Adoption of pesticides safety practices among cucumber farmers in Giwa Local Government Area of Kaduna State, Nigeria

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ABSTRACT

The study assessed pesticides safety practices adopted by cucumber farmers in Giwa Local Government Area of Kaduna state, Nigeria. The specific objectives were description of the socio-economic characteristics of the cucumber farmers, identification of safety practices adopted by the cucumber farmers and determination of factors that influence the adoption of safe pesticide practices. Multistage sampling procedure was used to select 144 cucumber farmers. Descriptive statistics such as frequency, percentage and mean were used to analyze socio-economic characteristics of the cucumber farmers. The use of safe pesticides practices was analyzed by adoption index while multiple regression analysis was used to establish the relationships between socio-economics characteristics of the cucumber farmers and adoption of safe pesticides practices. Most (88%) of the cucumber farmers had low level of education, while 52.9% of them had access to extension services. About 40.2% of them were trained but only 26% of the training content was on pesticides safety. The mean age, household size, household labour and farm size of the farmers were 32.24 years, 10 persons, 3 persons and 0.91ha, respectively. Majority (70.6%) of the cucumber farmers used inorganic pesticide. Result of regression analysis showed that years of inorganic pesticide usage (r=0.009), frequency of pesticides spray (0.004), education (0.138) and extension services (r=1.908) were significant and positive variables that influenced adoption of safe pesticides practices. Thus, the study recommended that routine training and educational programs focusing on pesticides safety practices should be conducted by the extension agents for the farmers in local languages.

Keywords: Adoption, Pesticide safety, Pre-harvest interval, Re-entry interval.

INTRODUCTION

Cucumber is a popular cultivated plant in the gourd family (Kaur and Sharma, 2022). It is an important vegetable that can be cultivated in various ecological zones of Nigeria. Its production cuts across the rainforest to the savannah zones of Nigeria with variation in production pattern and volume depending on the place. The five highest cucumber producing states in Nigeria are Plateau, Kaduna, Katsina, Kano and Benue. Others with high production potentials are Enugu, Ebonyi, Akwa Ibom, Oyo, Cross River, Rivers and Nassarawa (Bernard and Japhet, 2020). Cucumber can be grown year-round due to its short growing period and with farmers' access to supplemental irrigated water during the dry season, thus allowing for multiple harvests in a year. Godfrey *et al.,* (2023) reported that cucumber is an important vegetable grown in Nigeria in terms of production scale and consumption level.

Cucumbers are nutritious food with several health benefits such as rehydrating the body, regulating blood pressure, body weight management, cholesterol reduction, cancer prevention, bone health, diabetes cure and antioxidant activity (Bello *et al.,* 2014, Naganatha and Hartline, 2015, Kumar *et al.,* 2010). According to Uthpala *et al*., (2020) cucumber contains 95% water. The high-water content makes the crop refreshing and hydrating during hot weather. Hina *et al.,* (2024) opined that cucumbers are traditionally used to treat a variety of diseases, including high blood pressure, blood sugar issues, cancer, high cholesterol, kidney stones, constipation, Alzheimer's disease, eczema, hypertension, atherosclerosis, and diabetes-related problems. The cosmetics uses of cucumber was expressed by Shrivastava and Roy (2013), who stated that regular intake of cucumber can improve hair growth, soften skin texture, useful in skin problems, sunburn and for curing swelling under the eye.

Cucumber production in Nigeria is growing due to increased awareness of the health benefits as well as its skin care uses. This has progressively affected cucumber cultivation and increased outbreak of pests and diseases of this crop. In Nigeria, yield losses due to pests and diseases is aided by extreme temperatures, heavy rainfall and high humidity. Umeh and Ojiako (2018), pointed out that pests and diseases is one of the most serious constraints of cucumber production in Southwest Nigeria, while Arogundade *et al.,* (2020) revealed that more than 30 pests and diseases are known to contribute to cucumber yield loses across Africa. FAO (Food and Agricultural Organisation), (2019) revealed that about 40% of global crop production are lost to pests and diseases annually. The quest to meet production demand and to combat

production losses due to pests and diseases infestation resulted in the massive use of pesticides by farmers. Yousefi *et al.,* (2021), Hammood *et al.,* (2024), stated that pesticides are substances mostly used to control these harmful elements.

Pesticides are substances used to prevent or control and eliminate pests, insects, rodents, fungi, weeds and other unwanted organisms that affect plants growth (Einsiedel *et al.*, 2024). Globally, China, USA, Brazil, Argentina, Canada, Ukraine, France, Malaysia, Australia, Spain are the top ten pesticide consuming countries, while South Africa as the twenty-country listed in order of pesticide use (World Atlas, 2018). The annual net weight of pesticides used in Nigeria was 23,412.5 Mt, thus ranking Nigeria as the second largest pesticide user after South Africa (Hughes, 2021). Estimates of herbicides importation into West Africa doubled in five years, from 218,948 tons to 437,930 tons in 2015 and 2020, respectively (Boll, 2023). Nigeria alone imported 147,446 tons exceeding that of South Africa (87,403 tons) and North Africa (109,561 tons) in 2020 (Boll, 2023). Agmas and Adugna, (2020) cited that the extent of pesticides usage are declining in developed countries but it is on the increase in the developing countries because they are used for agricultural and public health purposes. Similarly, Riyaz *et al.,* (2021), stated that the use of synthetic pesticides in agriculture is steadily growing with pesticide residue levels in the environment (air, water, and soil) also increasing. United Nation Human Right Council (UNHRC), (2017), cited that 99% of the deaths associated with pesticides occur in developing countries, where only 25% of the pesticides produced worldwide is used due to intense and unsafe practices among others.

The benefits of pesticides in agricultural production have been widely promoted but many risks have been reported with it use. The improper use and handling pose significant hazards to the environment, non-target species, farm workers, and consumers. Studies (Karunamoorthi *et al.*, 2012; Ojo, 2016; Adesuyi *et al.*, 2018) have shown that most small-scale farmers in Nigeria are ignorant about the health and environmental implications of the pesticides misuse, or regulatory rules that guides pesticide usage. As a result, they are unable to take requisite precautions to protect their health and the environment nor the use of necessary Personal Protective Equipment (PPE). This study therefore, assessed pesticides safety practices adopted by cucumber farmers in Giwa Local Government area. The specific objectives of the study were to: describe the socio-economic characteristics of the cucumber farmers in the study area; identify safety practices adopted by the cucumber farmers and determine factors that influence the adoption of safe pesticide practices among cucumber farmers in the study area.

METHODOLOGY

The study was conducted in Giwa Local Government area (LGA) of Kaduna State. It is located at latitude of $11^0$00.00 and $11^0$20'00N and longitude 7°00'00 and 7°40'00E and has a land area of 3, 350km^2. The Local government Area is located northwest of Zaria. It is bounded in the North by Katsina State and on the West and South by Birnin Gwari and Igabi Local Government areas of Kaduna State respectively. Giwa LGA is divided into 11 wards: Shika, Idasu, Kadaga, Danmahawayi, Kidandan, Galadimawa, Gangara, Giwa, Kakangi, Pan Hauya, and Yakawada (https://www.eduweb.com.ng › giwa-lga-wards-new-and...) (Figure 1). Agriculture is the dominant economic activities of the people. Some of the vegetables commonly grown in the area are cucumbers, onions, tomatoes and watermelon.

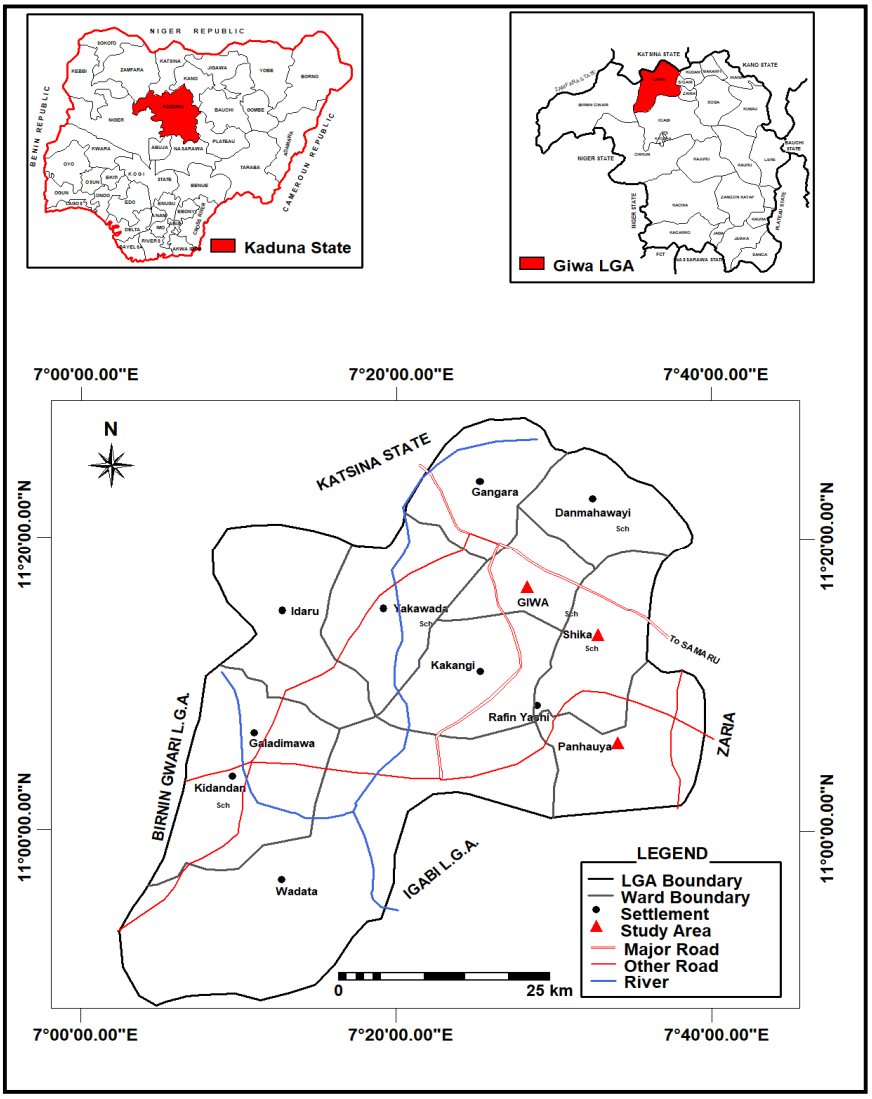

Figure 1: Map of Giwa local government showing the studied villages

Multistage sampling procedure was used for the study. The first stage involved purposive selection of Giwa LGA since agriculture is a major economic activity, with cucumber as a valuable crop grown. The second stage involved purposive selection of three wards in the LGA namely Shika, Giwa town, and Panhauya based on high concentration of cucumber production among farmers in the wards. The final stage involved random selection of 60% of the cucumber farmers from the sampling frame which gave 144 cucumber farmers (Table 1).

Table 1: Summary of sample frame and size

LGA	Wards	Sample frame	Sample size
Giwa	Giwa Town	50	30
	Shika	150	90
	Panhauya	40	24
Total	**3 wards**	**240**	**144**

Source: Field Survey, 2024

Primary data were collected with the aid of questionnaire administered to 144 cucumber farmers, but 119 questionnaires were recovered from the cucumber farmers and used for the study. Analysis of data collected from the field was done using descriptive statistics such as frequency, percentage, mean, adoption index and multiple regression analysis.

Adoption of each of the safety practices was measured as Yes =1 or No =0. Furthermore, adoption index was constructed using adoption scores. Each safety practices was arbitrary assigned a score of 1. The total safety practices in this study were 16. Adoption index was calculated using adoption score which is the number of farmers that use each of the 16 safety practices to the total number of farmers studied. (Adapted from Gawde *et al.,* (2006).

$$\text{Adoption Index} = \frac{\text{Number of farmers using each of the 16 safety practices}}{\text{Total number of farmers used for the study}} X\ 100$$

Based on the index, adoption was categorized as: High >50%; Moderate =50 and Low < 50%

The regression model specified thus:

$Y= a+b_1 X_{1,} +b_2 X_{2,} +b_3 X_{3,} +b_4 X_{4,} +b_5X_{5,} +b_6 X_{6,} +b_7 X_{7,} +b_8+X_8, +b_9+X_9, +e$
e = error term, a = constant
b_1-b_9 = Regression coefficient
X_1 = Age (years)
X_2= Education (years of schooling)
X_3= Household size (number)
X_4= Household labour (number)
X_5 = Farm size (hectares)
X_6=Training (number of trainings received on pesticides)
X_7=Access to extension services (number of extension services received on pesticides)
X_8=Years of using inorganic pesticide
X_9=Frequency of spraying (number)

RESULTS AND DISCUSSION

Socioeconomic characteristics

Table 2 presented the socioeconomic characteristics of the cucumber farmers. The age distribution showed that 47.0%, 37.8% and 14.2% of the cucumber farmers were within the age of 21-30 years, 21-40 years and 41-50 years respectively. A mean age of 32.24 years was obtained, indicating an active and young cucumber farming population in the study area (Table 2). Finding is similar with Ojeleye *et al*., (2021) who reported a mean age of 39 years among cumber farmers in Kadawa, Kano State. Investigation on household size and family labour used in cucumber production revealed a mean of 10 and 3 persons, respectively. The use of household labour for pesticide application without strict adherence to safety practices and non-use of PPE could be a potential health risk for the household members. Findings on farm size indicated that 54.6% of the cucumber farmers cultivated 1-2 hectare (ha) of farmland, with a mean of 0.91ha. It therefore, implies that cucumber farmers in the study area were small scale producers. This finding is supported by Ojeleye *et al.,* (2021) who reported a mean of 0.38ha as farm size put into cucumber production. Educationally, 45% and 43% of the cucumber farmers in the study area had primary and secondary education, respectively. Cumulatively, an overwhelming majority (88%) of the cucumber farmers had low level of education. This may affect the cucumber farmers' ability to read, understand and interpret safety instructions on pesticides label, hence their decision to adopt safe pesticide practices may be affected. The results in Table 2 also showed that 52.9% of the cucumber farmers did not have access to extension services. Extension workers are saddled with the responsibility of providing information, training among other services to farmers. Lack of access to extension services implied lack of effective extension services offered to pesticides users in the study area.

Findings on training showed that only 40.2% of the cucumber farmers had access to training (Table 2). Further investigation revealed that 20.7% of the cucumber farmers received training on pesticides related contents (Application (2%), usage (20%), handling (2%) and safety precaution (2%) (Table 2). The low pesticide related training content among the beneficiaries presents significant risks to the health of farmers, crops, the environment, the ecosystem on the long run, highlighting the need of training and education on pesticide safety among farmers in the study area.

Table 2: Socioeconomic characteristics of cucumber farmers

Socioeconomic characteristics	Classification	Frequency	Percentage	Mean
Age (years)	21-30	56	47	
	31-40	46	37.8	32.24
	41-50	17	14.2	
	Total	**119**	**100**	
Household size (number)	1-10	75	54.6	
	11-20	49	41	10.26
	21-30	4	3.4	
	31-60	1	1	
	Total	**119**	**100**	
Household labour (number)	1-5	103	86.6	
	6-10	16	13.4	2.92
	Total	119	100	
Farm size (hectare)	less than 1	53	44.5	
	1-2	65	54.6	0.91
	3-4	1	0.08	
	Total	**119**	**100**	
Educational level (years)	Primary	54	45	
	Secondary	51	43	
	Tertiary	1	1	
	Arabic	13	10.9	
	Total	**119**	**100**	
Access to extension services	Yes	63	52.9	
	No	56	47.1	
	Total	**119**	**100**	
Type of training received on:	Did not receive training	73	59.8	
	Production	19	16.2	
	Seedling	4	3.3	
	Pesticide application	2	1.6	
	Pesticide usage	20	15.9	
	How to handle pesticide	2	1.6	
	Safety precautions	2	1.6	
	Total	**122***	**100**	

Source: Field survey, 2024 *Multiple responses

Pesticide use and awareness of safety practices

Results in Table 3 showed that 70.6% of the cucumber farmers used inorganic pesticides, 7.5% used organic, while 21.8% used both organic and inorganic pesticides on their farms. Finding is supported by Abubakar *et al.,* (2015), that 93.8% of the respondents applied pesticide along river Ngadda of Maiduguri area, Nigeria. Also, Okafoagu *et al.,* (2017) reported 65.3% pesticides use among farmers in Sokoto State. Frequency of applying pesticide per production cycle was investigated to determine farmer's extent of exposure to pesticide. A mean of 6.28 years was obtained (Table 3). Cucumber have short growing period and can be grown two or more times in a year. By implication, majority of the cucumber farmers will be expose to pesticide in multiples of 6 depending on the number of cultivations per year if safety precautions were not adhered to.

Years of using pesticide was investigated to assess the duration of farmers' exposure to pesticides.

Majority (85.5%) of the cucumber farmers had been using pesticides for about 1-10 years with a mean of 6.08 years (Table 3), yet, this majority (74.7%) did not wear PPE when spraying pesticides (Table 3). Farmers' non-use of PPE during pesticides handling and application implied that majority of the cucumber farmers were being exposed to pesticides risks and its hazards for about 6 years. Results in Table 3 showed that 93% of the cucumber farmers were aware of safe pesticide practices but majority of them did not wear PPE while spraying. This indicates an urgent need to educate farmers on safe pesticides practices.

Table 3: Distribution of the farmers based on pesticide use and awareness of safety practices

Variables	Grouping	Frequency	Percentage	Mean
Type of pesticide used	Organic	9	7.5	
	Inorganic	84	70.6	
	Both	26	21.8	
	Total	**119**	**100**	
Frequency of spraying (number)	1-5	65	54.6	
	6-10	35	29.5	6.28
	11-15	19	15.9	
	Total	**119**	**100**	
Years of using organic pesticide	1-10	102	85.5	
	11-20	17	14.2	6.08
	Total	**119**	**100**	
Wearing of PPE	Yes	30	25.2	
	No	89	74.7	
	Total	**119**	**100**	
Awareness of safe Pesticide practices	Yes	111	93.3	
	No	8	6.7	
	Total	**119**	**100**	

Source: Field survey, 2024

Adoption of safe pesticides practices

Findings on adoption of safe pesticide practices showed that 37.8% read and understood pesticide label instruction before use. About 25.2% and 17.6% understood pesticide label colours and knew the meaning of symbols on the pesticide containers. The range of 37.8%-17.6% is an indication of low adoption and invariably will determine how well the farmers will be able to put into practice the recommended safety precaution. Observation of re-entry intervals (restricted interval) and pre-harvest intervals was low as only 23.5% and 26.1% of the cucumber farmers observed these respectively. The implication is that pesticides residues and vapour level is still very unsafe both for the farmers and the consumers. A low percentage (23.5%) of the cucumber farmers reported complete wearing of PPE and ensured that it is in good condition and properly fitted. Another 27.7% and 29.4% of the cucumber farmers reported separate washing of PPE from other cloths and keeping of washed PPE separate from other cloths respectively (Table 3). It can therefore be inferred that less than 30% of cucumber farmers are not exposed to dermal pesticides poison such as skin irritation when PPE come in contact with the skin.

Findings further revealed that 40.3% of the cucumber farmers store pesticides in well-ventilated and secured place (out of bound) away from other people while 67.2% store pesticide away from food, water sources, and animals (Table 3). This finding is at variance with that of Kurui *et al.*, (2014) who found that most farmers stored pesticides either in stores together with cereals or in living rooms. Result in Table 3 indicated that 35.3% of the cucumber farmers puncture and dispose pesticide container/pack by burying or burning. Finding by Kurui *et al.,* (2014) revealed that only 6% of the respondents disposed pesticides container by burying. Finding also showed that only minority (16.8%) of the cucumber farmers acknowledged that they do not allow non-sprayers in the farm during spraying. It can therefore be inferred that only few cucumber farmers observed the rule that people are not allowed to stay in the farm or it surrounding during pesticides spraying. This practice will predispose non sprayers to pesticide residues especially by inhalation, skin contact or through eyes. Finding is in line with Adesuyi *et al.*, (2018) that 60% of the respondents stayed within the farming environment between 30 minutes and 5 hours after pesticide application.

Result of high adoption of pesticides practices is presented in Table 3. About 68.9% of pesticides sprayers reported that they do not come in contact with family members until after clean up (wash hand, take bath with soap, water and change cloth) (Table 3). By implication the risk of spreading pesticides residues to family members by more of the cucumber farmers is less. Finding also showed that 79.8% of the cucumber farmers agreed that they don't eat/drink/smoke while applying pesticides thus decreasing the chances of oral pesticide ingestion (Table 3). This is in contrast with Oshingbade *et al.,* (2025) who affirmed poor hygiene and safety behaviour among 87.1% of the respondents, who have at some point drank/ate while handling pesticides,

Table 3: Distribution of the cucumber farmers according to safe pesticides practices adopted

Pesticide safety recommendations	Adoption	Percentage
Read and understand pesticide label instruction before use	45	37.8
Understand the meaning of pesticide label colours	30	25.2
Know the meaning of pesticide label symbols	21	17.6
Observe pesticide re-entry intervals (restricted entry interval)	28	23.5
Observe pesticide pre-harvest interval	31	26.1
Wear complete PPE	28	23.5
Wash PPE items separately	33	27.7
Keep PPE items separately from other cloths	35	29.4
Store pesticides in well a ventilated, secured and restricted place	48	40.3
Store pesticide away from food, water sources, animals, etc.	80	67.2
Proper disposal of pesticide container/pack (puncture, burnt or bury)	42	35.3
Non sprayers are not allowed in the farm during spraying.	20	16.8
Do not come in contact with people after spraying until after clean up	82	68.9
Eating/drinking/smoking while applying pesticides is not allowed	95	79.8
Mix pesticides in well-ventilated areas to reduce exposure.	98	82.4
Use tools like funnels or measuring devices to minimize spills/splash.	111	93.3
Pooled mean		**43.4**

Source: Field survey, 2024.

Mixing of pesticides in well-ventilated areas and the use of measuring tools to reduce exposure and minimize spillage were reported 82.4% and 93.3% of the cucumber farmers (Table 3). Further finding on the overall adoption of all the safety practices by the cucumber farmers shows a low adoption mean of 43.38%. The low adoption mean of safe pesticides application practices could have dire consequences on farmers' health and the environment. Finding on this lent credence to Kurui *et al*., (2014) that most farmers rarely practiced safety precautions when handling, mixing and spraying chemicals.

Factors affecting adoption of safe pesticide practices

Result of the multiple regression analysis in Table 4 showed that years of inorganic pesticide usage, frequency of pesticides spray, education and extension services were explanatory variables that significantly influenced the adoption of safe pesticides practices among cucumber farmers in the study area. Years of inorganic pesticide usage (r=0.009) was significant at 1% level and positive. Implying that farmers that have been using inorganic pesticides for a long time adopted more safety practices than those that started using it not long.

Table 4: Multiple regression results of socio-economics characteristics and adoption

Variables	Regression coefficient	SE	T-value
Adoption (Y)	20.192	2.146	9.408
Age (X_1)	-0.163	0.115	-1.424
House size (X_2)	0.043	0.097	0.443
Education (X_3)	0.138	0.06	2.282**
Household labour (X_4)	0.306	0.195	1.567
Years of inorganic pesticide usage (X_5)	0.009	0.138	6.502***
Frequency of spraying (X_6)	0.004	0.188	2.131**
Farm size (X_7)	0.135	0.85	0.159
Training (X_8)	-0.516	0.857	-0.602
Extension services (X_9)	1.908	0.96	1.986*

***p<0.001 **p < 0.05 *p < 0.10 R = 0.804 R^2 = 0.647 SE=Standard error

Source: Field survey, 2024

Frequency of pesticides spray (0.004) and education (0.138) were statistically significant at 5% level each and positive while extension services (1.908) was statistically significant at 10% level and positive. The positive influence of frequency of spray implied that farmers that spray pesticides frequently adopted more safety practices than those that spray occasionally. It can also be inferred that the educated cucumber farmers adopted safe pesticide practices more than the non-educated ones. The positive influence of extension services to adoption implies that farmer' access to extension services enhanced the adoption of safe pesticides practices. These findings agree with Obulamah, *et al.,* (2022) report that education and

extension services were statistically significant to adoption of safe use of agrochemicals. The coefficient of multiple regression (R^2) was 0.647. This implies that about 64.7% of the variation observed in the adoption of safe pesticides practices were explained by the selected socio-economic characteristics of the cucumber farmers.

CONCLUSION AND RECOMMENDATIONS

The findings of this study established that cucumber farmers in the study area applied inorganic pesticides on their farms. They had low level of education, lacked access to extension services and very few of them received training on pesticide related content. Majority of the cucumber farmers were aware of safe pesticide practices but many of them did not adopt it (low adoption). Factors that positively influenced adoption of safe pesticide practices were years of inorganic pesticide usage, frequency of pesticide spray, education and extension services at varying levels. Based on findings of this study, the following recommendations were made:

i. Routine training and educational programs focusing on pesticides safety should be conducted by extension agents for the farmers

ii. Based on low educational level of majority of these farmers, improved access to information on pesticides safety practices through extension agents in local languages is suggested.

iii. Organic farming should be encouraged among the farmers by the extension agents and other agencies/bodies that are involved in training farmers on crop protections.

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