

# Exposure and Health Risk Assessment of Farmers to DDT during Khat Production in Chiro Woreda, West Hararghe Zone: Ethiopia

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**Abstract** This research work assesses exposure and health risk of farmers using DDT during Khat production and farmer's knowledge and perception towards the toxicity of pesticides sprayed on Khat. Personal interviews were completed with a random and purposive sample of 85 farmers, 5 health workers/officers/ and 5 agricultural workers /officers/. The observed study shows there is no any personal protective device (PPD) in the study area at all, most farmers in the study area have no access to technical information on proper use of pesticides. In this study, thus, assessment of possible health risks of using DDT and farmers' perception towards toxicity of pesticides used on Khat was undertaken. Results of interviews and questionnaires showed that majority of farmers in Chiro Woreda use DDT and other unknown pesticides to grow their Khat and majority of them mix DDT and other pesticides, especially malathion. Most of the farmers are illiterate and could not read and understand instruction on pesticides packages. Most of the interviewed farmers are chewers of Khat and have more than 15 years experience in spraying pesticides on Khat. Local markets, pesticides imported through smuggling, local health and agricultural bureaus were seen to be sources of DDT and other pesticides used on Khat. Most of the farmers have misperception on the toxicity of pesticides used on Khat. The farmers that sprayed Khat have also developed new health symptoms that were not known before the start of using DDT and other pesticides. The main purposes why farmers use pesticides on Khat are to control Khat pests that hinder its normal growth. Farmers that produce Khat with more chemical pesticides, in particular, experience acute adverse effects on the digestive system such as stomach irritation, bulging of belly, loss of appetite, and chronic adverse health effects including mouth dryness, headaches, and other related problems. Farmers also who chew homemade Khat on which they sprayed chemical pesticides by themselves may have the highest possible health hazards. It is concluded that chewing Khat grown with chemical pesticides causes considerable adverse health effects in human beings as well as to consuming animals. However, majority of the farmers believe that advantages of using DDT and other pesticides on Khat outweighed its effects. In general, there is no any satisfactory intervention to tackle these problems. The main objective of this study was to investigate exposure and possible health risks of farmers using DDT and other pesticides on Khat (*Catha edulis*), and to assesses the knowledge, perception and awareness of farmers towards toxicity of pesticides used during Khat production.

**Keywords:** pesticides, health risk assessment, DDT, protective

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## 1. Introduction

Khat is an evergreen shrub, which is cultivated as a bush or small tree. The leaves have an aromatic odour. The taste is astringent and slightly sweet. The plant is seedless and hardy, growing in a variety of climates and soils. Khat can be grown in droughts where other crops have failed and also at high altitudes. Khat is harvested throughout the year. Planting is staggered to obtain a continuous supply [1]. Khat is mainly grown in Ethiopia, Kenya, Yemen, Somalia, Sudan, South Africa and Madagascar.

It has also been found in Afghanistan and Turkestan. Previously, khat leaves were available only near to where they were grown. Recently, improved roads and air transport have allowed a much wider distribution. Khat is harvested in the early hours of the morning and sold in markets in late morning. It is presented as a bundle of twigs, stems and leaves, wrapped in banana leaves to preserve freshness [2]. The phenylalkylamines (cathinone and cathine) and the cathedulins are the major alkaloids. These compounds are structurally related to amphetamine and noradrenaline. Cathinone is mainly found in the young leaves and shoots. During maturation, cathinone is metabolised to cathine; as cathinone is presumably the

main psychoactive component of khat, this explains why fresh leaves are preferred. The chewing of khat leaves probably pre-dates the use of coffee. The earliest written record of the medical use of khat appears to be in the New Testament. Khat has been used to treat various ailments, including relieving the symptoms of depression. Some believe it to be a dietary requirement [2]. The vast majority of those ingesting khat do so by chewing. Only a small number ingest it by making a drink from dried leaves, or, even more rarely, by smoking dried leaves. The chewer fills his or her mouth with leaves and stalks, and then chews slowly and intermittently to release the active components in the juice, which is then swallowed with saliva. The plant material is chewed into a ball, which is kept for a while in the cheek, causing a characteristic bulge [3]. Chewing khat is both a social and a culture-based activity. It is said to enhance social interaction, playing a role in ceremonies such as weddings. In Yemen, Muslims are the most avid chewers. Some believe that chewing facilitates contact with Allah when praying. However, many Christians and Yemenite Jews in Israel also chew khat. Khat is a stimulant and it is used to improve performance, stay alert and to increase work capacity [4]. Workers on night shifts use it to stay awake and postpone fatigue. Students have chewed khat in an attempt to improve mental performance before exams. Yemeni khat chewers believe that khat is beneficial for minor ailments such as headaches, colds, body pains, fevers, arthritis and also depression [5]. Khat has recently expanded into a global market, provoking calls for its prohibition. Khat now occupies an ambiguous category-banned in some countries, whilst legal in others. However, some argue that khat harms the economy by encouraging laziness and absenteeism: as workers go to lunch and then engage in khat sessions and do not return. An estimate suggests that over 4 billion hours of work a year were lost as a result of khat chewing [6].

With the increase of Khat production and the use of pesticides over recent years, residual pesticide is a cause of concern for Khat chewers. DDT and other pesticides are being used on Khat in some parts of Ethiopia. Farmers spray DDT and other unidentified pesticides on Khat. They do not use any protective devices. Most of interviewed farmers use different pesticides and spray it on Khat. The disposal practices of left-over Khat can lead to contamination of humans as well as animals and leads to high health risks. Therefore, the researcher has investigated to assess farmer's perception on the problems in one of the West Harareg called Chiro woreda, which is known in producing quality Khat and also known for pesticides use on Khat.

The Socio-economic as well as cultural values of Khat among West Hararghe society is not estimated. Chiro woreda, which is found in West Hararghe Zone, is well known for producing world class quality Khat products. Farmers in this area and the whole West Hararghe faced Khat growing problems associated with pests, insects, diseases and other challenges. To solve these problems, they use DDT and other unknown pesticides.

This study is therefore aimed at assessing the exposure possible health risks of farmers using DDT on Khat. DDT is the most widely used insecticide on Khat in the study area followed by Malathion. DDT (Para, para"-Di chloro dipheniltri chloroethane) is a persistent organochlorine compound which was widely used as insecticide in

agriculture in different countries including Ethiopia. The compound was synthesized in 1874 where its insecticidal properties were clearly identified in 1939. The use of DDT was also common up to the level of blanket coverage in the context of vector born diseases control including malaria and other pest control in different parts of the world in which it was effective to eradicate malaria; namely, USA (until 1972), United Kingdom (until 1984), Germany (until 1974) Canada (until 1989) Sweden and Norway (until 1970) were some of them [7]. So far, no study had been conducted concerning possible risks of using DDT on Khat in the area in particular and the country as a whole. Therefore, there is a gap on the identified problems and related issues. This study was conducted to fill the gap and to provide data bases for further research undertakings and for policy makers as well as other interested groups.

Farmers in several areas of Ethiopia confirmed that, they often use the mixture of DDT and Malathion on Khat. This practice of using DDT and other pesticides on Khat crop is causing different environmental problems such as extinction of some useful insects like honeybees, and social as well as human health effects which need further investigation.

Therefore, this particular study is considered to be important in providing original information for concerned bodies as well as government officials, who are responsible in protecting the lives of the people from the harm of pesticides which are hazardous to human beings and the environment. The paper is focused to assess the exposure and possible health risks of farmers using DDT on Khat. The main study problems include: prevalence of using DDT and other pesticides on Khat and the emerging health problems related to pesticides use in the area and identifying people who are at high possible health risks caused by using DDT and other pesticides on Khat.

## 2. Materials and Methods

### 2.1. Study Area Description and Location

The study was conducted in Chiro Woreda, West Hararghe Zone, Oromia region. The site was selected based on preliminary survey and due to the fact that these areas are highly known for their extensive Khat production, huge dependence of the people in the area on Khat crop and the well-developed Khat culture due to recent development of basic infrastructure; mainly roads and the proximity to market centers and vital for the commodity. Chiro Woreda is known for its production of different varieties of Khat, which are highly demanded both on national and international markets, especially with local trade name "Matakesha", Chirokela and "Medicho".

The researcher has contacted with the woreda agricultural officers to identify which woreda is famous in production of quality and quantity of known Khat as well as suspected for using DDT and other pesticides. Based on responses from the officials Chiro Woreda was identified due to its proximity and more famous in Khat production.

This Woreda is 325 kilometer away from Addis Ababa. It is geographically located between 34°18'43" to 43°04' E Latitude and 10°09'24" to 30°18'43" N longitude.

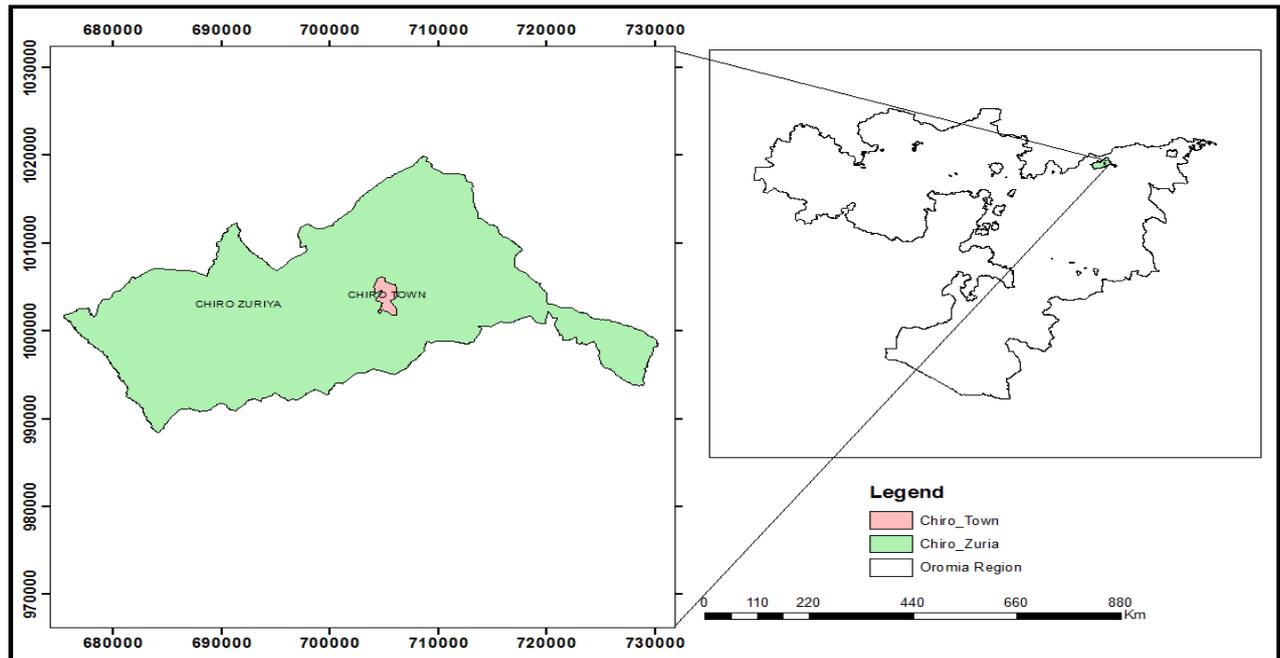


Figure 1. Map of Study Area

## 2.2. Study Design

In case of evaluation of farmers' perception towards toxicity of different pesticides used as Khat growing chemicals, various techniques including semi-structured interviews, field and market visits observations have been used during the study to get adequate information.

## 2.3. Sample Size Determination

The sampling techniques and sample population, data collection instruments and the methods of data analysis used in this research are all outlined hereunder. The researcher has taken 5 agricultural officers and five health officers from the Chiro Woreda health bureau by using purposive sampling, have been involved in providing information and filling questionnaires prepared particularly for each of the groups. Besides, based on the information obtained from the zonal Agricultural and Rural Development Office (ZARDO) there exist about 989 households in Chiro Woreda of which 850 households have Khat farms. Taking into account the budget available for this research, 10% of Khat growing farmers, which are 85 households have been taken and randomly selected to represent the total Khat growing farmers in the town.

## 2.4. Sampling Procedure

The sample of farmers was taken from Chiro woreda which is known for its quantity as well as quality Khat production and this peasant association (PA) was selected after assessing which farmers uses more DDT or produce more Khat products with the help of different pesticides. In the same area 85 farmers were interviewed to get the perception they have on pesticides they use on Khat and possibility of health hazards caused by DDT used to grow Khat and used as pest control, as well as cure for different diseases.

## 2.5. Data Collection and Analysis

A structural questionnaire and interview was used as data collection tool. The questionnaire was developed by referring different literatures and modified according to the objectives of this study. The questionnaire has four parts which enabled to collect information on general background to the household and farmers, pesticide practice, pesticide knowledge and perception and pesticide use and environmental effects. The questionnaire was first developed in English and it was translated in to local language (Oromifa) for data collection. Prior to data collection, the questionnaire was pre-tested on selected farmers in the study area which were not including in the main data collection. It was, therefore, checked for its clarity and some corrections were made. The researcher had recruited Grade 12th students, who are fluent in Afan Oromo, were involved in data collection after getting trained on how to collect relevant data using questionnaires prepared for this purpose. Finally, the collected data was analyzed using Microsoft Excel program. Statistical association was done when appropriate and level of significance was taken at 5%. Analyses were done item by item and the results were displayed visually, both graphically and in tabular form as depicted under the results and discussion section.

## 3. Results and Discussion

### 3.1. Age of respondents

The ages of the respondents, who have adequate experiences in applying DDT and other pesticides on Khat were shown in Figure 2 below. According to Figure 2, out of the total 85 interviewed farmers, majority, 51.71%, are between the ages of 20-35 years, followed by 36.16% who are also aged between 36- 51 years. This indicates that majority of the sprayers are highly

concentrated under youth and adult ages who are in the productive groups.

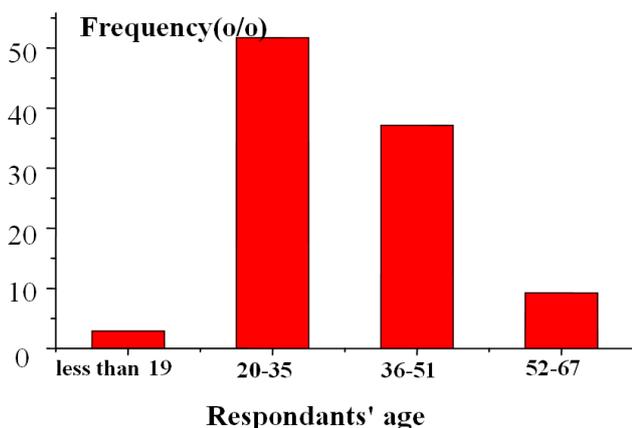


Figure 2. Age of farmers who apply DDT and other pesticides on Khat

In addition, around 10% are in the age group between 52-67 years of age. The result shows almost all age groups are involved in the application of pesticides on Khat. From the above result it can also be concluded that, adults and young reproductive age groups are highly exposed to pesticides applying it on Khat. Most of them have more than 10 years of applying pesticides, like DDT and others, on Khat. The researcher has been informed that there is no any personal protective device (PPD) in the woreda and farmers around 15 have never heard about PPD at all. This situation may exacerbate level of exposure to pesticides.

### 3.2. Educational Level of Respondents

As shown in Table 1, analysis of educational levels also revealed that majority of the respondents, 70.5%, are illiterate. The rest of the respondents are, 14.2%, 9.4%, and 5.9%, 1st cycle primary, 2nd cycle primary, and high school from Grade 9-12, respectively. Therefore, most of the farmers who use pesticides on Khat are illiterate.

Generally, the results of the above Table 1 clearly indicate that majority of the farmers in the area are illiterate and highly prone to toxic pesticides since they could not understood the toxicity and safety rule, on the packages.

Table 1. Educational level of farmers

Educational Level	Frequency	%
Illiterate	60	70.5
Primary level	12	14.2
Junior school level	8	9.4
High school level	5	5.9
Total	85	100

### 3.3. Status of Khat Production Problem and DDT Utilization

Table 2. Status of Khat production problem and DDT utilization

Status of Khat production problem and DDT utilization	Frequency	%
Have Khat growing problems like diseases, pests and others, that can affects its market values	Yes	81
	No	4
	Sometimes	-
Total	85	100

According to Table 2 above, majority of the farmers, 95.2% out 85 respondents, have Khat growing problems while very small farmers, 5.8%, have occasionally such problems.

### 3.4. DDT and other Pesticide Utilization Trends of the Farmers

Besides, as shown in Figure 3 below, most of them, i.e., 88 % out of all the respondents confirmed using DDT and other pesticides on Khat with 6% of respondents who use pesticides less frequently. Additionally, only 6 % respondents claimed not to use pesticides on Khat.

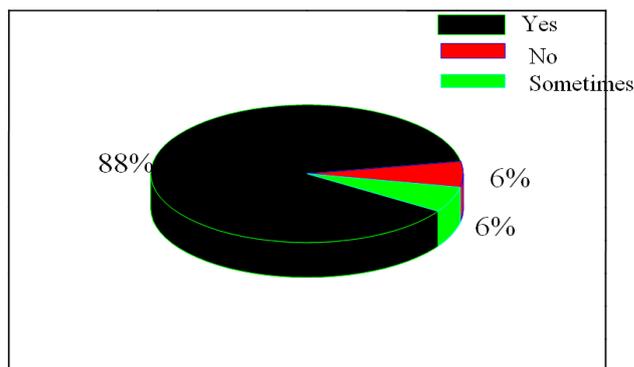


Figure 3. DDT and other Pesticide utilization trends of the farmers

Results of Figure 3 clearly showed that most of the farmers have Khat growing challenges. To solve these challenges, majority of farmers used chemicals pesticides to improve the yield of khat production by preventing foreign plants or insect pests especially during the time it occurred on a large scale. There are different kinds of diseases and insects which create problem to Khat growers.

### 3.5. Habits of Using Non-Recommended Pesticides and Frequency of Using DDT on Khat

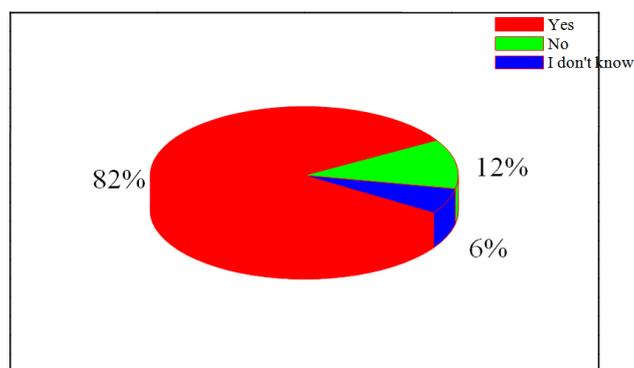


Figure 4. Habits of using non-recommended pesticides

According to results in Figure 4 most of the interviewed farmers, 82 %, use non recommended pesticides on Khat. Among these pesticides, DDT is the most commonly used followed by Malathion. They apply DDT in the form of liquid, by smoking it around Khat field, and apply it in powdered form. The powdered form is applied with very thin towel and towel like clothes. Most farmers have spraying tools, but they do not have PPD.

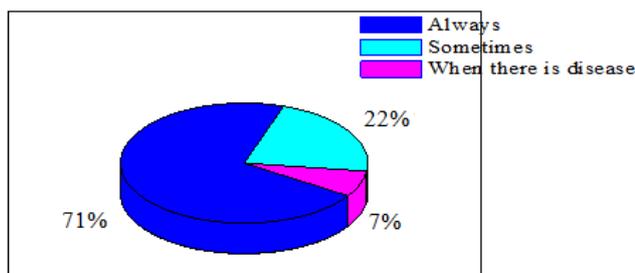


Figure 5. Frequency of using DDT

In addition, as shown in Figure 5 the frequency of using DDT on Khat was confirmed by majority, 71%, of the farmers, i.e., out of 85 farmers interviewed, always use DDT on Khat while 22 % have used it based on disease type. Besides, very small numbers of the respondents, 7%, used it only some times. Generally speaking, all farmers in the study area have the experience of spraying DDT on Khat.

### 3.6. Responses of Agricultural and Health Workers on Types of Pesticides that Farmers Use on Khat

All health and agricultural workers responded that farmers use DDT and other illegal pesticides on Khat. However most of farmers were used different types of pesticides like 2, 4 D by themselves without any consult. From this it can be suspected that farmers exposure to pesticide during formulation, spraying and storage due to unsafe handling and mismanagement could be high. They also confirmed that there is no awareness raising programs in the study area concerning safety use of pesticides and toxicity. They confirmed that all of these pesticides are being used on Khat and majority of sprayers and chewers are at high health risks of exposure. The interviewed health workers and agricultural workers did not have enough training on safety use of pesticides. These conditions exacerbate the possible health hazards of DDT, which is highly persistent in the environment. This may also lead to possible health hazards such as cancer and other related diseases.

### 3.7. The Status of Protective Devices Utilization by Farmers

Among the farmers who take part in spray operation, 97 % worn any ordinary suit with old rubber shoes during spraying and formulation. Indeed, the protective devices such as glove, shoes, eye-glass, cap, face coveralls and hand-kerchief were all absent. However, very small percent; i.e. 3 % of sprayers fulfilled the body protection requirement. Therefore, it can be seen that using protective equipments during spray operation is mandatory in the area, to minimize exposures to pesticide during formulation and spraying time. Majority of farmers were also seen mixing and spraying pesticides without any PPD. According to responses from health and agricultural officers, there is no trained man power and training program for such purposes. Most farmers are complaining on the effects occurred so far on: humans and animals health as well as local environments. Generally, it can be concluded that farmers have misperception on toxicity pesticides they use and there is high possibility of health risks from pesticides.

### 3.8. Trainings Given/Provided for Farmers

The importance of public awareness raising trainings just prior to the preparation and spray operation of pesticides is vital. This is because, irrational usage of strange pesticides may result in danger directly or indirectly to handler and to those who are not take part in pesticides processing and application [8,9]. As it is illustrated in Figure 6, even though 6 % of the respondents indicated that they could read labels on pesticide containers, only 94 % could not understand and follow instructions on containers. Some of them also responded that they even bought pesticides without labels. As it was observed from the respondents, even though awareness raising trainings must be mandatory by professionals, it is not so enough. This situation implies that in addition to governmental aid, NGOs support is of paramount importance to minimize intoxication of chemical handlers and concentration of pesticides in the environment.

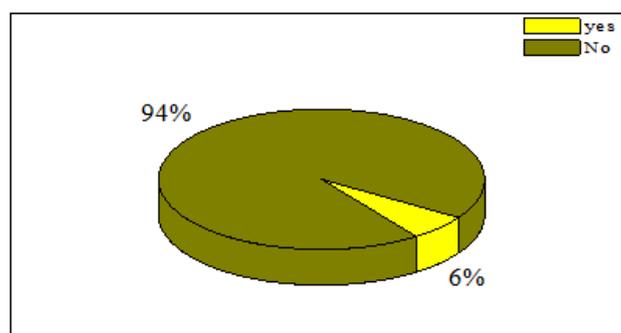


Figure 6. Ability of farmers who understand information on pesticide container

### 3.9. Farmers' Knowledge and Perception on Pesticide Effect

Knowledge and perception on the nature of pesticide and their effect by farmers is crucial to prevent risk associated to pesticide application. However do farmers have knowledge and perception about health effects of various pesticides being utilized? As illustrated in Figure 7 knowledge and perception, 98 % of the farmers was considering pesticides as useful and 2 % of the farmers perceived pesticide as harmful and also indicated that pesticides cause damage to all human, animal and wildlife health and water bodies. From this we can conclude that almost all of the farmers need further training and education on pesticide management, handling and associated adverse effects.

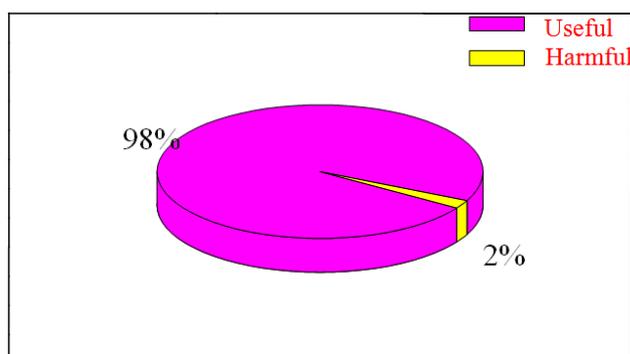


Figure 7. knowledge and perception of farmers on pesticide effects

### 3.10. Pesticides Spraying and Possible Health Risks

Good pesticide management practices could help to minimize potential hazards of pesticide poisoning and pollution of the environment. As it is discussed above, some of the good management practices to consider when working with pesticide are: follow pesticide label directions, use protective devices, avoid spills, disposal of pesticide wastes and containers properly, elimination of unnecessary application and use of proper pesticide storage. Based on the survey 93.22 % of the respondents claimed illness after pesticide spraying, head ache, vomiting, skin irritation, nausea, dizziness, loss of appetite, colds, difficulty in breathing, weakness, fever and depression. However most of them drink milk and take bath after spraying, this help them to relief their illness. Even though, they knew about the channel of reporting of pesticide incidents none of them reported their sense of illness to concerned body.

### 3.11. Farmers Pesticide Spraying Trend and Its Effect on Environment

Most pesticides are highly persistent in the environment, with a reported half life of between 2-25 years [10,11] and are immobile in the soil. Routes of loss and degradation include runoff, volatilization, photolysis and biodegradation (aerobic and anaerobic) [12]. These processes generally occur only very slowly. Due to their extremely low solubility in water, pesticides will be retained to a greater degree by soils and soil fractions with higher proportions of soil organic matter [13]. It may accumulate in the top soil layer in situations where heavy applications are (or were) made annually. The survey made in this study indicated that, when farmers mix pesticides most of them did it in the farm (80 %). 10.1% did it near well water, 7% of them did it in front of their house and 2.9 % did it inside the house Figure 8. Even though 89.7 % of the respondents consider wind direction during application of pesticides, chemicals disperse away from target area and to soil, water body and on the sprayer him/her self. Thus, the sprayer is victim of chemical hazard and the soil and water bodies (if present near spraying area) are too.

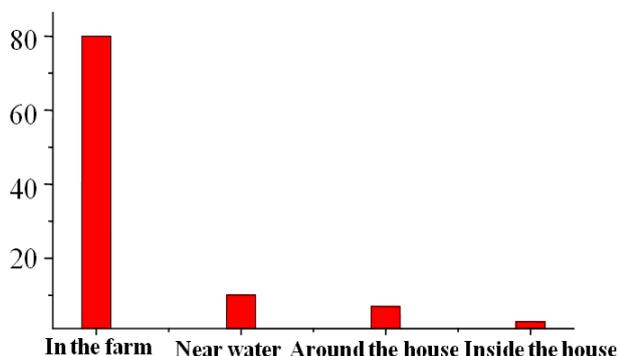


Figure 8. Farmers' pesticide spraying trend

## 4. Conclusion

Use of pesticides (especially those persistent organic pesticides) as agricultural input is not recommended.

However the result of the study in Chiro Woreda showed that, farmers use pesticides for Khat production. According to the assessment carried out in this study, the awareness level in the community is low. As it is clear that proper application of pesticide can minimize, the environmental and public health impacts being caused by inappropriate utilization of pesticides. Additional education is needed on the use of protection equipment and follow-up of protection precaution in the study area. The result of these study highlight the need for further study and monitoring of the level of different pesticides in different food crops including cereals and other biological samples. Key to effecting change in response to pesticide contaminations is community based programs that replace toxic pesticides with alternative non-chemical practices and products. Communities should adopt no-pesticide policies and launch community education programs.

## 5. Recommendations

Based on results of the study, the following recommendations were forwarded:

- Recommend the sellers and users to reduce risk by washing the leaves before consumption would minimize the risk from pesticides.
- Establishment of illegal pesticide control group with legal representation, with authority to supervise and regulate the use of pesticides at local or state levels, and responsive to public and private concerns.
- Regular training for health extension, development agents, and woreda experts on precaution that should be taken while working with pesticides.
- Establishment of a registry and of follow-up procedures to ensure that each reported case of acute intoxication is fully investigated; each case should be considered as part of a cluster that may indicate the need for additional studies.

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