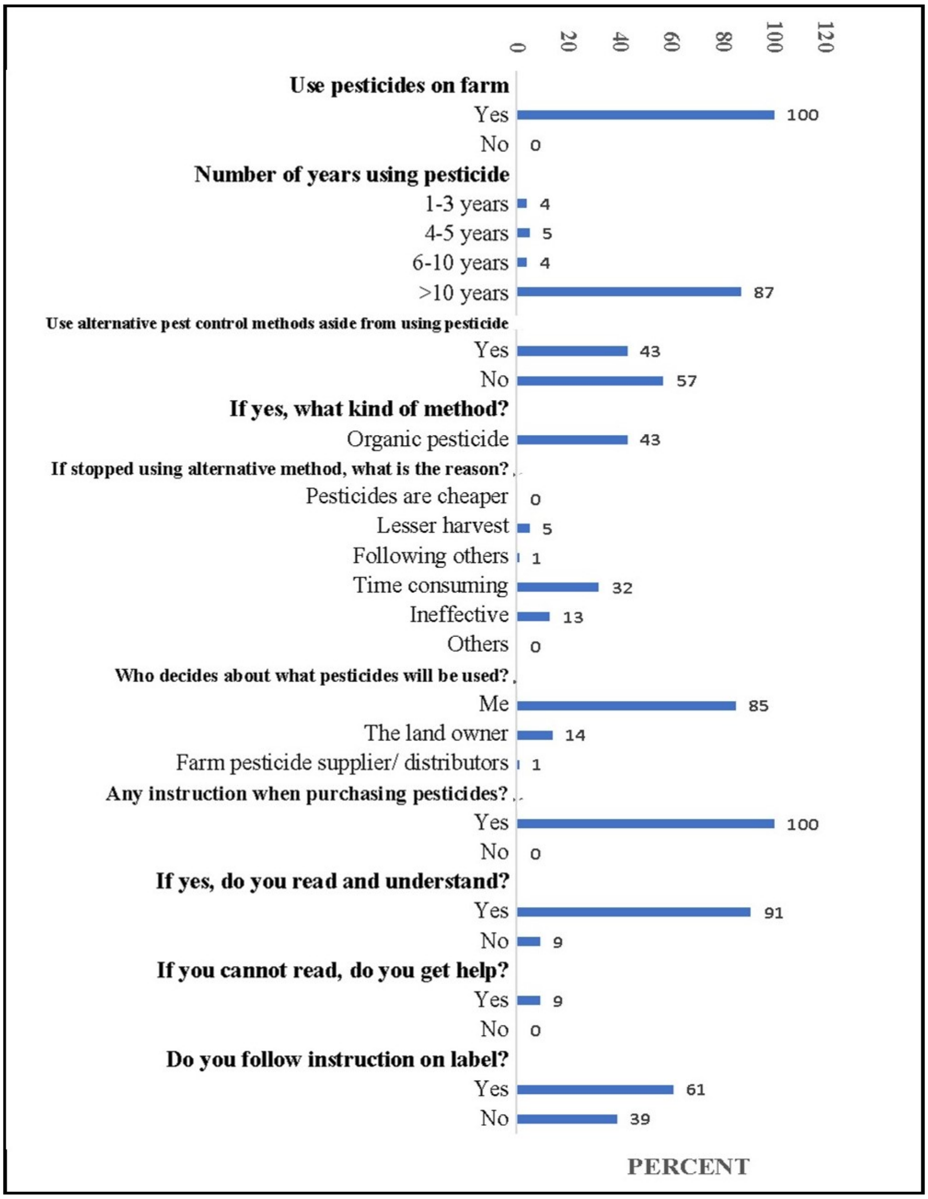

Figure 2: Pesticides used by the farmers (N=100) in Alegria, Surigao del Norte.

medication teaspoons per spraying container.

Unfortunately, the most widely used and prevalent pesticides are inexpensive, widely accessible, potent, and harmful. Participants often consider stronger insecticides more effective and offer better crop protection. Prohibited or restricted pesticides that have a lethal impact on human health tend to be the least expensive in the market, according to previous studies (Recena, 2006; Bagheri *et al.*, 2021). Law enforcement of regulations prohibiting toxic pesticides in the Philippines is another reason farmers can use hazardous chemicals while being aware of their possible health concerns (Rola and Pingali, 1993; Rahmat *et al.*, 2018).

There is abundant evidence that the massive use of pesticides poses a danger to human health and other living forms and has negative environmental impacts. Long-term, low-dose exposure to some pesticides may affect the natural hormone characteristics of humans, resulting in immunological suppression, hormone disruption, reduced IQ, reproductive abnormalities, and cancer (Dey, 2010; Brhich *et al.*, 2022). Other studies have linked pesticide exposure to an increased risk of prostate cancer (Koutros *et al.*, 2013), sarcomas, multiple myelomas, cancer of the pancreas, lungs, ovaries, breasts, testicles, liver, kidneys, intestines, and brain tumors, as well as aberrant sperm quality and numbers (Hossain *et al.*, 2010). Surface and groundwater pollution via runoff, leaching from treated soil, and air contamination from pesticide sprays that may spread and ultimately kill or harm non-target plants, fish, birds, and other animal species are unintended environmental impacts (Lamers *et al.*, 2011; Ganaie, 2021).

Table 2: Names of the pesticides used by the participants (N=100) in Alegria, Surigao del Norte

Pesticide Name	Target Pest	N	%	No. of Times Applied per Cropping Cycle	Amount of Pesticide per Spraying Container
Rogue	Weeds	73	73	1 (84.93%)	1-2 Sardines can (20.54%) 3-4 Sprayer Cup (19.18%) 1-2 Medicine Cup (17.81%) 1-2 Sprayer Cup (13.69%)
Brodan	Insects	59	59	4-6 (44.07%) 1-3 (27.12%)	1-2 Medicine Cup (38.98%) 1-2 Sprayer Cup (16.95%)
Machete	Weeds	55	55	1 (98.18%)	1-2 Sardines can (25.45%) 1-2 Medicine Cup (16.36%) 3-4 Medicine Cup (14.54%) 3-4 Sprayer Cup (14.54%)
2.4-d	Weeds	35	35	1 (77.14%)	1-2 Medicine Cup (22.86%) 3-4 Sprayer Cup (20%) 3-4 Medicine Cup (17.14%)
Endrin	Insects	33	33	4-6 (51.51%)	1-2 Medicine Cup (39.39%) 1-2 Sprayer Cup (21.21%)
Lannate	Insects	29	29	4-6 (55.17%)	1 Sachet (65.52%)
Inferno	Insects	27	27	4-6 (40.74%)	1-2 Medicine Cup (55.56%)
Lampas	Weeds	20	20	1 (95%)	41-50 ml/Measuring Cup (30%) >50 ml/Measuring Cup (20%)
Winner	Insects	17	17	1-3 (41.18%) 10->10 (23.53%)	1-2 Medicine Cup (35.29%) 1-2 Sprayer Cup (23.53%)
Karate	Insects	14	14	7-9 (50%)	1-2 Sprayer Cup (35.71%) 1-2 Medicine Cup (21.42%)

Mixing of Pesticides

The findings of this study reveal some concerning behaviors among farmers regarding the mixing of pesticides. Specifically, only a small percentage of farmers (9%) reported using gloves while mixing pesticides and refilling tanks (Figure 03). This indicates farmers' lack of concern for personal protective equipment, which could result in serious health consequences. Interestingly, many farmers reported mixing two or more types or brands of pesticides (80%) to increase efficacy and pest control. However, this approach can be dangerous due to pesticides' synergistic or amplifying action, as noted by previous research (Okafoagu *et al.*, 2017). Farmers must be aware of the potential dangers of mixing different types of pesticides and follow recommended safety protocols when doing so.

Farmers in this study also reported altering their pesticide dosage due to pesticide resistance, a desire for greater efficacy, or recommendations from their distributor or farm owner. While it is understandable that farmers may want to increase the effectiveness of their pesticide use, it is important to follow recommended dosage guidelines to avoid adverse health and environmental impacts.

Application of Pesticide

All participants in the study reported using knapsack sprayers to apply pesticides, as shown in Figure 04. The majority of participants (49%) applied pesticides every week. Notably, all participants reported observing wind direction before starting a spraying session, indicating

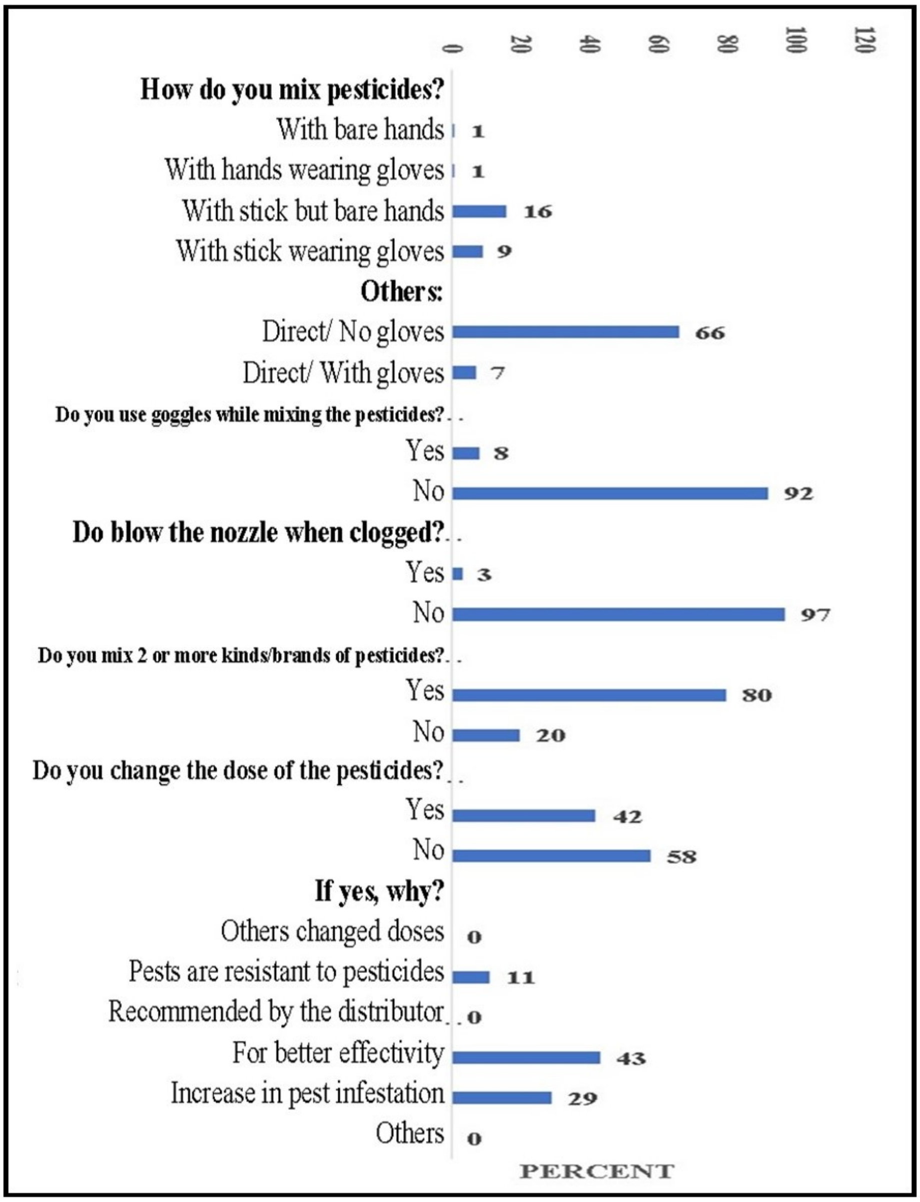

Figure 3: Farmer's practices in mixing pesticide (N=100) in Alegria, Surigao del Norte.

an awareness of the importance of reducing pesticide exposure. However, an alarming finding was that 38% of the participants still sprayed even in strong winds, which could increase the risk of inhalation and skin absorption (De Vreede *et al.*, 1998; Figueiredo *et al.*, 2021). Drinking while spraying was reported by 35% of the participants, which is a worrisome behavior that may increase their exposure to pesticides and have negative health impacts in the short and long term (Okafoagu *et al.*, 2017).

All farmers did not fully comply with the use of personal protective gear and clothing during spraying. While the majority of participants wore hat/head covers (98%), full-sleeve shirts (99%), full-length trousers (99%), and masks (66%), most of these items were made of absorbent cotton, which is not suitable for pesticide spraying. It has been reported that cloth facemasks are not appropriate personal protective devices for some chemical contaminants and may even increase the absorption rate of pesticides (Dey, 2010; Perez *et al.*, 2015).

In addition, disposable dust masks may not prevent the passage of hazardous pesticide fumes (Lekei *et al.*, 2014). Only 9% of the participants wore protective goggles, 13% wore gloves, and most did not wear shoes or rubber boots (95%) while spraying, as it made it difficult to move around the rice field. Factors such as discomfort, high cost, and hot climate were cited for partially utilizing personal protective equipment (Perez *et al.*, 2015). However, inadequate use of protective gear could increase the risk of dermal, ingestion, and inhalation exposure to pesticides, which have been identified as common routes of entry into the human body (Del Prado-Lu, 2007; Zyoud *et al.*, 2010; Wang *et al.*, 2017a). In particular, dermal exposure is the most significant route of absorption,

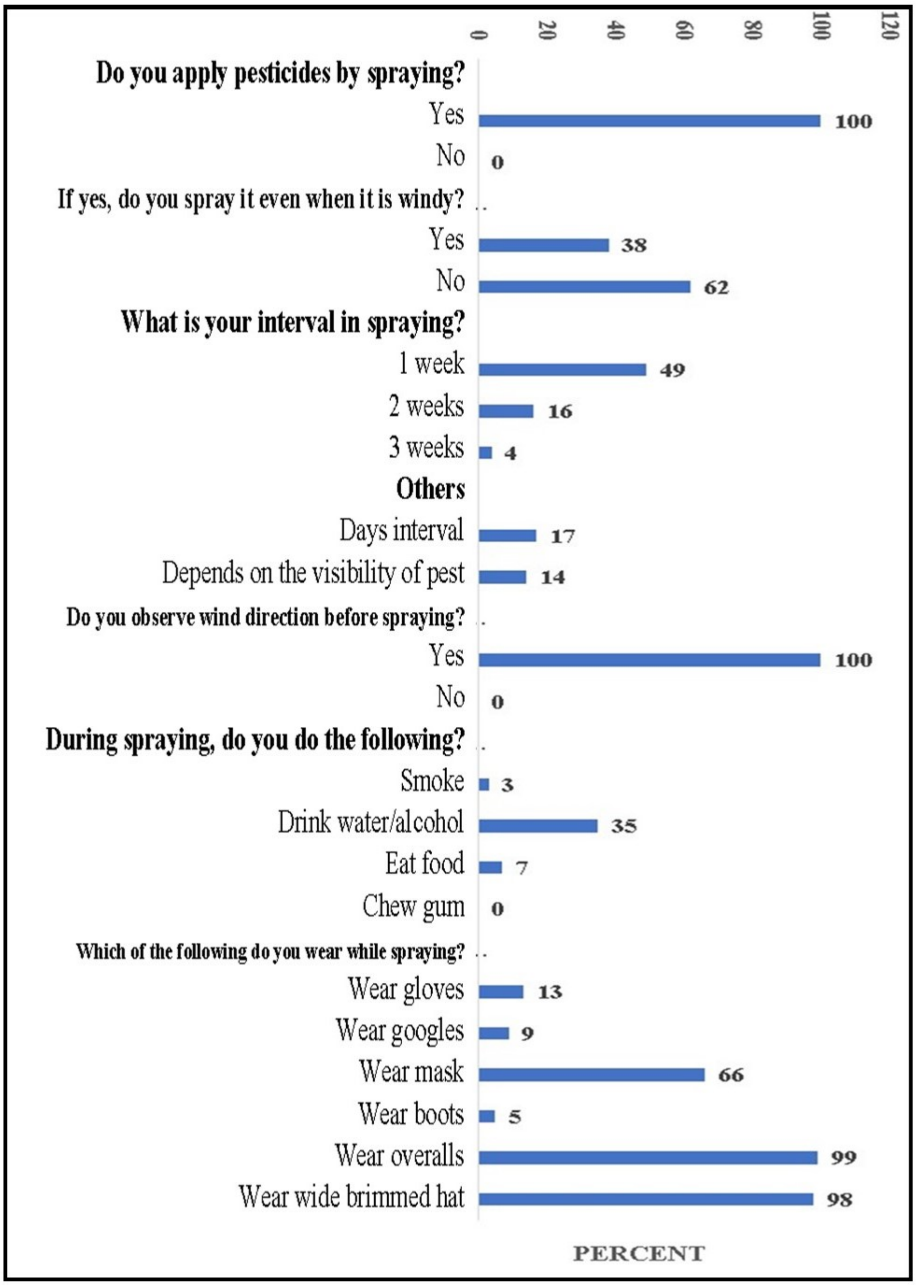

Figure 4: Pesticide application practices of the farmers (N=100) in Alegria, Surigao del Norte.

leading to acute pyrethroid poisoning (Sapbamrer and Nata, 2014; Boedeker *et al.*, 2020). Inadequate use of protective gear has also been reported in other countries, including India, Cambodia, Bangladesh, Indonesia, China, the Middle East, most African countries, and Latin America (Perez *et al.*, 2015). Studies have shown that using protective measures can result in a decrease in pesticide exposure, including the use of gloves by farmworkers (Okafoagu *et al.*, 2017).

After Spraying

Farmers' health: All participants followed sanitary practices such as changing clothes and washing after spraying. Specifically, 100% of participants reported washing their hands with soap and water and changing clothes, while 85% took showers (Figure 05). These findings are consistent with other studies, showing that farmers recognize the importance of removing pesticides from their bodies by washing and changing clothes to reduce the health risks associated with exposure (Jensen *et al.*, 2011; Sapbamrer and Nata, 2014; Boedeker *et al.*, 2020). Most participants reported washing and cleaning their knapsack sprayers after spraying sessions along nearby canals or rivers (71%), some did so directly on the field (20%), and a few washed them in the faucet or pump well at home (18%) or nearby well (3%). However, improper areas for washing/cleaning knapsack sprayers can harm human health and the environment by killing the natural enemies of pests and other non-target organisms, such as birds, frogs, fishes, spiders, dragonflies, and other insects (Perez *et al.*, 2015; Saeed *et al.*, 2017). Regarding the storage and disposal of

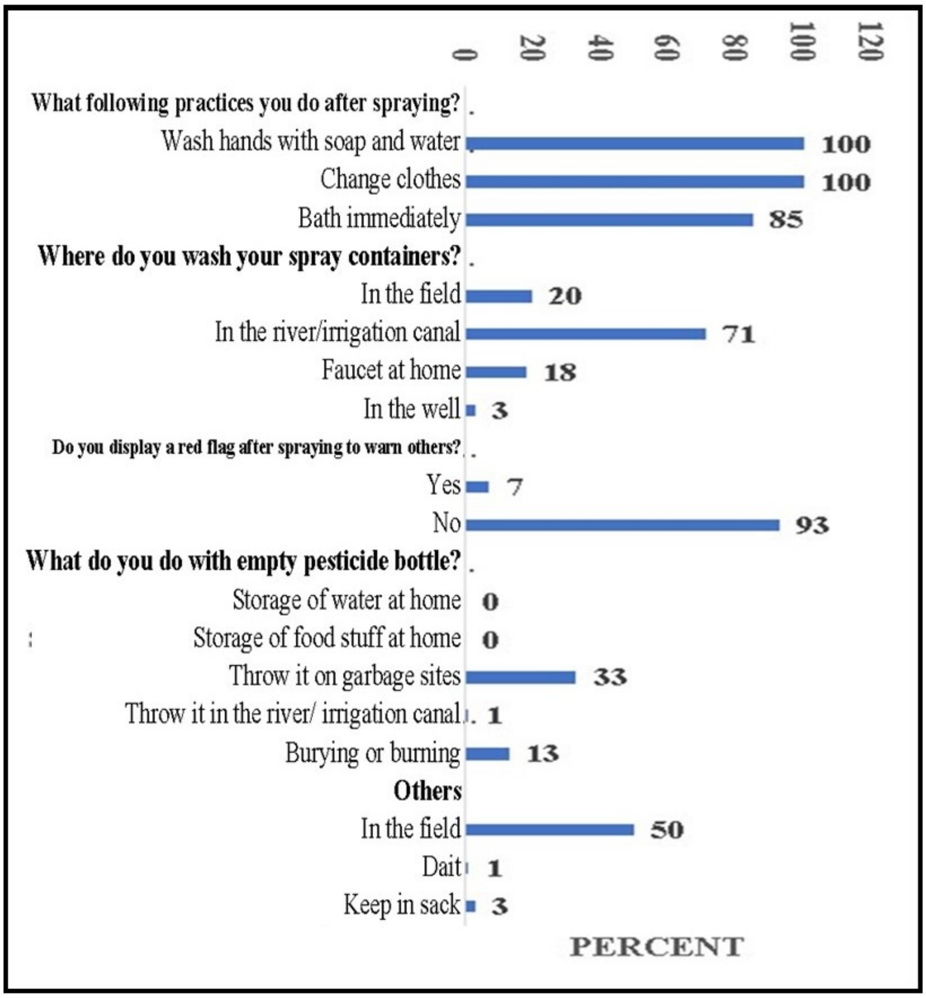

Figure 5: Farmer's activities after spraying of pesticide (N=100) in Alegria, Surigao del Norte.

empty pesticide bottles, half (50%) of the participants reported leaving them anywhere in the field, which is an unsafe practice and has been reported as a significant problem in several studies (Okafoagu *et al.*, 2017). However, 33 participants reported keeping the empty containers in special storage with waste materials or in places that are not easily accessible to children. Additionally, 13% of participants reported burying or burning empty pesticide bottles, but there were no reports of farmers keeping these empty pesticides in the kitchen with other utensils, a practice that could expose children and adults to hazardous risks. Improper dumping of empty pesticide containers, such as discarding them in immediate surroundings, local waste bins, or burying and reusing them at home, can harm the environment and the general public (Perez *et al.*, 2015; Saeed *et al.*, 2017).

Lifestyle habits of the farmers: It is concerning to note that almost half of the participants reported a history of smoking (Figure 06. This is consistent with other studies conducted in agricultural settings where smoking is common among farmers (Wang *et al.*, 2017b). It is important to note that smoking is a major risk factor for many diseases, including respiratory illnesses such as chronic bronchitis and lung cancer, which could be exacerbated by pesticide exposure (Alavanja *et al.*, 2013; Koutros *et al.*, 2013; Mostafalou and Abdollahi, 2017). Furthermore, the number of cigarettes consumed by some farmers in this study are alarming, as they reported smoking 1-2 packs or boxes daily. This indicates a need for targeted interventions to reduce smoking prevalence among farmers and increase awareness about the health risks associated with this habit. Nevertheless, it is concerning that most individuals admitted to only sometimes drinking alcohol. Alcohol consumption, particularly at high levels can impair judgment and lead to unsafe pesticide-handling practices, putting the farmers and the environment at risk (Wang *et al.*, 2017a; Dar *et al.*, 2020).

Sign and symptoms of pesticide poisoning: Figure 07 shows that the signs and symptoms of pesticide poisoning among farmers in the present study are consistent with previous research that has reported skin and eye irritation as the most common symptoms experienced by farmers after pesticide exposure (Sapbamrer and Nata, 2014; Nagami *et al.*, 2017). However, it is alarming that despite experiencing

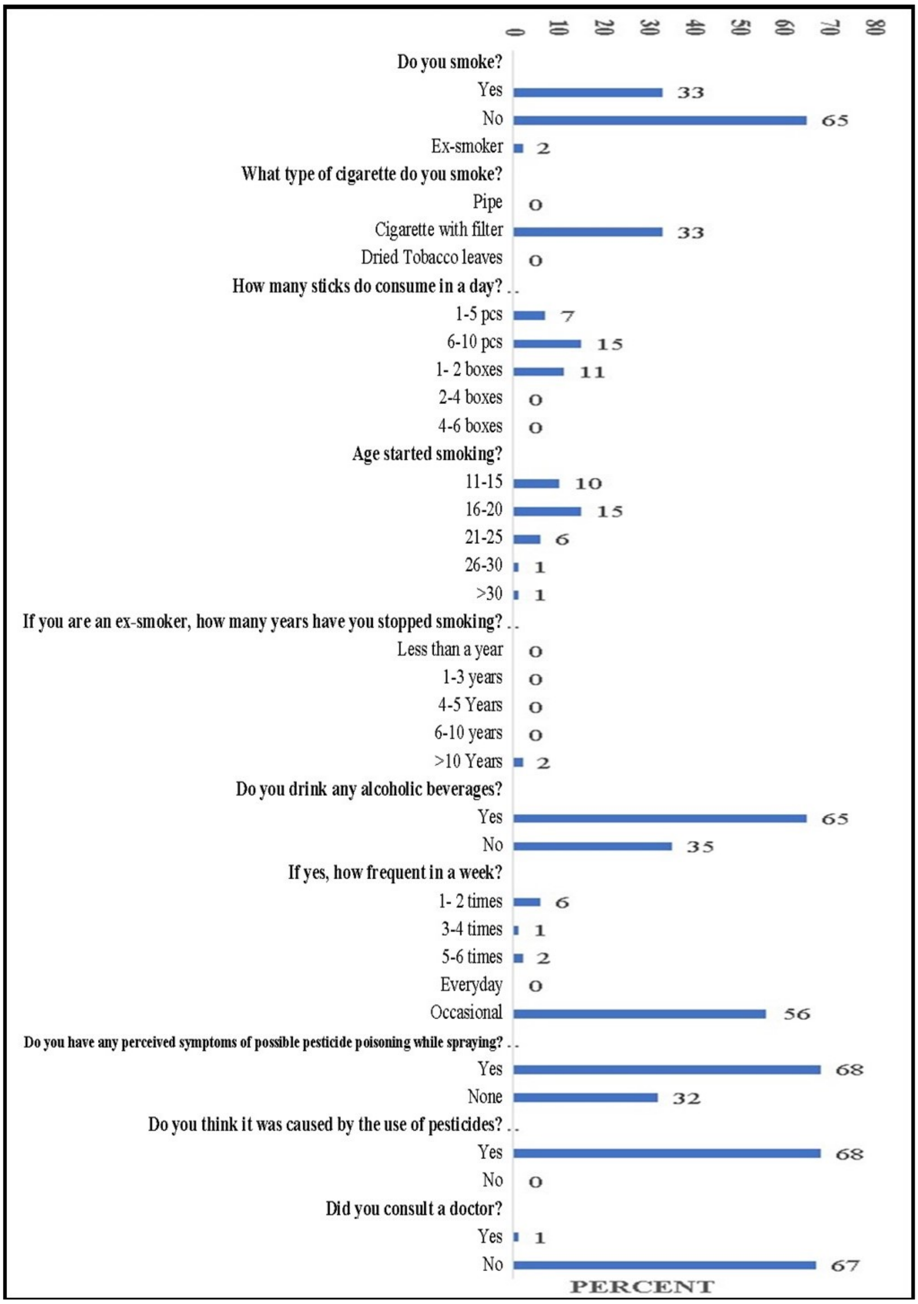

Figure 6: Lifestyle habits of the farmers (N=100) in Alegria, Surigao del Norte.

Figure 7: Signs and symptoms of pesticide poisoning.

such symptoms, many farmers do not seek medical attention and instead rely on self-remedies that may not be effective or safe. This may be due to various factors, including lack of access to healthcare facilities, inadequate knowledge of pesticide toxicity, and the perception that the symptoms are not severe enough to warrant medical attention. Farmers' low utilization of personal protective devices (PPDs) in the present study is a cause for concern as it increases their risk of pesticide exposure and related health effects. Studies have shown that using appropriate PPDs, such as gloves, goggles, and respirators, can significantly reduce pesticide exposure and related health risks among farmers (Harris, 2000; Sapbamrer and Nata, 2014; Lu, 2015).

CONCLUSION

The results of this study highlight the prevalence of symptoms of pesticide poisoning among Filipino farmers in Alegria, Surigao del Norte. The longevity of pesticide exposure, unsafe practices in the storage and disposal of pesticides, and lack of use of personal protective equipment were identified as contributing factors to this problem. Factors such as the high cost and discomfort associated with protective gear were also found to limit its use among farmers. Farmers must receive proper training on safe pesticide use and the use of personal protective equipment to reduce health risks associated with pesticide exposure.

The study also revealed an overuse of insecticides and herbicides among participants, which may decrease the effectiveness of reducing the risk associated with pesticide use. Some farmers hesitated to reduce pesticide use because they believed it would decrease farm output. Additionally, some farmers reported discontinuing alternative pest control methods, such as organic pesticides, due to the perceived inefficacy and time-consuming nature.

Putting farmers' health first when using synthetic chemicals to protect both farmers and the environment is crucial. Proper training and awareness raising on safe pesticide handling practices, including proper storage and disposal of pesticides and the use of personal protective equipment, must be emphasized. Additionally, it is crucial to promote alternative pest control methods, including organic pesticides, through education and extension services. By implementing these measures, the health and well-being of farmers in Alegria, Surigao del Norte, can be safeguarded while promoting sustainable agricultural practices.

Farmers need thorough training in pesticide handling and alternative pest management methods. Regular monitoring of pesticide safety and education on hazards and prevention are essential. Encouraging farmers to join local groups fosters idea exchange, provides access to inputs and protective gear, and facilitates market access. Local agriculture units should promote integrated pest management for sustainable and cost-effective practices. Enhanced regulation and grassroots monitoring through peer groups will ensure access to quality chemical crop protection products.

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