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Smallholder Farmers' Attitude and Knowledge of Pesticide Utilization: A Showcase from West Shewa Zone of Oromia, Ethiopia

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Abstract: The results of this study showed that the majority of the farmers (90 and 57%) reported that pesticides were harmful to human and animal health, respectively. Among 121 respondents 34.7% were not read, understand and follow pesticide labels and instructions and 90% of them were not aware of obsolete pesticides Also, it was found that more than 77% of the respondent stored pesticides in their living room. About 13.1% of the respondents disposed leftover and/or expired pesticide by applying on other untargeted crops and 34.3% of them re-used empty pesticide container for different purpose. Over 83.6% of the respondents' used one or partial personal protective equipment during handling and spraying of pesticides, while, 16.4% of the respondents did not use any type of PPE. In general, most of the respondents have poor attitudes and practices of pesticide usage and handling which likely expose them to high risk of pesticide. Therefore, regular training on the safe and proper use, handling, storage and disposal of pesticides is required to minimize risks to health and environment.

Keywords: Pesticide handling and use; Pesticide hazards; Safety equipment; Smallholder farmers; Ethiopia.

Research Paper

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1. INTRODUCTION

Agriculture, being a crucial sector for the food security supporting livelihoods of nearly 85% of the citizens, is still based mainly on smallholder farms in Ethiopia. Agricultural development is considered to be vital for sustainable economic growth and poverty reduction in the country.

Pests (diseases, insects and weeds) cause serious losses to crops in terms of both quality and quantity in the Tropics and Sub-tropics in general and in Ethiopia in particular (Keneni *et al.*, 2011). In most low income countries like Ethiopia, intensification of agriculture has led to an increase in the use of chemical pesticides as a means to increase agricultural production (Jors *et al.*, 2006). Without the use of pesticide in hot environment especially in tropical low income countries, there could be an estimated 50% yield loss of crop production and productivity (Damalas and Eleftherohorinos, 2011).

The inception of the use of pesticides goes back to the 1960s in connection with the establishment of state farms (Mekuria *et al.*, 2021)). Later on the agricultural extension systems, in an effort to increase crop production and productivity, pesticides were also introduced to the farming system of smallholder farmers (Tadesse, 2016). Since then, the use of pesticides by

smallholder farmers showed a steady growth till 1990s and grown rapidly since then with the recent development of the flower growing sector and small scale irrigation (FAO, 2020). Between 2005 and 2019 alone, the average import and use of pesticides in the country has grown from less than 250 tons in 1993 to over 4000 tons per annum in 2019 (FAO, 2021).

It is universally agreeable that the application of pesticides, even though vital in agriculture to prevent loss of crops by pests, are inseparably associated with a number of drawbacks including high costs and concerns about environmental pollution and food safety (Keneni *et al*., 2011). If not properly handled and managed, pesticides could create major environmental, human and animal health risks (Vergucht *et al*., 2006; Mahmood *et al*., 2016).

While risks associated with chemical pesticides by its nature itself is sufficient to complicate their

application even by an expert, it is evident that the situation is rather expected to be worsened by the low level of knowledge, skill and awareness of small scale farmers in Ethiopia. Evidences show that pesticide usage by small holder farmers was frequently accompanied by misuse (abuse and overuse) of pesticides and resulted in poisoning users and caused chronic health effects; pesticide residue in food and drinking water (Amera, 2011]. A great majority of pesticides user farming community in Ethiopia are not adequately informed of the hazards to pesticide usage (Mengistie *et al*., 2017), as it holds true in many places of the African continent (Benjamin *et al*., 2019). In addition, safe application of pesticides sometimes not be possible because of the economic background of the farmers. For instance, the storage structures in use under small-scale production conditions of the Tropics and Sub-tropics are not suitable for the use of chemical insecticides especially for formulations like fumigants (Chen *et al.,* 2007). In most cases, the storage structures are built within the same houses the families dwell and this makes the use of chemical insecticides more hazardous to human health (Ignacimuthu and Prakash, 2006; Chen *et al.,* 2007). Experience show that, as compared to other technologies like seed based interventions which are easier to transfer to farmers, pesticide based technologies are difficult to transfer to farmers because of the associated more complex knowledge and skill based practices (Edmeades *et al.,* 1998). A series of formal mass trainings, followed by a wide scale demonstration, have been delivered to small holder farmers particularly as part of the nation-wide Extension Package Program conducted during the last couple of decades on the use of improved technologies of various crops including application of agro-chemicals (Fiker L.O., 2016). The trainings that have been given to small holder farmers and the wide scale demonstrations of pesticide application here and there all over the country, are believed to improve not only knowledge and skills of pesticide application by farmers but also methods of handling in relation with the application of the required safety procedures. Assessments of the effects of the series of formal mass trainings and demonstration of pesticides handling and application methods during the last two decades would absolutely be essential not only in promoting reflective practices towards proper utilization of pesticides, identification of problems associated with application of the required safety procedures and suggest possible corrective measures assuring effectiveness and efficiency. However, the effects of such mass trainings and demonstration of pesticides handling and application and the progresses realized so far in terms of improving knowledge and skills of smallholder farmers have not yet been well studied and documented in Ethiopia in general and West Shewa Zone of Oromia in particular. Limited studies in related areas rather depicted negative environmental and occupational effect of pesticide exposure with higher health risks to the general public as well as occupationally exposed farmers (Gebremichael *et al*., 2016; Negatu *et al*., 2016b). The objective of this study was, therefore, to assess the level of knowledge, attitudes and practices of smallholder farmers towards the use of pesticides and their associated health hazards in West Shewa Zone of Oromia.

2. METHODOLOGY

2.1. Description of the Study Area

The study was conducted in Wolmera and Ejere districts of West Shoa Zone of Oromia Regional State, Ethiopia. These two districts are located 34 and 40 kms, respectively, west of Addis Ababa on the main road to Ambo.

Wolmera District is bordered by the districts of Sebeta Hawas in south, Ejere in west, Mulo in north and Addis Ababa city in east directions. The capital town of Wolmera is Holetta located at 9^0 3ˆ N and 38^0 30ˆ E longitude. The district practices mixed crop-livestock farming system. Wolmera, with altitude ranging from 2000 to 3380 meters above sea level (masl), represents the highland and the transitional highland agro-ecologies (WWAO, 2021). The district has a mean monthly temperature of 16.5^0 C with a total annual rainfall of 1067 mm. Likewise, Ejere district, with altitude ranging from 2060-3185 meters above sea level, annual rainfall of 900-1200 mm and annual temperature of 9^0 C – 18^0 C, represents the highland and the mid-altitude agro-ecologies (EWAO, 2021). Ejere is bordered by the districts of Wolmera in east, Dendi in west, Adaberga in north and Alemgena in south directions. The district is characterized by subsistence mixed farming system in which both crop and livestock production play the major economic role for the community. Annual crops are predominant and rain-fed agriculture is mainly practiced using animal power.

2.2. Sampling Techniques and Sample Size

The representative sample units for this study were selected from all actors involved along pesticide use. Multi stage sampling strategy was employed for selection of sample households. West Shewa Zone was targeted for this study. Districts and villages were selected in consultation with District agricultural experts and Development Agents. Wolmera and Ejere districts and three Kebeles in each district namely Sademo, Dufa and Telecho from Wolmera and Cheri, Arbasa and Kimoye from Ejere were selected purposively based on their potential use of pesticides. Finally, 121 sample respondents were selected randomly, using probability proportionality size following a simplified formula provided by (Yamane, 1967). Accordingly, the required sample size at 95% confidence level with degree of variability of 5% and level of precision equal to 7% were used to obtain a sample size required which represent a true population.

$$n = \frac{N}{1 + N(e)^2}$$

Where n is sample size, N is the population size (sampling frame), and e is the level of precision considered 7%

2.3. Data Collection Method

Formal and informal interviews were used to gather information on farmers' knowledge, attitudes and practices towards the safe use of pesticides. Both primary and secondary data were collected. Secondary data sources included Districts' Bureaus of Agriculture, Districts' Trade and Market Development Office and its associated primary cooperatives, Central Statistical Authority (CSA), and published and unpublished reports and bulletins. Both qualitative and quantitative data were collected and used for the study. Primary data sources were smallholder farmers from six villages per district. Primary data were collected using informal and formal surveys and key informants interviews. For informal survey focus group discussion and key informant interview was used with checklists. The formal survey was undertaken through face to face interviews with 121 randomly selected farmers directly involved in pesticide use using a structured questionnaire. Focus group discussions were held with two groups based on predetermined checklists and a total of 15 key informants were interviewed from different organizations and institutions.

Enumerators from research staff were recruited and trained for data collection. Before data collection, the questionnaire was pre-tested on three farmers to evaluate the appropriateness of the design, clarity and interpretation of the questions, relevance of the questions and to estimate time required for an interview. Subsequently, appropriate modifications and corrections were made on the questionnaire. The questionnaire covered different topics in order to capture relevant information related to the study objectives.

2.4. Data Analysis

All collected data were coded, entered, and then analyzed using SPSS version 20 and Micro Office Exel 2010 software. Descriptive results were expressed as frequencies and percentage and the Chi-square test (x^2) was used to measure the possible association between nominal variable (28). We used $\alpha \leq 0.05$ as a criterion for statistical significance. Factors affecting utilization of protective clothing during pesticide application (use and do not use) was analyzed using binarylogistic model. Hill and Kau (1973) and Pindyck and Rubinfeld (1998) pointed out for the farmer to use or not to use a specific technology, a reaction threshold of different factors affect. This is modeled as:

$$Y_i = \beta X_i^* + u_i$$

Where Y_i is equal to one (1) when a choice is made to use and zero (0) otherwise and X^* represents the combined effects of the independent variables (X_i) at the threshold level. The above binary choice model involves the estimation of the probability of use of a given technology (Y) as a function of independent variables (X). The probability of using and not using is also modeled as:

$$prob(Y_i = 1) = F(\beta' X_i)$$
$$prob(Y_i = 0) = 1 - F(\beta' X_i)$$

Where Y_i is the observed response for the i^{th} observation of the response variable Y and X_i is a set of independent variables such as household head sex associated with the i^{th} individual, which determine the probability of using, (P). The function, F may take the form of a normal, logistic or probability function. The empirical model for the logit model estimation is specified as:

$$Z_i = \log\left(\frac{p_i}{1 - p_i}\right) = \alpha + \beta' X_i + \varepsilon_i$$

Where, X_i is the combined effects of X explanatory variables that promote or prevent farmers' decision to use modern agricultural production technologies. $\log\left(\frac{p_i}{1-p_i}\right)$ is the log-odds in favor of farm households' decision to use modern agricultural technologies (Wooldridge, JM, 2003; Maddala, GS., 1985; Pindyck, SR., and Rubinfeld, LD., 1998; Haill, l., and KUA, p. 1973).

3. RESULT AND DISCUSSION

3.1. Demographic Characteristics of the Farmers

The socioeconomic characteristics of the farmers are presented in Table 1. The result showed that the highest number of respondents (64.46%) were in the age group of 31-54 years old followed by those belonged to 55 years and over (20.66%), while 14.88% of the respondents fall in the 18-30 age group with an average age of 44.33 years (Table 1). Among 121 respondents interviewed, 90.9 were male and 9.1 were female.

Regarding the education level of the respondents, 21.5% were illiterate, 13.2% were informally educated and 65.3% were formally educated i.e. 46.3% of them were completed primary school (2-8 grades), 18.2% were completed secondary schooling (9-12 grade) and one respondent has received a university degree. According to Rios-Gonzalez *et al.* (2013) literate farmers have a better understanding of the effect of pesticides on health and the environment than illiterate ones. Among 121 respondents, 74.4% had the ability to read and 71.1% of the respondents had the ability to write. When we consider the size of the family, the majority of the respondents (61.1%) have a usual member of 5 to 8 followed by 28.9% with a member of 1 to 4 and the lowest (10%) number of respondents have family size of 9 and above with an average family size of 5.74 (Table 1).

Table 1: Socioeconomic characteristics of the respondents (n=121)

Variables	Respondents (N)	Percentage (%)
Age group (years)		
18-30	18	14.9
31-54	78	64.5
≥55	25	20.7
Education level		
Illiterate	26	21.5
Informally educated	16	13.2
Primary	56	46.3
Secondary	22	18.2
College	1	0.8
Family size		
1-4	35	28.9
5-8	74	61.1
≥9	12	10
Ability to read and write		
Able to read	90	74.4
Unable to read	31	25.6
Able to write	86	71.1
Unable to write	35	28.9

Source: Authors' analysis using primary data (2021)

3.2. Pest Management Methods:

In order to enhance crop production, farmers have increased the use of pesticides to meet their food sufficiency targets. Currently, farmers mainly rely on pesticides for increasing agricultural productivity by controlling different insect pests, diseases and weeds. In the study areas, majority of the interviewed small-holder farmers (76.9%) were used pesticides to control pests and diseases while some of them (19.8%) were used integrated pest management (IPM) methods. The remaining 3.3% of the respondents were used cultural practices to control pests (Table 2). The result also revealed that respondent farmers were used different weed control methods among which chemical herbicides alone (38%) took the lion share followed by hand weeding, crop rotation, grazing and herbicides (48.8%); hand weeding and herbicides (7.5%) and mechanical hand weeding 5.8% respectively (Table 2).

Table 2: Different pest management methods practiced by respondents in both study areas

Variables	Respondents (N)	Percentage (%)
Insect pests and diseases control method		
Chemical pesticides	93	76.9
IPM	24	19.8
Cultural practices	4	3.3
Weeds control method		
Hand weeding	7	5.8
Chemical herbicides	46	38.0
Grazing, weeding, crop rotation & herbicide	59	48.8
Hand weeding & herbicide	9	7.5

Source: Authors' analysis using primary data (2021)

3.3. *Farmers Knowledge, Attitude and Understanding of Pests and Pesticide Use*

Farmers' knowledge, attitude and understanding of pesticide use and their effect on human health and environment including laws and regulation are presented in table 2. The result showed that while 90% and 57% of the respondents were aware of pesticides effect on human health and the environment, respectively; the remaining 9.9% and 43% of the respondents were not aware of its hazards on human health and the environment. Different studies conducted on the attitudes and knowledge of smallholder farmers indicated that the common pesticide use practice in developing countries are unsafe and cause health issues and environmental hazards (Macharia *et al*., 2013; Abang *et al*., 2014; Damt and Tabor, 2015). Although, the great majority of the farmers (92.5%) replied that pesticides were indispensable for high crop yield and productivity. It is very important to acquaint farmers on the use of alternative cropping system and organic farming that are not dependent on pesticide use. The present study indicated that 65.3% of the respondents were not read or follow instructions on pesticide labels on the bottles or containers. Among 121 respondents interviewed, only 34.7% of the farmers were able to read, understand and follow pesticide label instructions

correctly. Result of the current study is in lined with previous study by Damalas and Khan (2016) who reported similar finding about farmers' attitudes towards pesticide labels.

The majority of the respondent farmers (91.1%) were not aware of obsolete pesticides which have been banned or restricted to use, while a few respondents (8.9%) have the information on banned or restricted pesticides. Similarly, Mekuria *et al.*, (2021) in their study of small-scale farmer knowledge and practice and impacts on the environment and human health in Ethiopia indicated that only 7.6% of the respondents knew some of the banned or restricted pesticides for use. Regarding possible reasons for those banned or restricted pesticides, 3.3% of respondent farmers who had some awareness about it responded because of its highly toxic, 3.3%, responded because of expensive, 1.6% responded because not effective and 91.7% did not know the reason for banning or restricting. The respondents also asked how pesticides enter to the human body, accordingly about 32.2% of the respondents replied through inhalation and oral, 20.7% of them responded through inhalation, oral and eye contact; 14.9% responded through inhalation, dermal, oral and eye contact and 6.6% were responded that inhalation is the most common routes of exposure to pesticides. The remaining 3.3% of the interviewed farmers lack the knowledge on how pesticides enter the human body (Table 3).

Table 3: Farmers Knowledge, attitude and understanding of pesticide use and its hazards(n=121)

Variables	Respondents (N)	Percentage (%)
Pesticides affect human health		
Strongly agree	66	54.5
agree	43	35.5
Disagree	12	9.9
pesticides affect the environment		
Strongly agree	39	32.2
agree	30	24.8
Disagree	50	41.3
Strongly disagree	2	1.7
Pesticides are indispensable for high crop yield		
Strongly agree	61	50.4
agree	51	42.1
Disagree	7	5.8
Read, understand & follow pesticide labels		
Strongly disagree	2	1.7
Strongly agree	11	9.1
agree	31	25.6
Disagree	50	41.3
Strongly disagree	29	24.0
How do pesticides enter the human body		
Inhalation & oral	39	32.2
Inhalation, oral & eye contact	25	20.7
Dermal, inhalation, oral &eye contact	18	14.9
Inhalation	8	6.6
Oral	5	4.2
Inhalation dermal & oral	7	5.8
Eye contact	5	4.1
Dermal & inhalation	3	2.5
Dermal and oral	3	2.5
I don't know	4	3.3
Do you know some pesticides are banned or restricted for use		
Yes	11	9.1
No	110	90.9
Do you know the reason why pesticides are banned or restricted		
Highly toxic	4	3.3
Expensive	4	3.3
Not effective	2	1.6
I don't know	111	91.7

Source: Authors' analysis using primary data (2021)

3.4. Farmers' Practices on Storage and Disposal of Pesticides

Table 4. Shows farmers' way of storing pesticides and disposal of residual pesticide solutions, expired pesticides and empty containers. The result showed that majority of the respondent farmers in the study areas (77.7%) stored their pesticides in their living area, followed by locked chemical store (8.3%), open shade (7.4%) and in the open field (4.1%) (Table 4). This result indicated that most of the respondent farmers lack knowledge of pesticides hazards and appropriate/safe pesticide storage methods. Regarding disposal of diluted leftover pesticides, 38.2% of them responded that they were applied on the same crop in other fields, 19.7% applied on the same crops on other times, 20.4% of the respondent replied that they mixed only the required amount of pesticide for the given crops. About 13.1% of the respondent farmers reported that they applied on other crops (Table 4).

Table 4: Methods used to store pesticides and dispose leftover and their empty containers in the study areas (n=121)

Variables	Respondents (N)	Percentage (%)
Where do you store pesticides?		
Stored in living room	94	77.7
Stored in locked chemical store	10	8.3
Stored on open shade just for pesticide	10	7.4
Stored in the open field	7	4.1
What do you do with the unused leftover (mixed, diluted) pesticides?		
Apply on the same crops in other fields	46	38.2
Apply in same crops on other times	24	19.7
Mix only needed pesticides	25	20.4
Apply on other crops	16	13.1
Dispose in the field	10	8.6
What do you do with old pesticide stocks?		
Buy only amount needed	116	95.9
Re-use when needed	3	2.5
Sell to other farmers	2	1.6
How do you dispose of used pesticide		
package/containers?		
Leave on the ground	44	36.2
Bury underground	12	9.8
Leave on the ground &throw into water	11	9.0
Used for storing other products	8	6.6
Throw into water	8	6.6
Sell at market	14	11.5
Used for carrying water	12	9.7
Used for buying kerosene	8	6.5
Burning	4	3.3

Source: Authors' analysis using primary data (2021)

Farmers often use different practices to dispose old pesticide stocks and empty containers. Out of 121 respondents asked, about disposal of old pesticides 95.9% reported that they buy only the needed amount, 2.5% responded that they sold to other farmers and the remaining 1.6% responded that they re-used when needed. Regarding to the disposal of empty container, most of the respondents (36.2%) were left on the ground, 34.3% of the respondents re-used them for household purposes like storing food products, carry water, buying kerosene and also sold at market with the assumption that once they are thoroughly washed with soap and water they didn't harm people. However,.9.8% of the respondents buried the container within their farm, 9.0% leave on the ground and throw into water and 6.6% thrown into water (Table 4).

3.5. Farmer's safety practices against occupational exposure to pesticides

Appropriate use of Personal Protective Equipment (PPE) and adoption of other protective measures and attitudes during preparation and application of pesticides are important to reduce occupational exposure to pesticides. Over 83% of the farmers reported that at least one personal protective equipment (PPE/C) was used when mixing or applying chemicals pesticides. The remaining 16.4% of the respondents didn't wear any PPE during handling, preparation and spraying of pesticides. Farmers were asked to list the PPE items used when applying liquid formulations. The PPE wear by farmers during the application of liquid chemical pesticides were 25.0% rubber shoes; 20.6% rubber shoes and mask; 6.9% mask, long sleeves and rubber shoes; 5.7% long sleeves and mask; 11.4% gloves, mask and rubber shoes; 5.7%

overall and rubber shoes and 5.5% goggles, gloves and rubber shoes. The result in the table showed that a rubber shoe was one of the items most commonly used by majority of the farmers during applying of the chemicals. Among 121 respondents asked about the use of PPE during the application of liquid chemicals, 19.2% of them were not used any of the PPE listed in the questionnaire. Farmers also asked to list the type of PPE used for the application of dust chemical pesticides; 48.4% of the respondents replied that they didn't use any one of the item listed in the questionnaire, 15.6% of the said they wear mask and gloves, 12.8% wear only mask, 12.3% wear gloves and 10.9% wear mask and rubber shoes.

Although, farmers indicated that 96.7% of them were not wear any type of PPE when applying fumigant (applied to soil prior to planting) chemicals/formulation while only 3.3% use PPE when applied fumigant pesticides. Over 82.7% of the respondents reported that they did not use any of the PPE when they applied chemical pesticides to stored grain. About 17.3% were used PPC when applied pesticides to stored grain. Moreover, the result in the table showed that respondents reported that 83.6%, 95.9% and 98.4% of them were not wear any type of PPC when they applied liquid, dust and fumigant (phostoxin) pesticides to treat stored grains (Table 5).

Table 5: Farmers' use of PPE during preparation and application of pesticides

Questions	Variables	N	%
List of PPE/C wear when applying liquid chemical pesticides/formulations	Do not wearing any type of PPE	23	19.2
	Rubber shoes	30	25.0
	Rubber shoes and mask	25	20.6
	Rubber shoes, mask and long sleeves	8	6.9
	Mask and long sleeves	7	5.7
	Rubber shoes, mask and gloves	14	11.4
	Rubber shoes and overall	7	5.7
	Rubber shoes, gloves and goggles	7	5.5
List of PPC wear when applying dust chemicals	Do Not wear any type of PPE	59	48.4
	Mask and gloves	19	15.6
	Mask	15	12.8
	Rubber shoes and mask	13	10.9
	Gloves	15	12.3
List of PPC wear when applying fumigant chemicals	Do not wear any type of PPE	118	97.6
	Gas mask	3	3.3
Do you wear PPC when applying chemical pesticides to stored grain	Yes	100	82.7
	No	21	17.3
List the PPC when applying liquid chemical pesticides/ formulation to stored grain	Do not wear any type of PPC	102	83.6
	Gas mask	7	5.7
	Gloves	5	4.1
	Rubber shoes and gloves	2	1.6
	overall and gloves	2	1.6
	Goggles, gloves and gas mask	3	2.4
List the PPC when applying dust chemical pesticides/ formulation to stored grain	Do not wear any type of PPE	117	95.4
	Mask	1	0.8
	Gloves	1	0.8
	Mask and gloves	2	1.6
List the PPC when applying fumigant chemical pesticides/ formulation such as phostoxin to stored grain	Do not wear any type of PPC	119	98.4
	Mask	2	1.6

In addition to PPE use, the respondents were asked other safety measures if they practice to reduce their risk of exposure to pesticides. Table 6 below presented farmers operational practices implemented in the study area. Among 121 respondents asked 81.8% were not eat/ drink while spraying pesticides, only 18.2% of them eat or drink when mixing or spraying pesticides. Furthermore, 52.9% take a shower immediately after applying pesticides; 100% wash their hands after mixing or spraying pesticides; 45.5% wash clothes after spraying pesticides; 91% wash hands after applying lime and fertilizer and 31.1% wash clothes after applying lime and fertilizer. On the other hand, 47.1%, 54.5%, 9% and 69.9% of the respondents reported that they do not take shower, washing hands and clothes after spraying pesticides and applying lime and fertilizer on their farms (Table 6).

Table 6: Operational practices exhibited by the respondent during pesticide applications

Questions	Variables	Respondents (N)	Percentage (%)
Do you eat/drink when spraying pesticides	Yes	22	18.2
	No	99	81.8
Do you take shower after spraying	Yes	64	52.9
	No	57	47.1
Do you wash hands after spraying	Yes	121	100
	No		-
Do you wash clothes after spraying pesticides	Yes	55	45.5
	No	66	54.5
Do you wash hands after using lime and fertilizer	Yes	110	91.0
	No	11	9.0
Do you wash clothes after using lime and fertilizer	Yes	37	31.1
	No	84	69.9

Source: Author's analysis using primary data

3.6. Source of Pesticides and Pesticide Information

The source of pesticide and pesticide information was given in table 7. The data in the table revealed that the majority of the respondents (86.1%) in the study area were not received any training or information on safe use of pesticide application. Only 13.9% of them were stated that they had got training or information from different sources like government extension service, research, agricultural colleges and private. The main reason reported by the majority of the respondents why they did not get training/ information on pesticide usage was unavailability of organization that provides training to the farmers. Although, farmers were asked the source of pesticides to control their products, they said that 28.7% purchased pesticides mainly from private (agrochemical retailers, informal traders from local markets and follower); 27% of them reported from private and unions; 13.1% from government and private; 19.6% from government, private and unions; 8.2% from government and unions; 5.7% from unions and 2.5% from government. In this study the result showed that private was the major source of supply for chemical pesticides.

Table 7: Sources of pesticide and pesticide information (N=121)

Questions	Variables	Respondents (N)	Percentage (%)
Have you ever receive any training or information on pesticide application	Yes	17	13.9
	No	104	86.1
If no why	No organization provide information or training	104	86.1
	I am not interested to be trained	17	13.9
If yes who provide the training	Government organization	81	66.7
	Research centers	21	17.0
	Agricultural college	13	10.9
	Private	6	5.4
Sources of pesticides	Private	35	28.9
	Private and union	33	27.3
	Government and private	16	13.0
	Government, private and unions	17	14.0
	Government and unions	10	8.3
	Unions	7	5.8
	government	3	2.5

Source: Authors analysis using primary data (2021)

3.7. Possible health disorders related to pesticide use

The most common symptoms reported by the respondents during the interview were stinging/burning eyes 24.8%, rashes on skin 16.5%, blister 8.3%, skin irritation 17.4%, and headache 19.0%, coughing 8.3% and vomiting 5.8% after applying pesticides. The respondents were asked whether they face any serious health problems by theirs or their family, they reported that 8.3% face serious poisoning incident with related to pesticides that needs medical treatment in a hospital while 91.7% were not face any serious problems on their health (Table 8).

Table 8: Human health problems reported by the effect of pesticides

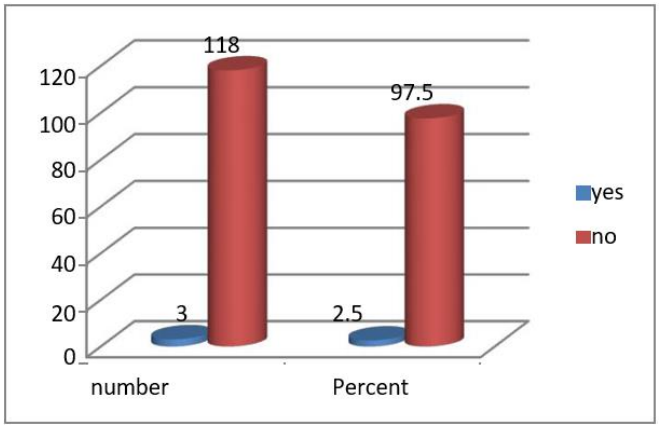
Questions	Variables	Respondents (N)	Percentage (%)
Do you know the negative impact of these chemicals on human and animals	Yes	113	93.4
	No	8	6.6
Did you or your family face any health problem due to pesticide	Yes	10	8.3
	No	111	91.7
If yes effect of pesticides on human health	Stinging eyes/burning	30	24.8
	Headache	23	19.0
	Skin irritation	21	17.4
	Rashes on skin	20	16.5
	Blister	10	8.3
	Coughing	10	8.3
	Vomiting	7	5.8

Source: Authors analysis using primary data (2021)

The respondents in the study area were requested if their animal suffered from the effect of pesticide and 2.5% of the respondents stated that some animals were suffered and died by the effect of pesticides while 97.5% replied that their animals were not suffered by the effect of herbicides (Figure 1&2). Similarly, farmers also reported that there was a decrease in the population of honeybees visiting their farm in the study area.

Table 9: Human health problems reported by the effect of pesticides

Questions	Variables	Respondents (N)	Percentage (%)
Did any of your animal suffered from the effect of pesticides	Yes	3	2.5
	No	118	97.5



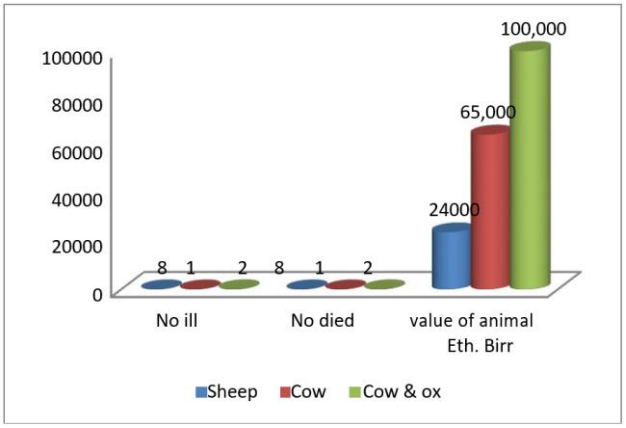


Figure 1 and 2: Animals suffered and died due to the poisoning of pesticides

3.8. Econometric Result

The study has used binary logistic model to identify socio demographic factors affecting the use of protective clothing during chemical application. The model in table 10 exhibited that location, gender, education, family size, knowhow of the negative effect of chemicals on human, animal and environmental health and understanding and follow up of labels on the chemicals affect the use of protective clothing significantly at the 0.01 and 0.05 levels. Pseudo R^2 is 0.35, indicating that the explanatory variables explain about 35% of the variation in farmers knowledge regarding safety measures. The result of the model is elaborated below one by one for significant variables.

Woreda: Welmera district positively and significantly (0.006 ***) related to the use of protective clothing for pesticide application at 0.01 level. The result implies that the district has better awareness in using protective clothing as compared to Ejere district. This could be due to application of different intensive demonstrations and farmers' field days by Holeta Agricultural Research Center (HARC) than Ejere district.

Sex of the Household Head: The result of the binary logistic model showed that male headed households (0.078 more likely to use protective clothing during herbicide application than the female counterparts. The reason could be due to the fact that male headed households have high access to information and extension services than female headed households.

Although, farmer to farmer and farmer to extension agent relation is high for male headed households.

Household head education: The result also exhibited that education boosts the likelihood of use of protective clothing during pesticide application. Education increases critical thinking and boosts the search of written and audio information regarding improved agricultural technologies and practices.

Family size in the household: There is a negative and significant relationship between family size and the use of protective clothing during chemical application. The logic behind could be these farmers who have low family size use hired labour for chemical application and they may not care for the hired labor.

Know negative effect of chemicals on human and animal health: The econometric result also showed that those farmers who know about the adverse effect of misuse of chemicals on human and animal health are more likely to use protective clothing. This suggests the need of efforts to intensively aware farmers in the use of chemicals using different information dissemination mechanisms.

Read, understand and follow up pesticide labels: Those farmers who read, understand and follow up pesticide labels are more likely to use protective clothing. This could also be related to education of the household to read and understand labels.

Know negative effect of chemicals on environment: The result also exhibited that those farmers who have knowledge and awareness about the adverse effect of chemicals on environment are more likely to use protective clothing during chemical application.

Table 10: Factors affecting the use of protective clothing during pesticide application

Variables	Coef.	S.E.	t	P-value
Woreda [Welmera]	3.159	1.145	2.76	0.006***
Sex of the household head [Male]	2.112	1.116	2.16	0.078*
Household head age	0.022	0.033	0.66	0.508
Household head education	0.236	0.126	1.88	0.061*
Family size	-0.289	0.145	-1.99	0.046**
Know negative effect of chemicals on human and animal health [Yes]	1.932	1.140	1.69	0.090*
Family member faced health problem due to pesticide [Yes]	-0.807	1.231	-0.66	0.512
Read, understand and follow up pesticide labels [Yes]	2.663	1.451	2.11	0.044**
Know negative effect of chemicals on environment [Yes]	1.014	1.211	1.92	0.078*
Training on pesticide use [Yes]	0.994	0.978	1.02	0.310
Know some pesticides are banned to use [Yes]	-0.425	1.729	-0.25	0.806
Constant	3.121	4.394	0.71	0.477

Pseudo r-squared = 0.349; Chi-square = 30.661; Number of obs = 121; Akaike crit. (AIC) = 95.869; Bayesian crit. (BIC) = 131.112;
**** p<0.01, ** p<0.05, * p<0.1*

4. CONCLUSION

The present study showed potential opportunities for human and environmental exposure to pesticides use in west Shewa zone of Wolmera and Ejere districts. The descriptive analysis results revealed awareness among the farmers on the importance of protecting themselves and the environment from hazards associated with handling pesticides is still low; especially on the safe use of pesticides and attitudinal practices regarding storage, handling, and disposal of pesticides. They had poor safety and operational practices, specifically for disposal of pesticides and empty pesticide containers, storage of pesticides and use of PPE. This may lead to acute pesticide poisoning, chronic health problems and environmental hazards. The result of the econometric model also showed that awareness and knowhow on the labels and how to use the chemicals, and knowledge about the adverse effect of agricultural chemicals on human, animal and environment affect the use of protective clothing positively and significantly.

To fill this gap, there is a need to increase farmers' knowledge, attitude and awareness of pesticides by providing training on the health–related effects of pesticide exposure, the effect of pesticide on the environment, as well as the proper disposal and storage of pesticide, and the use of PPE. When provided the training, it must address health effects associated with exposure to pesticides, the effects of pesticides on the environment, improvements in disposal and storage of pesticides, pesticide risk reduction strategies, and understanding of the pesticide regulatory framework in Ethiopia. Pesticide retailers' training to increase their knowledge of pesticides is also essential; since they are farmers' primary source of information regarding pesticides. Efforts are needed to enhance the decision making capability of local people by prompting IPM methods as alternative to chemical pesticides.

Note: Wereda' is an administration unit equivalent to district, whilst 'Kebele' is the lowest administration unit in Ethiopia

Abbreviations

FAO: Food and Agricultural Organization;
WWAO: Wolmera Wereda Agricultural Office;
EWAO: Ejere Wereda Agricultural Office;
CSA: Central Statistical Agency;
PPE: Personal Protective Equipment.

Declarations

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Authors' Contributions

Chernet Designed and supervised all stages of the study. Cherenet participated in data collection and data collection supervision. Chernet prepared the data set for analysis and Samueal and Chernet performed the statistical analysis. Chernet wrote the first draft of the manuscript. All authors have read and approved the final manuscript.

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Availability of Data and Materials

The authors want to declare that they can submit the data at any time based on the publisher's request. The data sets used and/or analyzed during the current study will be available from the authors on reasonable request.

Ethics Approval and Consent to Participate

To care for both the study participants and the researchers, ethical clearance letters were obtained from Addis Ababa University and Holetta Agricultural Research Centers. During the survey, official letters were written for the district and Kebele administration, and each respondent provided informed verbal agreement and confidentiality was maintained by assigning codes to each respondent rather than recording their identity. Clients were informed that they had the ability to terminate or decline participation in the study. As a result, all participants in the study, including survey households, enumerators, supervisors, and key informants, were fully informed of the study's purpose. Until the end of the study, they were approached in a friendly manner.

Consent for Publication: Not applicable.

Competing Interests: The authors declare that there is no conflict of interest associated with the subject of the article.

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