ORIGINAL ARTICLES

Pesticide Usage and Safety Measures Awareness of Small Scale Farmers in Gera District, Jimma Zone, Western Ethiopia

Negash Aliyi[1], Solomon Sorsa Sota[2*] and Ermias Deribe[3]

[1] Firi-Gemta preparatory High school, *Email: neggashaliyi@yahoo.com;* Gera woreda, Jimma Zone, Oromia Regional State, *Ethiopia*
[2] Department of Biology, College of Natural and Computational Sciences, Hawassa University, Email: sorsasota@yahoo.com; P. O Box 493, Hawassa, Ethiopia
[3] Department of Biology, College of Natural and Computational Sciences, Hawassa University, Email: erimdw@gmail.com; P. O Box 5, Hawassa, Ethiopia
*Corresponding author: sorsasota@yahoo.com; Tel. = +251916828248; P. O Box 493, Ethiopia

ABSTRACT

The use of pesticides has drastically increased worldwide. Despite their importance to increase yield, their adverse effects on our environmental and human health have been well documented due to mishandling and use. The aim of this study was, therefore, to assess the pesticide utilization and safety measures knowledge, practices and perception of the farmers in Gera districts of Jimma zone, Oromia region. A cross-sectional design and quantitative methods were used, and multi-stage random and purposive sampling techniques were employed to select households (HHs) and Key Informants (KIs), respectively. For HH survey, the sample size was determined using a single population proportion formula. A total of 500 respondents (475 farmers HHs and 25 KIs) have participated in the study. Structured and both closed and open-ended questionnaires were used to collect data. All HHs reported using one or more of the agrochemicals and pesticides use was reported by highest proportion (40.2%). About 24% of HHs reported using untrained employed daily labors to spray pesticides. Means of transporting pesticides used include public transport (37.1%), back of a donkey (36.6%), open truck (22.1%) and 4.2% even carrying by themselves. Majority (80.6%) of HHs reported storing pesticides anywhere in living house. Farmers disposed of leftover pesticides and empty containers by throwing at waste dump place (53.9%), burying in the ground (34.1%) and burning (1.5%), and some 19.0% wash and re-use them for household purposes. About 52% of the studied HHs indicated never practicing general safety measures. About 70% of the farmers confirmed never using one or more of the recommended Personal Protection Equipment during pesticide preparation and application. About 97.0% of user farmers reported using incomplete protective equipment. Those who did not use PPE gave reasons such as high cost (34.5%), unavailability in the market (32.4%), felt no need of it (17.4%), not having it for use (16.5%) and feeling discomfort in use (15.6%). The study demonstrated that pesticides are widely used by farmers in the study area but safety measures practice is poor and inadequate. Therefore, continuous and appropriate training programs need to be provided to raise awareness among farmers, farm workers and vendors about the importance of proper pesticide management during all phases of handling them. Also, availability of PPE must be ensured at low cost so as to enhance their usage and popularity among the farmers and farm workers.

Keywords: Pesticides, safety measures, knowledge, practice, farmers, Gera district, Ethiopia

INTRODUCTION

Although the benefits of synthetic pesticide use are clear, pesticides have an adverse effect on non-target organisms and concerns about its negative human health and environmental effects have increased over the past several years (Pimentel 2005; Naidoo *et al*., 2010**)**. Exposure to pesticides is one of the most important occupational risks among farmers in developing countries (Wesseling et al. 2001; Konradsen et al. 2003; Coronado et al. 2004; Shalaby et al. 2012) and it represents an important source of morbidity in farmers and farm workers (Moses, 1989).

The World Health Organization (WHO, 2005) have estimated 1-5 million cases of pesticide poisoning among agricultural workers each year. Globally there has been an increase in the incidence of pesticide poisoning with an estimated 1–41 million people suffering health effects from exposure to pesticides every year (PAN International 2007). According to the World Health Organization (WHO, 2009), a minimum of 300,000 people die from pesticides poisoning each year. FAO (2004) indicated that although developing countries account for only about 25% of global pesticide use, they experience around 99% of pesticide related deaths, most occurring among farm workers. In general, Ngowi and London (2006) and Naidoo *et al*., (2010) noted that adverse effects on human health have arisen as a result of inappropriate use and handling of pesticides by inadequately trained farmers and farm workers

Studies on farmers and farm workers in developing countries have reported low to moderate levels of knowledge about pesticides (Bailia and London, 1998; O'Malley, 1997), incomplete or non-usage of personal protective equipment (PPE) (London et. al., 1998; Wolf *et.al*.,1999), unsafe pesticide storage at homes (Bleecker, 1992; Wolf *et.al*., , 1999), poor disposal of empty pesticide containers (Bailia and London, 1998, Wolf *et.al*., , 1999), misuse of pesticides and relatively low knowledge about pesticide safety labels (Wolf et.al., 1999; Lekei *et.al*. 2014).

Except for few studies conducted in some areas (Yalemtsehay and Agonafir, 2002; Amera and Abate, 2008; Kalayou and Amare, 2015; Beyene, *et.al*, 2016), pesticide users and sprayers' knowledge, attitude and practice towards safety measures have not been broadly and exhaustibly assessed in Ethiopia. The main objective of this study was, therefore, to assess the pesticide utilization and handling practices, and safety measures knowledge and practice of farmers in Gera districts of Jimma zone, Oromia region, Ethiopia.

MATERIAL AND METHODS

Study area and population

Gera district is one of the rural districts in Jimma zone, Oromia regional state, South West Ethiopia. It is located 445 km South of Addis Ababa and 99 km from Jimma town. The altitudinal range of the area is 1600 – 2500 m and the topography varies from gentile to rugged slopes. The annual precipitation varies between 1280 - 2080 mm, a monthly mean temperature range between 14 - 26 ^{0}C and the altitude is 1900m above sea level (unpublished report of district agricultural office, 2015).

The study was conducted between September 2015 and September 2016.

Study design

Cross-sectional descriptive survey design and quantitative method were used in the study. The quantitative study method was used to collect data on demographic characteristic of the study participants (respondents); pesticide use and awareness and practice of safety measures.

Sampling procedure and sample size determination

The study employed a multistage sampling method including random sampling and systematic random sampling to select the study sites and HHs, and purposive sampling technique to select Key Informants (KIs).

From the 28 rural kebeles (administrative units) in the district, seven were randomly selected namely, Secha, Gangi-Callaa, Sadi, Wanja-Qarsa, Gara-Naso, Dusta and Qaco. List of HH heads in each kebele was obtained from respective kebele administrations. The studies HHs were randomly picked from the sampling frame using systematic random sampling method. HHs who lived in the study area for one year or longer was considered.

Sample size (n) of HHs who participated in the study was determined using the single population proportion formula developed by Cochran (1977) with the desired degree of precision for HHs. Therefore, sample size calculation gave a total of 475 household respondents and these were drawn by random sampling method from a sampling frame.

A total of 25 KIs were purposely selected to participate in the study based on their wide knowledge of crop protection agrochemicals including pesticide issues, the position they held in the agricultural sector, their closeness to appreciate the problems associated with pesticide use safety and management. These included district agricultural office experts and extension workers.

Data collection tools

To collect data from HH heads, a semi-structured questionnaire with closed and open-ended interview questions were used and the interview was carried out by researchers in the house of the households. For KIs, a structured individual questionnaire was used, self-administered to the selected 25 KIs and collected back by the researcher. Part of the questionnaires was adapted from the WHO field surveys of exposure to pesticides standard protocol (WHO, 1981).

The original questionnaires were prepared in English language and then translated into local language, "Afan Oromo". To check the accuracy of the translation, a back translation was made by an independent person before administering in the field. Prior to data collection, the questionnaire was pre-tested on selected farmers in the study area which were not included in the main data collection. A pre-test is carried out in order to check the clarity of the questions, to eliminate difficulties, and to estimate the length of time a respondent takes to complete. Therefore, any problems in the content of the questionnaires were resolved during the pre-test.

Data analysis

Statistical analysis of data was carried out using SPSS version 20.0 statistical package program. Data were recorded, organized and summarized in simple descriptive statistics methods and mean, percentage, frequencies and range were used to describe the findings, and results were presented using tables and charts. One-way ANOVA was used to test the significant differences or associations between independent and dependent variables.

Ethical considerations

Ethical clearance was obtained from the Ethical Clearance Committee of Hawassa University. Before entering the study area to collect data, local authorities and community leaders were briefed about the objective of the study. Respondents participated in the study was voluntary and each respondent was asked to give verbal consent to participate and each household was assured that the information provided will be kept confidential.

RESULTS AND DISCUSSION

Socio-demographic characteristics of the respondents

A total of 500 respondents have participated in the study, and among these 475 were farmer HHs and 25 KIs or agricultural workers (14 extension workers and 11 experts in district agricultural office). Among the 475 HHs, 467 (98.3%) were males and 8 (1.7%) were females. The mean age of the respondents was 35.3 years with range of 18- 60 years. Majority (68.8%) of the HHs were in the age group of 31 to 45 years, and 24.4% of them were in the youngest age group (18 – 30 years), (6.7%) in the age group of 46-60 years. The majority (60.2%) of HHs were illiterate, 26.1% could read and write, 10.3% attended primary and 3.3% secondary schools (Table 1).

The mean family size of the HHs was 4 persons. Sixty eight percent of HHs had 4 to 5 family members and 16.8% of them were with more than 5 family members. About 99.0% of the HHs occupation was farming, but 1.2% of them participate in trading in addition to farming. About 59.0% of the HHs had 7-12 years of farming experiences, 24.0% with 3-6, and 14.1% with 13-20, about 3.0% had more than 20 years of work experience (Table 1).

Table 1. Socio-demographic characteristics of respondent farmer HHs and KIs

Demographic characteristics		Respondents	
		HHs (n=475)	KIs (n=25)
Sex	Male	467(98.3)*	19 (76.0)
	Female	8(1.7)	6 (24.0)
Age (years)	18-30	116(24.4)	9 (36.0)
	31-45	327(68.8)	12 (48.0)
	46-60	32(6.7)	4 (16.0)
Educational level	Illiterate	286(60.2)	-
	Able to read	124(26.1)	-
	Primary school (grades 1-8)	49(10.3)	-
	Secondary school (grades 9-12)	16(3.3)	
	College diploma	-	16 (64.0)
	First degree	-	8 (32.0)
	Second degree	-	1 (4.0)
Occupation	Farmers	469(98.7)	
	Traders beside farming	6(1.2)	
Work experience **	1-6	114(24.0)	17 (68.0)
	7-12	280(58.9)	6 (24.0)
	13-20	67(14.1)	2 (8.0)
	>20	14(2.9)	-
Family size (number of persons)	1-3	72(15.1)	-
	4-5	323(68.0)	-
	>5	80(16.8)	-

* *Numbers in parenthesis are percentage of n*

Among the KIs, 19 (76.0%) were male and 6 (24.0%) were female. Their age ranged from 18-60 years and the mean age was 33.9 years. Eighty-four percent of them were in younger (18-30 years) and middle (31-45) age groups and only

16.0% belong to the oldest age group (46-60 years). About two-thirds of the KIs were college diploma holders and neary a third (32.0%) were first-degree holders. A majority (68.0%) of them had 1-6 years of work experience and 24.0% with 6-10 years of work experience (Table 1).

Pesticides use pattern and handling practice of farmers

All HHs reported using agrochemicals, of which 305(64.2%) used them always and the rest 170(35.8%) sometimes (Table 2). Also, KIs reported almost similar proportion (68.0%) of farmers in the study area using agrochemicals always (Table 3). Among the types of agrochemicals used, pesticides use was reported by highest proportion (40.2%) of HHs, followed by chemical fertilizers (35.0%) and organic fertilizers (24.8%) (Table 2).

Farmers in this study reported using one or more of the four classes of chemical pesticides, (namely, insecticides, fungicides, fungicides and herbicides) (Table 2). And this finding is consistent with that reported from North Showa zone, Amhara regional state of Ethiopia (Kalayou and Amare, 2015). But the proportion of farmers reported in this study (44.8% of insecticides, 39.6% fungicides, 100% herbicides and 7.6% rodenticides) were higher than that of aforementioned study findings. The result indicated that pesticides were widely used by local farmers in the study area

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Table 2. Farmers practice on agrochemical and pesticide uses

Variables		Respondents (n = 475)	
		Frequency	**Percent**
Used agrochemicals	Yes, always	305	64.2
	Yes, sometimes	170	35.8
Types of agrochemicals used	Chemical fertilizers	166	350
	Organic fertilizers (compost)	118	24.8
	Pesticides	191	40.2
Class of pesticide used*	Insecticide	213	44.8
	Fungicide	188	39.6
	Herbicide	475	100
	Rodenticide	36	7.6
Reason for using pesticides	Solves pest problem	258	54.3
	Increases crop production	217	45.7
Person consulted in making decision to use pesticides	My self	138	29.0
	pesticide vendor	81	17.1
	agricultural extension workers	256	53.9
Person that prepares and sprays pesticides	My self	142	29.9
	Family member with experience	74	15.6
	Trained personnel	143	30.1
	Untrained daily laborer	116	24.4

** Multiple responses on classes of pesticide used are possible and therefore the sum of percentages may be greater than a 100.*

Concerning benefits they got through using the pesticide, HHs indicated that it solved their pest problems (54.3%) and increased crop production (45.7%) (Table 2), but these responses were higher (89.4% and 83.3%, respectively) in the case of finding from North Showa zone, in Ethiopia (Kalayou and Amare, 2015).

More than half (53.9%) of the HHs made the decision to use pesticides by consulting agricultural extension workers, but a considerable proportion, 29% and 17.1%, decided only by their own and in consultation with pesticide vendors, respectively (Table 2). Such decision not based on consultation with professionals would result in a wrong selection of the kind, quantity, and formulation of pesticide that may cause environmental and health hazard.

Relatively higher proportion (30.1%) of the HHs sprayed pesticides using trained personnel, 142(29.9%) by themselves and 74(15.6%) by experienced family members. However, 24.4% of them reported spraying it using employed untrained daily labors (Table 2).

About 64.0% of the KIs indicated that farmers with high economic status using pesticides (Table 3) indicating farmers from higher income groups are more likely to use pesticides and this is consistent with the findings of Mengistie *et.al*. (2017).

According to Rı´os-Gonza´lez *et al*. (2013), education plays a significant role in changing farmers' lifestyles. The present study result revealed that only 28.0% of HHs reported relatively educated farmers using pesticides. As indicated by Rı´os-Gonza´lez *et al*. (2013) and Mengistie *et.al*. (2017), the low level of use by literate farmers might be because of their better understanding of the effects of pesticides on human health and the environment compared to less literate farmers.

Those reported supply or distribution by the agricultural office was 64.0% and 60.0% of them mentioned the supply was by purchasing the pesticides (Table 3).

Means of transporting pesticides used and reported by HHs include public transport (37.1%), back of a donkey (36.6%), open truck (22.1%) and some of them (4.21%) even carrying by themselves (Table 4). The KIs also reported farmers using similar means of transporting pesticides (Table 3). The results (Table 3 and 4) showed that considerable proportion of respondents reported using public transport and carrying themselves to transport pesticides, and this seems to be inappropriate transport practice. Such inappropriate practice is worrisome because it would result in high risks of pesticide exposure in case of damage to the container and/or spillage and may be a health risk to farmers and their families as leakages of these chemicals can be inhaled, come in contact with their body or contaminate drinking water and food.

Majority (80.6%) of the HHs reported storing pesticides anywhere in the living house (including kitchen and bedroom) and only 19.4% reported storing it in separate places out of the living house. But Mengistie *et.al*. (2017) reported low proportion (only 32.0%) storing in living houses. About 69.0% of them store the spray equipment anywhere in the living house (Table 4).

Storing pesticides and spray equipment in living house practiced in the study area also seems inappropriate because it would pose exposure. For instance, the Northern Presbyterian Agricultural Services (NPAS) (2012) reported that 15 farmers in the upper East region of Ghana died in 2010 from suspected pesticides poisoning and most of these deaths was due to poor storage of pesticides.

Consistent with findings of the present study, other previous researchers (Ngowi *et al*., 2001 and Murphy *et al*., 2002) indicated that storage of pesticides in unguarded sites in residences is common in many developing countries. The present finding is also in agreement with those reported by Ogunjimi and Farinde (2012a, b) which stated that, a high percentage of cocoa farmers in Osun and Edo States, Nigeria, stored pesticides in the living room together with foodstuff.

However, finding of the present study is not consistent with the report by Tijani (2006) which stated that 87.5 % of cocoa farmers in Ondo State, Nigeria, kept their pesticides in the storerooms with very few (8.3 %) storing in their bedrooms.

Methods of disposing leftover pesticides and empty containers reported by farmers include throwing at waste dump place (53.9%), dumping on farmland (36.2%), burying in the ground (34.1%), burning (1.5%), throw it anywhere (14.7%) and about 19.0% of them reported washing and re-using the containers for household purpose (Table 4).

Table 3. The response of KIs on issues related to agrochemicals use, supply, transport and availability of PPE.

Variables		Agricultural workers (KIs) (n=25)	
		Frequency	**Percentage**
Agro-chemical use by farmers	Yes, always	17	68.0
	Yes, sometimes	8	32.0
	No	-	-
Economical status of the farmers using pesticides	Farmers with high income	16	64.0
	Relatively educated farmers	7	28.0
	All farmers commonly use it	2	8.0
Supply or distributing pesticides to farmers by office	Yes	16	64.0
	No	9	36.0
Means of transporting pesticides	Open truck	7	28.0
	Public transport (bus)	13	52.0
	Domestic animals (back of donkey)	3	12.0
	Carried by farmers	2	8.0
Availability of PPE to farmers*	Yes, at pesticide vendor	12	48.0
	Yes, at agricultural office	6	42.4
	No, not easily available in the market	8	32.0

** Multiple responses are possible for sources of PPE and therefore the sum of percentages may be greater than a 100.*

In the present study the proportions of farmers that practiced relatively safer means of disposing leftover pesticides and empty containers such as throwing at waste dump place (53.9%) and burying in the ground (34.1%) (Table 4) were greater than that reported by Tyagi and Prashar (2015) (10.4 % and 1.7%, respectively. However, that did practice burying in the ground reported by

Kumari and Reddy (2013) (48.0%**)** was higher than the present study. Relatively, a low proportion (1.5%) of farmers in this study practiced burning compared to that reported by Tyagi and Prashar (2015) **(**9.6 %**).** Compared with other similar studies **(**Kumari and Reddy, 2013**;** Tyagi and Prashar, 2015; Mengistie *et.al*, 2017) a low level of unsafe disposal, such as dumping on farmland (36.2%) and throw it anywhere (14.7%) (Table 4), were practiced in the present study.

Even though the proportion of farmers reported disposal method varied, findings of the resent study indicated that farmers commonly disposed of empty pesticide containers, unwanted pesticides or leftover spray solutions in unsafe ways. Similar findings were reported by Antwi-Agyakwa (2013), Lekei *et al*. 2014, Afari-Sefa *et al*. (2015) and Kumari and Reddy (2013). According to Briassoulis *et al*. (2014), usually around 2 % of the pesticides still remain in the empty packaging and, therefore, most of these disposal measures for pesticides packaging would pose significant environmental and health risks. As noted by Lekei *et al*. (2014), these inappropriate measures of disposal may be an important source of pesticides exposure and environmental pollution.

Table 4. Pesticides and spray equipment transports, storage and disposal practices of farmers.

Variable		Respondent HHs (n = 475)	
		Frequency	**Percentage**
Means of transport	Open truck	105	22.1
	Bus/minibus	176	37.1
	Domestic animals(donkey)	174	36.3
	Carried by user	20	4.2
Storage of pesticides	In separate place/store	92	19.4
	In living house/bedroom	263	55.3
	In the kitchen	120	25.3
Storage of spray equipment	General storage in the house	97	20.4
	Equipment store	22	4.6
	Ceiling board	30	6.3
	Any place in the living house	326	68.6
Disposal method of leftover pesticides and empty containers	Burying in the ground	162	34.1
	Open burning	7	1.5
	Leave on farm	172	36.2
	Re-use of household purpose	90	18.9
	Throw at waste dump place	256	53.9
	Throw anywhere	70	14.7

** Multiple disposal methods are possible, therefore the sum of percentages may be more than a hundred percent.*

The Environmental Health Manual (2010) identified the community rubbish damp site as the best place to discard empty pesticides containers after being washed three times with the appropriate solvent. The manual again warned against the burning of pesticides containers because they can give off poisonous gases that would cause air pollution. Therefore, farmers and farm workers must be trained to avoid such disposal practice and use the recommended safer ones.

Although a majority of farmers were aware of the risk of pesticides exposure, the finding of this study revealed that some farmers wash and re-use empty pesticide containers for other household purposes (to keep water and other food items such as salt, cooking oil, among others). This re-use of containers seems to be due to the wrong perception that once washed they pose no danger to their health. As noted by Briassoulis *et* al, (2014), traces of pesticides could still be found in the containers even after proper washing and rinsing and therefore such re-use of pesticide containers might represent a route of serious non-occupational human exposure. A similar re-use practice of pesticide containers for other household purposes has been reported in other studies (Ogunjimi and Farinde 2012b; NPAS, 2012; Kumari and Reddy, 2013; Lekei *et al*. 2014; Afari-Sefa *et al*. 2015).

Safety precaution practice and PPE use

Table 5 indicated that about 22.0% of farmer HHs not following safety precaution during pesticide preparation and application, but more than half (52.0%) of them never practiced (Table 8) general safety measures (that includes fundamental sanitary practices). A study conducted on farmers in Amhara regional state, Ethiopia, revealed that more than 95.0% of them not practicing the same (Kalayou and Amare, 2015), and a similar study in Haryana state (Faridabad), India reported more than half of them not practicing it (Tyagi and Prashar, 2015**)**. Poor safety precaution practice observed in this study indicates inadequate awareness of farmers on the consequence of not strictly following all the recommended safety measures.

To reduce the exposure to pesticides and health-related risks, the use of PPE by farmers during pesticides preparation and application has been recommended by the International Labor Organization (ILO) and the World Health Organization (WHO) (ILO, 1991).

About 70.0% of the farmers in this study confirmed never using the recommended PPE during pesticide preparation and application (Table 5). Those who did not use recommended PPE in this study were more than three times the 20.0% reported by Okoffo *et. al*. (2016) in Ghana**.** Also**,** findings of previous other studies in different countries (Sosan and Akingbohungbe, 2009; Ogunjimi and Farinde, 2012a; Antwi-Agyakwa, 2013) indicated that only a small percentage of farmers actually wear PPE during pesticides application.

Farmer HHs who did not use any PPE during pesticides application gave reasons such as high cost (34.5%), unavailability in the market (32.4%), felt no need of it (17.4%), not having it for use (16.5%) and feeling discomfort in use (15.6%) (Table 5). Similar findings of reasons for non-usage of PPE amongst farmers have been reported in studies conducted by Ntow *et al*. (2006) and Lekei *et al*. (2014).

Regarding kind of PPE they use, almost all of them reported using coveralls ("tuta"). However, 50.0%, 49.3%, 28.2%, 16.9% and 3.5% of them used protective shoes, respiratory protection, headdress, goggles and glove, respectively (Table 5).

Among HHs reported using PPE, 96.5% used it partially (Table 5) and this is more than two times greater than the 45.0% reported by Okoffo *et. al.* (2016) in Ghana. Some of the HHs (who were not using recommended PPE) observed using handkerchiefs or face towels in place of nose/mouth masks to prevent inhalation of pesticide droplets. This is not appropriate and effective in protecting farmers when spraying toxic pesticides and might increase farmers' health risk of exposure to pesticides.

Failure to use and not putting on full PPE during pesticides preparation and application, as observed in this study, might expose greater parts of farmer's body to pesticides through direct contact. Therefore, as noted by Okoffo *et al*. (2016)**,** the failure of farmers to use PPE during pesticides preparation and

application presents potential risks to pesticides exposure and might have exposed them to adverse effects of pesticides.

Koh and Jeyaratnam (1996) noted that for the most of pesticides, using protective measures results in a decrease of exposure to pesticides. And these authors also described that **t**he use of protective measures could contribute to decreasing the health effects of pesticides and consequently would lead, to a decrease in poisoning prevalence parallel to the reduction in exposure. Thus, properly designed education and training programs on the proper use of PPE during preparation and application should be given by concerned bodies to farmers and farm workers. Furthermore, about one-third (Table 3) of KIs, as well as farmers (Table 5), participated in this study reported that PPE is not easily available in the market. Therefore, availability of PPE must be ensured at low cost so as to enhance their usage and popularity among the farmers and farm workers.

Table 5. Safety precautions and personal protective equipment use practice of HHs

Variable		Respondents	
		Frequency	**Percent**
Safety precautions during pesticide preparation and application **(n = 475)**	Yes	372	78.3
	No	103	21.7
Using recommended PPE while preparing and spraying **(n = 475)**	Yes, always	44	9.2
	Yes, sometimes	98	20.6
	No/ never	333	70.1
Reasons for not using PPE**(n=333)***	Unavailability in the market	108	32.4
	High cost/expensive	115	34.5
	Discomfort in usage	52	15.6
	Feel no need	58	17.4
	Do not have PPE	55	16.5
Kind of PPE used **(n=142)**	Headdress/hat	40	28.2
	Goggle **(**protective eyeglasses)	24	16.9
	Respiratory protection (nose and mouth cover)	70	49.3
	Gloves	5	3.5
	Coverall/ body protection cloth ("tuta")	142	100
	Protective shoes (rubber boot)	71	50.0
Completeness of used PPE **(n=142)**	Partial	137	96.5
	Fully	5	3.5

** More than one reason for not using the PPE is possible and therefore, the percentage may be more than a hundred.*

CONCLUSION AND RECOMMENDATIONS

Findings of the present study revealed that farmers in the study area might have been exposed themselves to harmful effects of pesticides due to unsafe use or misuse such as lack of attention to safety precautions; lack of the use of PPEs during handling of pesticides particularly when transporting, storing, mixing and loading, and applying; and also to some extent because of incorrect beliefs of farmers about pesticide toxicity. This is believed to be attributed to farmers' inadequate technical knowledge of handling and exposure, ignorance of basic safety guideline on use of PPEs, the absence or weak follow up and support by extension services, weak or absence of legislative framework or law on safe distribution, handling and use of pesticides.

Therefore, promoting safe pesticide use requires changing and improving the existing inadequate KAP of farmers and farm workers towards safe use and handling of pesticides. This can be achieved by providing continuous and appropriate training programs to raise awareness among farmers, farm workers and vendors about the potential hazards of pesticide use and particularly about the importance of proper pesticide management during all phases of handling them. In addition, availability of PPE must be ensured at low cost so as to enhance their usage and popularity among the farmers and farm workers. Extension services could transfer 'best pesticide practices' from one farmer to another. However, extension workers were not adequately trained in pesticide management and hence unable to provide adequate services to farmers with regard to safe use and handling of pesticides. Thus, training and technical support for extension workers are necessary to address incompetence and gaps in technical knowledge.

Although pesticides are widely used by farmers in all corners of the country, additional studies must be conducted on local farmers, small and large scale irrigation farmers to get enough data on the patterns of use and status or magnitude of KAP of farmers. Also there is a need for further research on how to transform the existing knowledge and practices to more sustainable and safer ones.

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