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Pesticide Knowledge and Safety Practices among Vegetable Farmers of Iloilo City, Philippines

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Abstract

The unsafe and indiscriminate usage of pesticides in agriculture presents a major hazard to human health and the environment. This study aimed to assess to levels of knowledge, attitude, and practices of vegetable farmers of Iloilo City toward the safe use of pesticides. A total of 125 farmers participated in this study through site interviews and farm observations. The majority of the farmers are well knowledgeable that pesticides were harmful to health (71%) and the environment (67%). However, farmers' attitude toward pesticide safety and usage is insufficient. Over 81% of the farmers did not follow pesticide instructions on labels, and 62% did not use personal protective equipment such as respirators and protective boots (29%). Regardless of education, farmer respondents were significantly more likely not to use boots (x^2 = 165.95, $p<0.05$) and respirators (x^2 =187.33, $0<0.05$) during spraying. An alarming result on the application of pesticides not based on the recommended dosage was practiced by 90% of the farmer respondents (x^2=78.90, $p<0.05$) regardless of the number of years engaging in vegetable production. The same is true with the application of pesticide a week or few days before harvesting was almost practiced by the majority of the farmer respondents (x^2=56.01,$p<0.05$). A significant number (81%) of the farmers reported dizziness and fatigue (67%) as symptoms of acute pesticide poisoning. Although farmers' knowledge of pesticide hazards was high, the reported safety measures were poor. Comprehensive intervention measures to reduce the health and environmental risks of pesticides are needed, including pesticide safety training programs for farmers, stringent enforcement of pesticide laws, and promotion of integrated pest management and non-synthetic methods of pest control.

Keywords: farmers, health hazard, knowledge, safety practices, vegetables.

Introduction

Pest and disease infestations are common occurrences in agricultural production. Productivity of crops grown for human consumption is at risk due to the incidence of pests, especially weeds, pathogens, and animal pests. Crop losses due to these harmful organisms can be substantial and may be prevented or reduced, by crop protection measures Markett, 2005).

Pesticides have become an integral part of farmer's life, and play a major role in increasing agricultural productivity. However, the indiscriminate and over-usage of pesticides are the major environmental and public health problems that arise nowadays. The food safety issue has become a public health priority. Serious outbreaks have been reported over the past few decades because of eating unsafe food (Aban, et.al). Implications include secondary pest outbreaks, destruction of nontarget and beneficial organisms, soil, water, and air contaminations and residues in primary and derived agricultural products. These results undoubtedly endanger both the environment and human health. The improper handling and usage usually go hand in hand with the farm workers' exposure to chemical hazards which can be associated with an adverse health condition. Aside from direct exposure through handling and lack of protective clothing during application, improper storage and disposal practices and poor maintenance of spraying equipment are among the contributory causes of hazards to human and the environment.

Iloilo City is a highly urbanized city in the province of Iloilo. Aside from being awarded as one of the cleanest urbanized cities in the Philippines and the site of high-rising trade and commerce in western Visayas, its agriculture industry is amazingly growing that enables it to supply the needed requirements of its population of high-value vegetables. At present, the City has the Federation of vegetable farmers association consisting of five farmers associations within the City.

These are the following:

Tagbak Vegetable Growers Association

Lanit Vegetable Farmers Association

Sambag, Jaro Vegetable Farmers Association

Mandurriao Vegetable Farmers Association

Tacas, Jaro Vegetable Association

Personal communication and field visits to these associations' vegetable areas, revealed overreliance to synthetic pesticide.

In this study, we mainly focused on the understanding of farmers' knowledge and practices concerning pesticide safety. This is vital not only for identifying exposure conditions and knowledge gaps, but also to

provide valuable information that can contribute to educational and policy recommendations aimed at preventing or reducing the health and environmental hazards associated with pesticide usage. Therefore, this paper aims to assess the levels of knowledge, attitude and practices, of Iloilo City vegetable farmers regarding the safe use of pesticides.

Methodology

Questionnaire Development and delivery

The study was conducted from January to August 2022 at the five (5) major vegetable-producing barangays of Iloilo City, Philippines, namely:

Barangay Tagbak, Jaro, Iloilo City

Camalig, Jaro, Iloilo City

Sambag, Jaro, Iloilo City

Jibao-an, Manduriao, Iloilo City

Lanit, Jaro, Iloilo City

Data were collected through actual field observation and face-to-face interviews with 125 farmers who are directly involved in farm management and pesticide use. There were 25 vegetable farmer respondents selected from each Barangays. The sample size (125 farmers) was determined using the Sloven formula to provide a good estimate of the sampled population.

Purposive sampling will be used in the study. The questionnaire included closed and open-ended questions. The closed questions were set in a multiple choice format so that respondents have to select only the appropriate answer or answers that they think best describe their opinion or attitude on a particular issue. The questionnaire contains three main sections, to which:

The first section - is designed to collect information on the personal characteristics of the farmers including age, educational level, and years of farming experience.

The second section - will focus on collecting information on farmers' level of awareness of pesticide laws and regulations, and knowledge and understanding of pesticide with respect to environmental and human health. In addition, data will also be collected on self-reported toxicity symptoms associated with pesticide use, as well as farmers' knowledge about exposure routes.

The third section - include questions regarding pesticide handling and safety practices including reading and following label instructions, storing and disposing of pesticides and empty containers, and use of PPE and other protective practices during and after pesticide application.

Data Analysis

All data were coded, entered, and analyzed using Statistical Procedure for Social Sciences (SPSS). Descriptive results will be expressed as frequencies and percentages, and the Chi-square test ($\chi 2$) was used to measure the possible association between nominal variables and will be tested at a 5% level of significance.

Results

Demographic Characteristics and Profile of Vegetable Farmers

The majority of the farmers surveyed in the study were male, as farming activities especially those that are engaging in pesticide usage are performed mostly by men in Iloilo City vegetable farms. However, the results (62%) is not too far from the number of women that are engaged in farming (37%).The majority of the farmer (70.70%) respondents were over 50 years old with the average age being 5.8 years.. A considerable number of the farmers (14%) completed elementary education, 34% secondary education and 52% were educated to a tertiary level. Most of the respondents (76%) had 16umber of years of farming experience, 5% for 5- 10 years and 11 – 15 years in farming ,and 14% having 16 or more years of farming experience. Farm sized varied from less than a hectare to over 2 ha, with an average of 1ha per farmer.

Pesticides Used

Survey results show that all farmers that were interviewed are using synthetic pesticides in vegetable farming (Table 1). There were thirty-one (31) different active ingredients (5 herbicides, 18 insecticides, 8 fungicides) in 31 registered commercial pesticides. Remarkably, 17 out of 31 pesticides (54%) were moderately toxic pesticides (FPA classification). Among 17 synthetic pesticides applied, the most frequently used were methomyl, chlorpyrifos, Triazophos, and cypermethrin. Generally, insecticides were used by 100% of vegetable farmers, 56.8% used herbicides and 49.6% used fungicides in vegetable farming.

Table 1. Classification of pesticides used by vegetable farmers with corresponding Toxicological categories

PESTICIDES CLASSIFICATION BY HAZARD			
Active Ingredient	**Trade Name**	**Class**	**Chem Type**
Herbicide			
Fluazifop-p-butyl	Onecide	II	Pyridines
Bispyribac Sodium (Glyphosate and 2,4-D Amine)	Mower	III	Pyrimidines
Glyphosate	Sharp shooter	III	Glycine
Glufosinate-Ammonium	Basta	II	Organophosporus
Glyphosate	Glyphotex	III	Glycine
Glyphosate (Isopropylamine Salt Of Glyphosate... 480 G/L	Alecta	III	Glycine
Glyphosate Acid Equivalent)..... 360 G/L)"	Clearzero	III	Glycine
Imazamox	Clearmax	III	Imidazolines

Fungicide			
Benzimidazole	Benomyl	II	Hydroxyl Benzyloxy
Chlorothalonil	Daconil	U	Dinitrile
Copper Hydroxide	Funguran	II	Copper Compound
Copper Hydroxide	kocide	II	Copper Compound
Cuprous Oxide	Nordox	II	Copper Compound
Difenoconazole	Score	II	Dioxolanes
Difenoconazole + Propiconazole	Armure	II	Dioxolanes Triazoles
Mancozeb	Dithane	U	Dithiocarbamate
Mancozeb	Wallop	U	Dithiocarbamate
Mancozeb 800g/Kg	Tranzeb	U	Dithiocarbamate
Thiophanate Methyl	Fungitox	U	Thioureas

PESTICIDES CLASSIFICATION BY HAZARD

Active Ingredient	Trade Name	Class	Chem Type
Insecticide			
Bpmc+Chlorpyrifos	Brodan	U	Organophosporus
Cartap Hydrochloride	Cartap	II	Thiocarbamate
Chlorantraniliprole	Prevathon	U	Organophosporus
Chlorfenapyr	Kotetsu	II	Pyrethroid
Chlorpyrifos and Cypermethrin	Nurelle	II	Organophosporus
Clothianidin	Gold	II	Neonicotinoid
Flubendiamide	Fenos	U	Phthalic Acid Diamide
Cyantraniliprole	Benevia	U	Pyrazole
Diazinon	Parapest D	II	Organophosporus
Dinotefuran	Starkle	III	Neonicotinoid
Indoxacarb	Ammate	II	Oxadiazine
Methiocarb	Mesurol	II	Carbamate
Methomyl	Lannate	U	Carbamate
Spinetoram	Exolt	II	Spinosyn
Thiamethoxam (12.6%) + Lambdacyhalothrin (9.5%) Zc.	Alika	II	Neonicotinoids Pyrethroids
Tolfenpyrad	Bexar	Ib	Pyrazole
Zeta-Cypermethrin and bifenthrin	Sevin	II	Pyrethroid

Ala: Extremely hazardous; lb: Highly hazardous; ll: moderately hazardous; lll: slightly hazardous; U:

Unlikely to present acute hazard Knowledge, Attitude, and Perception of Vegetable Farmers about Pesticides

The farmer's level of knowledge of pesticides, including route exposure, effects on human health and environment, awareness of route of pesticides, laws, and regulations were analyzed in Table 2. The majority of the farmer respondents (71%) agreed that pesticides adversely affect human health and the environment (67%), respectively. In increasing crop yield, only 14% of farmers strongly believed that pesticide usage is indispensable, 57% agree with the necessity of pesticide while 29% disagree. Only 19% followed labels in applying pesticides while 81% formulate r own mixing and usually practice the 'cocktailing' method of mixing pesticides. When farmers were asked to indicate how pesticide enters the human body, inhalation (52%), dermal (29%), and eye contact (19%) were stated as the most common routes of exposure to pesticides. The majority of the farmers (86%) are aware that some pesticides have been banned or are restricted for use. However, among

this group, only 20% of the farmers knew the names of of some the pesticides that are banned or restricted for use. Among farmers who are aware that some pesticides have been banned or restricted for use, the high toxicity of the pesticides (86%), not effective (10%), and expensive (5%) were cited as major reasons for the ban or restriction.

Table 2. Farmer's knowledge, attitude, and perception of about pesticide (n=125)

Knowledge, attitude, and perception		n*	%
Pesticides affect human health	Strongly agree	36.25	29
	Agree	89	71
	Disagree	0	0
	Strongly Disagree	0	0
Pesticides affect the environment	Strongly agree	41.25	33
	Agree	83.75	67
	Disagree	0	0
	Strongly disagree	0	0
Pesticides are indispensable for high yield	Strongly agree	17.5	14
	Agree	71.25	57
	Disagree	36.25	29
	Strongly disagree	0	0
Do you follow pesticide labels?	Yes	23.75	19
	No	101.25	81
Pesticides entry to the human body	Dermal	36.25	29
	Inhalation	65	52
	Oral	0	0
	Eye contact	23.75	19
	I don't know	0	0
Do you know banned pesticides?	Yes	107.5	86
	No	17.5	14
Reasons for banning pesticides	Highly toxic	107.1	86
	Not effective	11.9	10
	Expensive	6.25	.05
	I don't know	0	0

*Multiple responses allowed

Pesticides Storage and Disposal by Farmer Respondents

Table 3 shows Farmers' attitudes towards storing and disposal of residual pesticide solutions, expired/old, and empty pesticide containers. The majority of the farmers (99.2%) stored their pesticides in locked storage while 14.4% stored their empty chemical bottles and containers in open sheds but with other farm implements and fertilizers. Farmers (88.8%) usually mixed only the needed amount while unused leftovers of the mixed and diluted pesticides are mostly (11.2%) applied to other pestinfested crops. When asked about the old pesticide stocks 95.2% of the farmers buy only the needed amount of pesticides while the rest (11.2%) dispose of old stocks in the field. Empty pesticide containers were incinerated on farms (72and %) and buried on farm (11.2%), while other wastes are placed in hazardous wastes collection sites (9.6%), and (8%) were re-used empty pesticide containers for other purposes such as insect fly traps.

Table 3. Farmers' attitudes towards storing and disposal of pesticide

Practices		n*	%
Where do you store pesticides?	Open shed just for pesticides	18	14.4
	Refrigerator with other item	0	0
	In the open field	0	0
	Locked storage	124	99.2
	Living area	0	0
	Animal House	0	0
What do you do with unused mixed or diluted pesticides?	Disposed of in the field	14	11.2
	Only mix the needed pesticide	111	88.8
	Apply to other crops	14	11.2
	Dispose of in sewer	0	0
	Hazardous waste collection site	0	0
What do you do with old pesticide stocks?	Return to retailer	0	0
	Hazardous waste collection sites	0	0
	Dispose in the field	14	11.2
	Buy only the needed amount	119	95.2
	Dispose in sewer	14	11.2

Practices		n*	%
What do you do with empty pesticide containers?	Discard on farm	0	0
	Place in trash		
	Incinerate on farm	90	72.0
	Hazardous waste collection sites	12	9.6
	Bury on farm	14	11.2
	Reuse for other purposes	10	8.0

*Multiple responses allowed

Farmers' safety practices during pesticide spray exposure

Most farmers (66%) always used coveralls and hats during spraying. Likewise, hats (66%), gloves (48%), and glasses (52%) were often used. Almost more than half (57%) of the farmers seldom use boots and glasses (52%) and 62% never uses respirator at all. Very few were using boots (14%), and respirators (13%). Regardless of education, farmer respondents were significantly more likely not to use boots (x^2 = 165.95, $p<0.05$) and respirators (x^2 =187.33, $0<0.05$) during spraying

Table 4. Use of personal protective equipment during spraying and mixing of pesticides to prevent pesticide exposure (n=125)[a].

Protective Equipment	Variable	N	(%)
Coverall	Always Sometimes	83	66
		36	29
	Never	6	5
Protective boots	Always	18	14
	Sometimes	71	57
	Never	36	29
Glasses/goggles	Always	36	29
	Sometimes	65	52
	Never	24	19
Gloves	Always	60	48
	Sometimes	35	28
	Never	30	24
Respirator	Always	17	14
	Sometimes	30	24
	Never	78	62

Protective Equipment	Variable	N	(%)
Hat	Always	83	66
	Sometimes	30	24
	Never	12	10

[a]=total number of farmer respondents

Other safety practices of farmers during the spraying of pesticides include no eating (95%), drinking (90%), and smoking (90%) while handling pesticides. Almost half (48%) of the total farmer respondents practice spraying following wind directions and those that wash immediately after handling pesticides. An alarming result on the application of pesticides not based on the recommended dosage was practiced by 90% of the farmer respondents (x^2=78.90, $p<0.05$) regardless of the number of years engaging in vegetable production. The same is true with the application of pesticides a week or a few days before harvesting was almost practiced by the majority of the farmer respondents (x^2=56.01,$p<0.05$).

Table 5. Other safety Practices of Farmers During the Spraying of Pesticides

Practices Variable	Variable	N	(%)
Eating while handling pesticides	Always	6	5
	Sometimes	0	0
	Never	119	95
Drinking while handling pesticides	Always	6	5
	Sometimes	6	5
	Never	113	90
Smoking while handling pesticides	Always	6	5
	Sometimes	6	5
	Never	113	90
Spray following wind direction	Always	60	48
	Sometimes	52	42
	Never	13	10
Washing immediately after handling pesticides	Always	65	52
	Sometimes	60	48
	Never	0	0
Wash work clothes after spraying	Always	89	71
	Sometimes	36	29
	Never	0	0
Apply the recommended dosage	Always	6	5
	Sometimes	6	5
	Never	113	90

Practices Variable	Variable	N	(%)
Apply pesticide a week	Always	52	42
before harvest	Sometimes	60	48
	Never	13	10

Health problems reported by farmers after handling pesticides

The majority of the farmer respondents reported dizziness (81%) fatigue (67%) and skin irritation (57%) and excessive sweating (48%), shortness of breath (43%) as among the top health-related problem experienced after pesticide handling. Other problems reported were itchy eyes (38%), coughing (28%), and nausea (24%). Only 5% of the farmer respondents reported no health impairment during handling.

Table 6. Health Problems Reported by Farmers After Handling of Pesticides

Symptoms	n	%
Dizziness	101	81
Fatigue	84	67
Skin irritation	71	57
Excessive sweating	60	48
Shortness of breath	54	43
Itchy eyes	44	38
Coughing	35	28
Poor vision	30	24
Vomiting	6	5

Discussion

Reducing the health and environmental hazard caused by chemicals in farm practices by farmers is a very important factor in likewise reducing problems associated with chemical usage. Likewise, understanding the level of knowledge and practices towards safe pesticide usage is vital in crafting sound policy and educational strategies that aim at promoting human and environmental health.

This study shows that majority of the vegetable farmers of Iloilo City are fully aware of the harmful effect of pesticides on human health and environmental safety and the fact that the majority of the farmers have reached the tertiary level of education (52%). However, farmer practices and attitudes toward the safe usage of pesticides do not concord with their perception of the judicious use of pesticides. Our study showed a worrisome practice of farmers which means that even though they are fully knowledgeable on the hazards of pesticides yet often practice over-mixing more than the recommended rate (90%) and even apply pesticides a week before harvesting vegetables (42%). Additional information gathered on the reasons is mainly to boost production and

the reliance on chemical pesticides to control pests and diseases. Another reason why farmers are more concerned with high economic returns from their crops than with their health (Mabota, et.al., 2009). Since agricultural intensification has successfully increased food production, following the steadily increasing demand due to population growth. However, the intensification of agricultural production in recent decades has led to a decline and loss of biodiversity due to the increasing use of chemical fertilizers, pesticides, insecticides & fungicides (Our Ecology, 2020).

Farmers in this study generally demonstrated poor practice in the usage of protective equipment, particularly in the use of respirators (62%) and protective boots (29%). The farmers-respondents find it difficult and uncomfortable to walk in their fields wearing boots especially when muddy; hence, they prefer to walk barefoot when spraying. Further, they seldom utilize protective goggles in handling pesticides since several farmers admitted that these items are costly, while others complained of inconvenience, especially during hot weather. According to reports, discomfort, extremely hot climate, and high cost are the major factors for the partial utilization of personal protective equipment (Macfarlane, E. et. al., 2008).).

Poor practices were also observed in the timing of pesticide application as most of them answered that they spray pesticides within one week before harvesting (42%) or even one day before harvesting. In Leon, Iloilo, poor practices on pesticide usage are on the timing of the application of pesticides such that most farmers spray pesticides within one week before harvesting, while others claimed that they even spray a day before harvesting. Another factor to consider is their high frequency of pesticide application which leaves high chemical residues in their farm produce making it unsafe for human consumption. Likewise, as observed, there is the indiscriminate use of pesticides by vegetable farmers. The higher percentage of farmers using Category ll of pesticides with a high frequency of application to attain higher yield poses intoxication and hazard to human health and the environment (Guantero, 2020).

Good practices by vegetable farmers are the use of appropriate PPE such as coveralls, glasses, gloves, and hats and good personal hygiene such as, showering, washing clothes, not drinking, eating, and smoking while handling pesticides. Personal protective equipment (PPE) is central in discussions of chemical risk prevention in agriculture. PPE includes skin and eye protective equipment (gloves, coveralls, safety shoes, helmets, and goggles) and respiratory protective equipment (respirators). Our findings indeed confirm that occupational safety interventions accord PPE the greatest importance in many countries (A. Garrigou, et.al., 2020). Other good practices by farmers include proper storage of chemicals in a locked container/cabinet, and buying and mixing only the needed amount of pesticides.

The findings in this study will give appropriate information on the status of vegetable farming in the rural areas of the City of Iloilo and will enable government agencies, especially the Department of Agriculture and its extension and regulatory services to craft appropriate policy recommendations and programs aimed at mitigating and reducing health and environmental hazard associated with pesticides usage. Farmers' involvement in training programs such as promoting integrated pest management increases farmers' knowledge on the use of other alternative pest control measures, health hazards due to over-reliance on chemicals, and indiscriminate spraying. Since this study has known that farmers are very much knowledgeable about the hazard brought about, especially by over usage of pesticides, yet continue to apply more than what is recommended just to attain better production and to further illuminate the pests, it is very empirical that the agricultural extension services also of the City Agriculture Office play a pivotal role in the training of farmers and in providing up-to-date information, easy to understand, easy to adopt, convincing and productive to change farmers frustrating moves and practices and to gain confidence and trust among the farmers. The frustrating claim of farmers is the absence of extension workers in their area to suppose serve as their consultants and advisers but mostly those that are present in their farms are the representatives of the chemical/pesticide company. Strategies to convince farmers of the legitimacy of technology for transfer should be coupled with field demonstrations for overcoming doubts and misinterpretations. Training significantly improved farmer knowledge, particularly for the more complicated pesticide characteristics that are harder to learn from experience. More experienced farmers had worse prior knowledge of pesticide toxicity, though they also had larger increases from training (J. Goeb, et.al.). safe and recommended pesticide handling practices are needed to be introduced through adequate integrated pest management (IPM) training programs and by improving farmers' formal education. Thus, creating awareness through IPM training programs among vegetable growers and enhancing formal education to encourage the adoption of precautionary measures and safe disposal methods for pesticide containers may reduce health risks and health costs (Y. Mehmood, et.al., 2021).

Conclusions

The knowledge, attitude, and practices on the handling of pesticides and their adverse effects have been documented. It was concluded that even though farmers are knowledgeable enough about the safety precautions and practices yet misuse and mishandling and pesticides prevail. Awareness among farmers of the importance of personal protective equipment is not fully applied and the hazard of over-usage of chemicals is still lacking. This study investigated the knowledge, practices, and attitude of farmers towards handling, storage, and disposal of pesticides. Our study reveals farmers are well knowledgeable of pesticide hazards but often adopt risky practices and attitudes when handling pesticides.

Poor practices included the over-mixing (cocktailing) of chemicals and not following the recommended dosage, over usage by applying even a week before harvesting, and not using PPE such as protective boots and respirators. To enhance farmers' practices regarding pesticides and reduced the hazards associated with pesticides, it is recommended that priority programs and extension activities emphasizing on safety and judicious use of pesticides coupled with technology demonstrations should be intensively provided to vegetable farmers. Likewise, intervention strategies of the regulatory services of the Department of Agriculture should take place to strengthen surveillance and monitoring of pesticide safety compliance not only on the farmer's level but to the sellers and retailers of agricultural chemicals in the City of Iloilo.

Bibliography

1. Aban ML, Concepcion SB and Montifl MO. 2009. Consumers' Perceptions on Food Safety of Vegetables in Davao City, Philippines. University of the Philippines Mindanao > BANWA: A Multidisciplinary Journal FPA (Fertilizer and Pesticide Authority). (2019). *Publication of Updated List of Registered Pesticide Products*. Retrieved from https://fpa.da.gov.ph
2. Garrigou A, Laurent C, Baldi I, Berthet A, Colosio C, Laubas-Letourneux V, Galey L. Goutille
3. F, Jackson Filho J.-M, Jas N. Jouzel J.-N, Judon N, Lebailly P, Samuel and Samuel O. June 2021.
4. Response from the authors of the article "Critical review of the role of personal protective Equipment (PPE) in the prevention of risks related to agricultural pesticide use" to the letter to the editor from the European crop protection association (ECPA) Occupational and bystander exposure expert group (OBEEG). Safety Science**,** Volume 123, March 2020, 104527 https://doi.org/10.1016/j.ssci.2021.105191.
5. Goeb J, and Lupi F. 2021. Showing pesticides' true colors: The effects of a farmer-to-farmer training program on pesticide knowledge. Journal of Environmental Management, 279. 111821. 0301-4797. https://doi.org/10.1016/j.jenvman.2020.111821.
6. https://kashmirobserver.net/2020/04/23/indiscriminate-use-of-pesticides-is-threatening-our-ecology/ Indiscriminate Use of Pesticides Is Threatening Our Ecology Guest Author | April 23, 2020
7. Jones, E.; Mabota, A.; Larson, D.W. Farmers' knowledge of health risks and protective gear associated with pesticide use on cotton in Mozambique. J. Dev. Areas 2009, 42, 267–282. [CrossRef]
8. Macfarlane, E. et. al. (2008). *Training and Other Predictors of Personal Protective*
9. Mehmood Y, Arshad M, Mahmood N, Kachele H and Kong R. 2021. Occupational hazards, health costs, and pesticide handling practices among vegetable growers in Pakistan. Environmental Research Journal 200: September 2021, 111340. https://doi.org/10.1016/j.envres.2021.111340