



Research Article

Effect of Pesticides Application on Human Health and Environment: A Case Study of District Sargodha, Punjab (Pakistan)

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Abstract | In Pakistan, agriculture is major contributor in GDP as well as engaging huge segment of population as agro-based labor force. Farming community in developing countries is striving to improve agriculture productivity for food security. To gain higher farm yields, farmers use different fertilizers and pesticides to protect their crops from diseases and insect pest attacks. In this perspective, current study was designed to explore negative consequences of pesticides applications on human health and environment in district Sargodha. A cross sectional survey method using convenient sampling was adopted for this research and data was collected from 300 respondents with the help of structured interview schedule. The results revealed that all the respondents (100%) considered 'enhance farm production', 'control of insect/pest' and 'weed eradication' as major factors for application of pesticides. Moreover, results also indicated that 66% of respondents were applying 2-6 and above times pesticides to their single crop. The knowledge level of the respondents was found to be highest regarding contaminate the soil and disturbs the soil fertility ($\bar{x}=3.7$), effects of pesticides on human body ($\bar{x}=3.67$), effects of pesticides on overall plant growth ($\bar{x}=3.67$) and regular application of pesticides disturbs the pH of soil ($\bar{x}=3.64$). Above 68% of respondents consider harmful impacts of pesticides on human health and 86% of respondents experienced ill health symptoms after pesticide application. The study recommends public and private extension organizations should encourage adoption of biological control measures among farming community and regular training workshops should be organized regarding safe handling and application of pesticides.

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Introduction

Agriculture is considered as one of the oldest professions of human civilization and also serve as the major source of income and livelihoods

for majority of the people since centuries (IFPRI, 2018). Like other developing regions of the world, agriculture sector in Pakistan is considered as one of the main contributors towards employment as well as country's overall development. The overall share

of agriculture sector in GDP of Pakistan is 22.7%. Around 38.0% of the total labour force of the country is engaged in agriculture sector (GoP, 2022).

In developing countries, farm production is very much crucial to enhance level of food security (Mahmood *et al.*, 2019). Farmers used to apply farm inputs especially fertilizers and pesticides in order to maximize farm income by increasing farm production. This is also very much essential to meet the food demands of ever-growing population (Salam and Hameed, 2022). To reduce farm production losses, the application of pesticides in Pakistan has increased significantly (Mustafa *et al.*, 2007). According to an estimate, there are about 2 billion people in the global world who used to earn income from farming and majority of them are using pesticides to protect their crops, fruits and vegetables from diverse nature of pests and diseases. In the past three decades, there is a steady increase in use of pesticides in agricultural sector (Abdullah *et al.*, 2019). As per report of Tech Sci Research (2018), the market of pesticides in the global world has been increased from 75 billion US dollars in 2017 to 90 billion US dollars in 2023.

Farmers apply pesticides in their fields due to multiple reasons. Major reasons behind the extensive use of pesticides by the farming community as reported by Damalas and Eleftherohorinos (2011) are prevention of crop from the attack of insect/pest; reduction of farm production/ yield losses; enhance/maximize farm production and improving quality of food. All these factors are interconnected by climate change as explained by Tudi *et al.* (2021) and illustrated in the Figure 1.

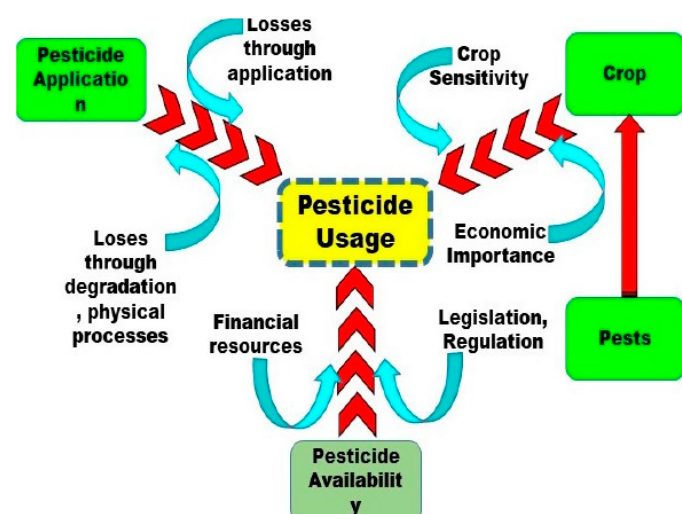


Figure 1: Factors influencing application of pesticides (Tudi *et al.*, 2021).

Like other developing countries the history of pesticides application in Pakistan is very long. This use was started in 1954 and this use is on the peak now a days. Initially, agriculture department of Government of Pakistan supported farmers to apply pesticides in their fields to tackle the pest and disease related issues (Rasheed, 2007). Pakistan being an agricultural country blessed with different climatic regions/zones that tend to produce a wide variety of crops, fruits and vegetables. Produce good quality of agricultural/farm products is linked with application of pesticides. Use of pesticides is also attributed to meet the national food production self-sufficiency (Mubushar *et al.*, 2019).

Need for the study

The extent of use and health hazards associated with use of pesticides differ from regions to region and countries to countries especially in the developing world (Atreya, 2008). In many of the developing countries like Pakistan application of pesticides especially in agriculture has become one of the serious threats to environment and human health hazards. It plays a significant role in the contamination of water, eco-system and other fauna and flora. According to Akhtar *et al.* (2007), application of pesticides in Pakistan has become an alarming human health and environmental issue. The same was also reported by Khan *et al.* (2015). They concluded that extensive use of pesticides in agriculture by the farmers is causing a number of health, economic and environmental related issues.

According to the report of World Health Organization (WHO, 2016), around one million people are being infected by pesticides. In such developing countries, majority of the farmers are illiterate and do not know safe use and handling of pesticides. In Pakistan more than 60% of the population is living in rural areas and are engaged in farming practices. This has been estimated that majority of the Pakistani farmers are unaware about negative impacts of pesticides' application. Due to which farmers apply pesticides against insects/pests to maximize production with unsafe handling which results in negative impacts on health of farmers as well as environment. With reference to Pakistan, around 10,000 farmers annually infected through pesticides application (Ejaz *et al.*, 2004). With this background, the current research was conducted in district Sargodha to assess the impacts of pesticides application on farmer's health

and environment.

Materials and Methods

Research approach and design

Keeping in mind the research questions and objectives of the study, descriptive design was adopted. This has been reported that by using descriptive research design, more information on a particular phenomenon can be generated (Creswell, 2014). Cross-sectional survey research method was used in the current study as the data were collected for one point in time.

Study settings: Description of research study area

The study was conducted in district Sargodha of Punjab (Pakistan). The map of the study area is presented in Figure 2.

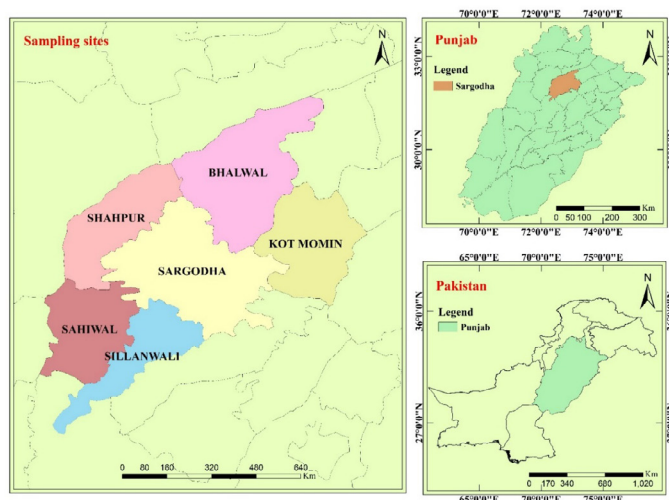


Figure 2: Map of the study area.

Population, sample and sampling procedure/technique

Convenient sampling method was used by the researcher for picking required sample from the population. As the District Sargodha comprises of six tehsils. From each tehsil, fifty (50) farmers were selected through convenient sampling. Total sample size of the study was 300. The verified list of farmers was collected from the office of the Agriculture Extension Department of the district.

Data collection method and technique

In the present research, quantitative method was used keeping in mind the specific objectives of research.

Data collection/research instrument

In the present research structured interview schedule was designed keeping in mind the specific objectives of the study for the collection of primary data. The

opinion of respondents was measured with the help of three (3) and five (5) point likert type scale. The validity and reliability of interview schedule was also measured. Content validity of interview schedule was measured by discussing the components of interview schedule with experts of field of Agricultural Extension and Rural Development. On the other hand, face validity of the same was measured by pre-testing the interview schedule in the field. Reliability of the research instrument (interview schedule) was measured by Cronbach Alpha through SPSS. The value of Cronbach Alpha for all items (Except demographic) of the interview schedule was 0.75.

Data analysis and description

The collected data were analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics was used for analyzing and interpretation of data.

Results and Discussion

Age of the respondents

The data regarding present age of the respondents was collected and tabulated in Table 1.

Table 1: Data regarding age of the respondents.

Age categories	Frequency	Percentage
Up to 25 Years	154	51.3
26-40 Years	106	35.3
41-55 Years	19	6.3
56 Years or above	21	7.1
Total	300	100

Data regarding age of the respondents as tabulated in Table 1 shows that around half of the respondents had age up to 25 years. This shows that majority (51.3%) of respondents were belong to young age group. As per definition of United Nations “all the persons having age between 15 to 24” are considered as youth. This indicate that majority of the farmers in the research area were youth. On the other hand, as per Government of Pakistan (2008) of Pakistan all the persons having age 15-29 years are placed in youth group. Data presented in Table 1 also shows that around 35% of the respondents had age between 26-40 years. This indicate that medium age group is on the 2nd number after youth in the research area. The old age group (farmer with age 55 years or above) are very few in the sample respondents. Due to the

high prevalence of youth/young age group in the research area, farming has become one of the least interest professions in Pakistan.

Literacy level of respondents

Literacy is very much essential as it plays a key role in the adoption of latest and innovative agricultural practices by the farmers. The data regarding literacy level of respondents in the research area was collected and tabulated in [Table 2](#).

Table 2: Data regarding literacy level of respondents.

Literacy level	Frequency	Percentage
Illiterate	19	6.3
Literate	281	93.7
Total	300	100

The data given in [Table 2](#) show that an overwhelming majority (93.7%) of respondents was found literate. However, a minor percentage (6.3%) of respondents was found illiterate. This indicate that majority of the young people in the research area were literate. This has been reported that young and educated farmers are more likely to adopt innovative agricultural technologies to maximize production and profit. High level of literacy level of farmers is also essential to enhance the technical capacity of the farmers. Literate farmers can easily enhance their farm production by the use of minimum level of financial resources. In comparison of present findings [Khan et al. \(2022\)](#) reported that a large majority (81.3%) of farmers was found illiterate while studying the impact of pesticides health of farmers in the Sindh Province. They also reported that in rural areas of Sindh province, the literacy level of farmers is very low as compared to farmers of the Punjab Province.

Educational level of literate respondents

After literacy level data regarding educational level of literate respondents were also collected and tabulated in [Table 3](#).

Table 3: Data regarding educational level of literate respondents.

Educational level	Frequency	Percentage
Upto matriculation	23	8.2
Intermediate	170	60.5
Graduation or above	88	31.3
Total	281	100

The data given in the [Table 3](#) shows that majority (60.5%) of the respondents was intermediate (12 years) of schooling. Out of literate farmers 8.2% had education up to matriculation (10 years of schooling). Only 31.3% of the respondents had graduation level (University level education). This indicate that higher education is not much common in rural areas. Majority of the rural people prefer to work after intermediate due to one or other reasons. Out of this lack of much financial resources is the major one. Higher educational level of farmers can boost their ability to obtain and understand updated information within limited time. It also plays role in improving the skills possessed by the farmers related to crop and livestock production.

Table 4: Data regarding methodology of insect/pest control being adopted.

Methodology of insect/pest control	Frequency	Percentage
Cultural	10	3.3
Chemical	262	87.3
Chemical + Cultural	165	55.0
Mechanical	35	11.7
Chemical + Mechanical	37	12.3
Biological	11	3.7
Chemical + Biological	94	31.3
IPM	44	14.6

Data presented in [Table 4](#) shows that a large majority (87.3%) of respondents adopt chemical control measures for the control of different insect and pests. Other methodologies were cultural, chemical + cultural, mechanical, chemical + mechanical, biological, chemical + biological and Integrated Pest Management as reported by 3.3%, 55.0%, 11.7%, 12.3%, 3.7%, 31.3% and 14.6% of respondents. This shows that in most of the cases farmers used to kill insects and pests through chemical and cultural control measures. Similar findings were also reported by [Bakhtawar and Afsheen \(2021\)](#). They concluded that chemical control of pests is the common practice of farmers as stated by majority (55.33%) of respondents. Cultural control of pests was reported by 32.33% of respondents. During data collection it was noted that most of the farmers preferred to adopt chemical control of insects chemical-based insecticides are very much effective intime. In most of the cases, one insecticide is very much effective to control a number of insects. But chemical control also some disadvantages as they adversely affect the

environment and human health especially those who are in close contact with these. It is very unfortunate that a few percentages of respondents applied biological control measures which is the safe and healthy method of insect/pest control.

Application of pesticides by the farmers

Farmers use different pesticides to kill or to control pests present in their fields. The data regarding application of pesticides by the respondents was collected and tabulated in Table 5.

Table 5: Data regarding application of pesticides.

Response regarding application of pesticides	Frequency	Percentage
Yes	300	100.0
No	0	0.0
Total	300	100

The data given in Table 5 show that cent percent of respondents used to apply pesticides in their fields. They said that insects, diseases, nematodes, viruses, bacteria and weeds damage their crops. In most of the cases insects and weeds play key role in the reduction of yield of major field crops. According to an estimate more than 9000 species of insects and 50,000 species of weeds are present in the fields of many of the developing countries and putting heavy loss to the crop production throughout the developing world. During data collection a number of respondents reported that around 45% of our crops are being damaged by different insects, weeds and diseases. They said that non use of pesticides leads to heavy loss.

Farmers also reported that pesticides had capacity to enhance farm yield up to 30 percent. Major types of pesticides being applied in field of Pakistan are well illustrated from the Figure 3.

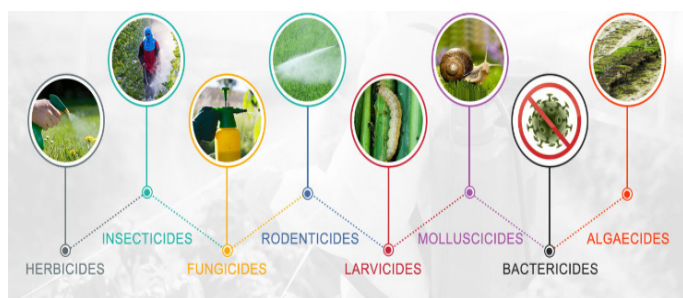


Figure 3: Major types of pesticides.

Reasons behind application of pesticides

Farmers of the research area reported a number of

reasons behind use of pesticides. The data in this regard is given in Table 6.

Table 6: Data regarding reasons/factors behind application of pesticides.

Factor/reason	Frequency	Percentage
Enhance farm production	300	100.0
Control of insect/pest	300	100.0
Weed eradication	300	100.0
Disease control	273	91.0
Household pest's control	71	23.7
Small size of land holdings	243	81.0
Other methods of pest are costly	239	79.7
No awareness regarding alternate methods of pest control	281	93.7
Non chemical pest controlling methods are ineffective	127	42.3
Non chemical pest controlling methods are least effective	271	90.3
Alternate pest controlling methods are not easily available	289	96.3
Improved quality of agricultural produce	246	82.0

**Multiple responses.*

Major reasons behind use of pesticides by the farmers of research area were enhanced farm production, control of insect/pest, weed eradication, disease control, household pest's control, small size of land holdings, other methods of pest are costly, no awareness regarding alternate methods of pest control, non-chemical pest controlling methods are ineffective, non-chemical pest controlling methods are least effective, alternate pest controlling methods are not easily available and improved quality of agricultural produce as reported by 100.0%, 100.0%, 100.0%, 91.0%, 23.7%, 81.0%, 79.7%, 93.7%, 42.3%, 90.3%, 96.3% and 82.0%, respectively. This indicates that farmers used to apply pesticides in their respective fields due to multiple factors. This also indicates that application of pesticides is essential for crop production but the irrational and non-judicious use of pesticides are harmful for environment and human health. In connection with these findings Nafees *et al.* (2008) reported that adulteration, use of unscientific methods of pesticides application and small size of land holdings are the major misuses of pesticides in Swat valley of Pakistan.

Frequency of pesticide's application per crop

Farmers used to apply different number of pesticides

in a specific crop. The data regarding frequency of pesticides being applied by the respondents per crop were collected and presented in [Table 7](#).

Table 7: Data regarding frequency of pesticide’s application per crop.

Frequency pesticide’s application	Frequency	Percentage
Single application	31	10.3
Two times	71	23.7
Three times	67	22.3
Four times	82	27.3
Five times	35	11.7
Six times or above	14	4.7
Total	300	100.0

The data presented in [Table 7](#) shows that majority (27.3%) of respondents applied pesticides four times per crop. Other frequency of pesticide application per crop was single application, twice, three times, five times, six times or above as pointed out by 10.3%, 23.7%, 22.3%, 11.7% and 4.7% of respondents, respectively. Farmers reported that they repeatedly applied pesticides in their fields due to the sale of poor quality of pesticides. These findings were also supported through results reported by [SDPI \(2018\)](#) that a large majority of respondents applied the recommended dose of pesticide in their fields. They said this is much safe for environment and health to apply the recommended dose of pesticides. Contrary to this, some of the respondents (15.7%) were stated that they didn’t apply the recommended dose of pesticides in their fields. They said that adulteration in pesticides is very common in Pakistan. Actual and original pesticides with full concentration of active ingredient is not available in the market. They also commented that recommended dose of pesticides is least effective to control insect/pest.

Criteria behind choice of pesticides by the respondents

Different criteria are being followed and used by farmers while selecting or purchasing pesticides for their fields. The data regarding these criteria were collected though four-point likert scale and presented in [Table 8](#).

The data placed in [Table 8](#) shows that consultation with fellow farmers was the main criteria being followed by majority of the respondents while purchasing and application of pesticides in their respective fields with highest mean (2.88/4.00) and SD 1.039. Other

criteria were consultation with extension field staff, consultation with staff of agricultural research wing, consultation with staff of plant protection department, consultation with sales man of the pesticide’s agency, personal previous experience, price of pesticides and efficacy of pesticides with mean value 1.82/4.00, 2.47/4.00, 2.59/4.00, 2.80/4.00, 3.06/4.00, 2.88/4.00 and 2.69/4.00. This shows that farmers rely mostly on their fellow farmers while selecting and purchasing pesticides. This is farmer-to-farmer extension service and common in many of the developing countries for transferring knowledge and information among farming community.

Table 8: Data regarding criteria followed by respondents while purchasing and application (choice) of pesticides.

Criteria	Mean	SD
Consultation with Extension Field Staff	1.82	0.851
Consultation with staff of agricultural research wing	2.47	0.828
Consultation with staff of plant protection department	2.59	0.993
Consultation with sales man of the pesticide’s agency	2.80	1.029
Personal previous experience	3.06	0.985
Consultation with fellow farmers	2.95	0.963
Price of pesticides	2.88	1.039
Efficacy of pesticides	2.69	0.874

Scale: 1=Never, 2=Rarely, 3= Occasionally, 4= Frequently

Respondent’s knowledge level about pesticides and its application

The knowledge of respondents with regard to pesticides, its impact on human health and environment and its application in the field were collected through the use of five-point likert scale and presented in [Table 9](#).

The data given in [Table 9](#) shows that knowledge level of respondents was found to be highest regarding contamination of the soil nutrients and disturbs the soil fertility by the pesticides with highest mean value (3.70/5.00) with SD 1.071. This is very unfortunate that knowledge level of respondents regarding “effects of pesticides on environment” was minimum with lowest mean value (3.21/5.00 and SD 1.079) as compared to other variables. In relation to these finding, [Abbassy \(2017\)](#) also concluded that residues of pesticides enter into the human body through inhalation by nose. A large majority of the respondents possessed a good knowledge level regarding impacts of

Table 9: Data regarding knowledge level about pesticides and its application.

Variable	Mean	SD
Affects of pesticides on human body	3.67	1.260
Unintentional ingestion cause loss of human life	3.23	1.200
Application of inappropriate pesticide cause chronic illness	3.48	1.077
Affects of pesticides on biodiversity (Aquatic life, damage of beneficial insects, non-targeted vegetation quality and taste especially in vegetables and fruits etc.)	3.50	1.102
Affects of pesticides on environment (soil and water contamination)	3.21	1.079
Affects of pesticides on agricultural products	3.34	1.069
Affects of pesticides on food safety	3.39	1.156
Regular application of pesticides disturbs the pH of soil	3.64	1.135
Contaminate the soil nutrients and disturbs the soil fertility	3.70	1.071
Contamination of ground water (water bodies)	3.42	1.141
Pesticides application enhances air pollution	3.60	1.064
Affects of pesticides on overall plant growth	3.67	1.177
Affects of pesticides on nutrients uptake mechanism of plants	3.51	1.083
Damage and reduce the soil biomass	3.55	1.101
Affects on the quality of milk by using fodder with pesticide's application	3.59	1.122
Affects of pesticides on animal health	3.53	1.236
Safe use of pesticides	3.51	1.158
Application of banned pesticides	3.51	1.189
Lose of human life (death) due to pesticide's exposure	3.51	1.111
Availability of pure pesticides	3.32	1.081
Consultation regarding choice of pesticides	3.44	1.103
Efficacy of pesticides being applied	3.39	1.132
Reduced efficacy of pesticides when applied immediately before irrigation or rainfall	3.48	1.058
Reduction in beneficial insects due to pesticides application	3.57	1.168
Methodologies/ways to mitigate risks of pesticides application	3.32	1.258

Scale: 1=Highly unlikely, 2=Somewhat unlikely, 3= Undecided, 4= Somewhat likely and 5= Highly likely.

pesticides on human body and the environment. He also reported that majority of the pesticides damage human health through ingestion. With similar lines, Damalas and Koutroubas (2016) also reported that pesticides entered into the human body mostly through three (3) ways (1) Inhalation (through lungs), (2) Ingestion (through mouth) and (3) Contact (through skin). In many of the developing countries like Pakistan, exposure to pesticides especially by the farm workers has become one of the major occupational health related risks.

Opinion of respondents regarding impact of pesticides on human health

This has been reported and is established fact that improper and non-judicious use of pesticides in agriculture have serious environmental and health related issues. The intensive application of pesticides by the farmers give rise to a number of serious health

issues (Yassin et al., 2002). In the present study data regarding opinion of respondents about harmful impacts of pesticides on human health was collected and presented in Table 10.

Table 10: Data regarding opinion of respondents regarding harmful impacts of pesticides on human health.

Response	Frequency	Percentage
Yes	205	68.3
May be	68	22.7
Not at all	27	9.0
Total	300	100.0

The data placed in Table 10 shows that majority (68.3%) of respondents were of the view that pesticides pose harmful impacts on the health of human beings. And only 9.0% of the respondents viewed that application of pesticide had no serious impacts on

the health of human beings. The data also indicate that about 23% of respondents were not sure about health-related concerns connected with application of pesticides. More or less similar findings were also reported by Khan and Damalas (2015), Banerjee *et al.* (2014) and Mahantesh and Singh (2009).

Table 11: Data regarding experience of ill health symptoms after pesticide's application.

Response	Frequency	Percentage
Yes	258	86.0
No	42	14.0
Total	300	100.0

The data placed in Table 11 indicate that an overwhelming majority (86.0%) of respondents faced ill health symptoms in case of unsafe exposure towards pesticides. However, few number of respondents (14.0%) were said that they didn't receive any ill health symptoms after application of pesticides in their fields. Data regarding major ill health symptoms reported by the participants was collected and presented in Table 12.

Table 12: Data regarding ill health symptoms after pesticide's application reported by the respondents.

Symptom	Frequency	Percentage
Nausea and vomiting	265	88.3
Cough	170	56.7
Body itching and irritation (Dermatitis)	95	65.0
Itching and irritation in eyes	122	40.7
Pain in eyes	147	49.0
Blindness	144	48.0
Damage of nervous system	158	52.7
Stomach problem/issues	133	44.3
Muscle stretching and pain	161	53.7
Excessive sweating	121	40.3
Shortening of breath	168	56.0
Disturbance in sleeping	144	48.0
Headache	163	54.3
Loss of appetite	138	46.0
Tightness of chest	146	48.7
Dryness of mouth	146	48.7
Pustules on skin	148	49.3
Formation of scars on skin	164	54.7
Diarrhea	133	44.3
Fever	142	47.3
Hypertension	150	50.0
Hormonal disturbance	157	52.3
Nose burning	166	55.3

Data presented in Table 12 shows that nausea and vomiting is the main ill symptom as pointed out majority (88.3%) of respondents. Other ill health symptoms were cough, body itching and irritation, itching and irritation in eyes, pain in eyes, blindness, damage of nervous system, stomach problem/issues, muscle stretching and pain, excessive sweating, shortening of breath, disturbance in sleeping, headache, loss of appetite, tightness of chest, dryness of mouth, pustules on skin, formation of scars on skin, diarrhea, fever, hypertension, hormonal disturbance and nose burning as reported by 88.3%, 56.7%, 65.0%, 40.7%, 49.0%, 48.0%, 52.7%, 44.3%, 53.7%, 40.3%, 56.0%, 48.0%, 54.3%, 46.0%, 48.7%, 48.7%, 49.3%, 54.7%, 44.3%, 47.3%, 50.0%, 52.3% and 55.3% of respondent, respectively. In connection with these findings, Chetty-Mhlanga *et al.* (2021) conclude that headache is a chronic health problem faced by farmers due to exposure towards pesticides. Other health related issues are skin allergy as reported by Magauzi *et al.* (2011), asthma reported by (Sekiyama *et al.*, 2007), cancer reported by Jensen *et al.* (2011), disturbance in male and female hormonal system as reported by de Magauzi *et al.* (2011) and many other research studies. With regard to Pakistan Anjum *et al.* (2018) reported that cancer, respiratory issues, damage of kidney, damage of liver, insomnia, headache, fatigue and skin diseases are the major health related issued faced by farmers of district Okara.

Adoption of precautionary measures by the respondents

Farmers adopt different precautionary measures to minimize or to mitigate the hazardous impacts of pesticides especially on human health. The rate of adoption of these precautionary measures was measured through five-point likert scale and the data in this regard is given in Table 13.

The data given in Table 14 shows that majority of the respondents mostly adopt "Use of overall/long-sleeved clothes" as precautionary measure with highest mean value (3.69/5.00 and SD 1.015). The adoption level of respondents was minimum in case of "Use of hand gloves" with minimum mean value (3.07/5.00 and SD 1.466). In connection with these findings, Damalas and Koutroubas (2016) concluded that farmers used different type of protective equipment to minimize exposure. Out of these, wearing long sleeve shirts, hats, boots and gloves are the most common protective and precautionary measures. This has been noted that highly toxic pesticides require a high level of adoption

Table 13: Data regarding adoption of protected/precautionary measures by the respondents.

Protected/precautionary measures	Mean	SD
Use of hand gloves	3.07	1.466
Use of hat	3.52	1.231
Use of sun glasses	3.38	1.137
Use of overall/long-sleeved clothes	3.69	1.015
Use of mask/respirator	3.61	1.127
Use of long/field shoes	3.39	1.250
Use of oil	3.48	1.223
Change clothes immediately after pesticide's application	3.39	1.229
Take shower immediately after pesticide's application	3.41	1.197
Do not smoke/eat/drink during pesticide's application	3.31	1.285
Eat and drink after washing hands with soap	3.55	1.267
Careful storage on safe place	3.49	1.172
Do not dispose empty bottles/containers/packs in the open fields	3.26	1.153
Dispose empty bottles/containers/packs of pesticides on safe place	3.53	1.197
Apply pesticides on the recommended dose	3.47	1.195
Follow instructions presented on pesticide's labels and manuals	3.41	1.249
Wash contaminated clothes separately	3.24	1.163
Keep unused pesticides out of reach of children	3.36	1.231

Scale: 1=Never, 2=Rarely, 3= Occasionally, 4= Frequently and 5= Strictly.

of protective measures. Use of proper precautionary or protected measures by the farmers depend upon different factors. These factors are reported by different researchers such as [Jallow et al. \(2017\)](#) stated that knowledge level of farmers regarding choice of appropriate pesticides and its health hazards are the major ones. Similarly, [Hashemi et al. \(2012\)](#) concluded that perception of farmers about exposure of pesticides are the main factor. Strong relationship was found between health of farmers and pesticide exposures.

Reasons of Non adoption of precautionary measures by the respondents

The data regarding non-adoption of precautionary measures by the respondents were also collected with the help of three (3) point likert scale and presented in [Table 14](#).

Table 14: Data regarding major reasons for not using protected/precautionary measure by the respondents.

Reason	Mean	SD
Too much expensive	2.48	0.514
Not necessary in each case	2.31	0.463
Feel uncomfortable	2.35	0.477
Time-consuming	2.25	0.436
Not useful	2.12	0.386
Unavailable when needed	2.26	0.481

Scale: 1=Disagree, 2= Undecided, 3= Agree.

The data given in [Table 14](#) shows that among different reasons behind non-adoption of protected/precautionary measures by the respondents “Too much expensive” was with maximum mean value (2.48/3.00). This indicate that majority of the respondents were agreed that protected/precautionary measures adopted minimize health hazards of pesticides.

In relation to these findings [Ullah and Nawab \(2019\)](#) concluded that majority of the farmers of KP province were not so cautious about health hazards connected with application of pesticides. This is due to multiple reasons. Out of these poor awareness level regarding human health issues and application of pesticides. Insufficient knowledge and skills level of farmers regarding safe and healthy use was also one the reasons. The same was also reported by [Abbassy \(2017\)](#). They stated that generally all the respondents of the study didn't use protective measures while applying pesticides. The major reason behind this was that a large majority of the respondents (96.5%) know about the safe use/application of pesticides. Majority of farmers were aware about Pesticides Protective Measures (PPMs) but no one adopted these precautionary measures.

The said behaviour of farmers was also identified and discussed in different research studies conducted in

different parts of the world like [Yassin *et al.* \(2002\)](#), [Al-Zaidi *et al.* \(2011\)](#), [Akhtar *et al.* \(2007\)](#), [Naidoo *et al.* \(2010\)](#), [Karunamoorthi *et al.* \(2012\)](#) and many others. In many parts of the developing world majority of the farmers didn't know about typology of the pesticides being used, mode of action of the pesticides, and health issues connected with the application of these pesticides and proper protective measures. Location of residence of the farmers also have association with occurrence of serious health related issues and concerns. According to [Indra *et al.* \(2007\)](#) cost of the protective measures, limps behavior of farmers and uneasiness/discomfort are the main reasons behind non-adoption of proper protective and precautionary measures. These factors that influence use of precautionary measures by the farmers during pesticide application were also studied by [Afshari *et al.* \(2019\)](#).

Conclusions and Recommendations

It was concluded that majority (51.3%) of respondents were belong to young age group having age up to 25 years. An overwhelming majority 93.7% of respondents were literate. The educational level of literate respondents was low as majority (60.5%) of the literate respondents possessed only 12 years of schooling mean intermediate. It was further concluded that wide nature of pests and diseases damage crops, fruits and vegetables in the research area. In order to control the reported insects/pests, farming community used a wide range of pesticides in their fields. These pesticides are classified into three major groups as Insecticides, Fungicides and Weedicides. Farmers used a variety of methods to control reported insects and pests. These methods are generally classified into four major categories as cultural control measures, mechanical control measures, chemical control measures and biological control measures. A large majority (87.3%) of respondents adopt chemical control measures for the control of different insect and pests. Biological control measure is not so common in the area. It was further concluded that consultation with fellow farmers was the main criteria being followed by majority of the respondents while purchasing and application of pesticides in their respective fields. Knowledge level of respondents was found to be highest regarding contamination of the soil nutrients and disturbs the soil fertility by the pesticides. Majority of the respondents mostly adopt "Use of overall/long-sleeved clothes" as precautionary

measure. Among different reasons behind non-adoption of protected/precautionary measures by the respondents "Too much expensive". Majority (68.3%) of respondents were of the view that pesticides pose harmful impacts on the health of human beings. An overwhelming majority (86.0%) of respondents faced ill health symptoms in case of unsafe exposure towards pesticides. Nausea and vomiting were the main ill symptom as pointed out majority (88.3%) of respondents. Based on the conclusions below are some recommendations:

- Use of new chemistry insecticides and encourage adoption of biological control measures
- Awareness seminars/workshops should be arranged at village level regarding harmful effects of pesticides
- Awareness campaign through mass media should be conducted regarding harmful effects of pesticides
- Regular training workshops should be organized regarding safe handling of pesticides
- Pesticide regulating bodies should take necessary measures to ban pesticides that are harmful for human health and environment

Novelty Statement

Farmers apply pesticides in their fields due to multiple reasons. Health hazards associated with application of pesticides in agriculture sector differ from countries to countries especially in the developing world. With reference, application of pesticides has become one of the serious threats to environment and human health hazards. Around 10,000 farmers annually infected through pesticides application. Current research study highlighted major health related concerns associated with application of pesticides by the farmers of district Sargodha.

Author's Contribution

Muhammad Luqman: Conceptualization, supervision.

Muhammad Talha Shoaib: Formal analysis, resources.

Muhammad Yaseen: Writing review and editing, project administration.

Umair Safdar: Funding acquisition, methodology.

Hassan Raza: Investigation, resources.

Conflict of interest

The authors have declared no conflict of interest.

References

- Abbassy, M.M.S., 2017. Farmer's knowledge, attitudes and practices, and their exposure to pesticide residues after application on the vegetable and fruit crops. Case study: North of Delta, Egypt. *J. Environ. Toxicol.*, 7: 5.
- Abdullah, A., Al-Zaidi, M.B. Baig, S.E.T. Muneer, S.M. Hussain and F.o. Aldosari. 2019. Farmers' level of knowledge on the usage of pesticides and their effects on health and environment in northern Pakistan. *J. Anim. Pl. Sci.*, 29(6): 1501-1515.
- Afshari, M., J. Poorolajal, F. Rezapur-Shahkolai, M.J. Assari and A. Karimi-Shahanjarini. 2019. Which factors influence farmers' use of protective measures during pesticides exposure? *Workp. Health Saf.*, 67(7): 338-349. <https://doi.org/10.1177/2165079919827042>
- Akhtar, A., M. Ahmad, T. Ali and M.I. Zafar. 2007. Vegetable growers' awareness about health safety measures and pesticide use in Punjab Pakistan. *Pak. J. Agric. Sci.*, 44(3): 28-35.
- Al-Zaidi, A.A., E.A. Elhag, S.H. Al-Otaibi and M.B. Baig. 2011. Negative effects of pesticides on the environment and the farmers awareness in Saudi Arabia: A case study. *J. Anim. Plant Sci.*, 21: 605-611.
- Anjum, R., A. Saghir, S. Usman, H.A. Raza and H.A. Khan. 2018. A study into determination of pesticide residual effects on environment and farmer's health in Okara, Punjab, Pakistan. *J. Biodiv. Environ. Sci.*, 13(2): 90-102.
- Atreya, K., 2008. Health costs from short-term exposure to pesticides in Nepal. *Soc. Sci. Med.*, 67: 511-519. <https://doi.org/10.1016/j.socscimed.2008.04.005>
- Bakhtawar and S. Afsheen. 2021. A cross sectional survey of knowledge, attitude and practices related to the use of insecticides among farmers in industrial triangle of Punjab, Pakistan. *PLoS One*, 16(8): e0255454. <https://doi.org/10.1371/journal.pone.0255454>
- Banerjee, I., S.K. Tripathi, A.S. Roy and P. Sengupta. 2014. Pesticide use pattern among farmers in a rural district of West Bengal, India. *J. Nat. Sci. Biol. Med.*, 5: 313-316. <https://doi.org/10.4103/0976-9668.136173>
- Chetty-Mhlanga, S., S. Fuhrmann, W. Basera, M. Eeftens, M. Roosli and M.Q. Dalvie. 2021. Association of activities related to pesticide exposure on headache severity and neurodevelopment of school-children in the rural agricultural farmlands of the Western Cape of South Africa. *Environ. Int.*, 146:106237.
- Christos, A., Damalas and S.D. Koutroubas. 2017. Farmers' training on pesticide use is associated with elevated safety behavior. *Toxics*, 5(3): 19. <https://doi.org/10.3390/toxics5030019>
- Creswell, J.W., 2014. Research design: qualitative and quantitative, and mixed methods approach. (4th edition). Sage publication.
- Damalas, C.A. and I. Eleftherohorinos. 2011. Pesticide exposure, safety issues, and risk assessment indicators. *Int. J. Environ. Res. Publ. Hlth.*, 8: 1402-1419. <https://doi.org/10.3390/ijerph8051402>
- Ejaz, S., C. Akram, C.W. Lim, J.J. Lee and I. Hussain. 2004. Endocrine disrupting pesticides: A leading cause of cancer among rural people in Pakistan. *Exp. Oncol.*, 26: 98-105.
- Government of the Pakistan. 2008. National Youth Policy, Ministry of youth affairs, Islamabad.
- Government of Pakistan, 2022. Agriculture, Government of Pakistan, Economic Advisor's Wing, Islamabad.
- Hashemi, S.M., R. Rostami, M.K. Hashemi and C.A. Damalas. 2012. Pesticide use and risk perceptions among farmers in southwest Iran. *Hum. Ecol. Risk Assess. Int. J.*, 18: 456-470.
- IFPRI, 2018. Agriculture is key for economic transformation, food security, and nutrition. International Food Policy Research Institute (IFPRI), Policy Report.
- Indra, D., R. Bellamy and P. Shyamsundar. 2007. Facing hazards at work: Agricultural workers and pesticide exposure in Kuttanad, Kerala. *S. Asian Netw. Dev. Environ. Econ.*, 19: 1-4.
- Jallow, M.F.A., D.G. Awadh, M.S. Albaho, V.Y. Devi and B.M. Thomas. 2017. Pesticide risk behaviors and factors influencing pesticide use among farmers in Kuwait. *Sci. Total Environ.*, 574: 490-498. <https://doi.org/10.1016/j.scitotenv.2016.09.085>
- Jensen, H.K., F. Konradsen, E. Jørs, J.H. Petersen and A. Dalsgaard. 2011. Pesticide use and self-reported symptoms of acute pesticide poisoning among aquatic farmers in Phnom Penh, Cambodia. *J. Toxicol.* 1-9.

- Karunamoorthi, K., M. Mohammed and F. Wassie. 2012. Knowledge and practices of farmers with reference to pesticide management: Implications on human health. *Arch. Environ. Occup. Hlth.*, 67: 109-116. <https://doi.org/10.1080/19338244.2011.598891>
- Khan, A., N. Jaffar and F. Murad. 2022. Practice and effect of pesticide use on farmers' health in Sindh, Pakistan. *J. Pak. Med. Assoc.*, 7(3): 587-592.
- Khan, M., H.Z. Mahmood and C.A. Damalas. 2015. Pesticide use and risk perceptions among farmers in the cotton belt of Punjab, Pakistan. *Crop Prot.*, 67: 184-190. <https://doi.org/10.1016/j.cropro.2014.10.013>
- Magauzi, R., B. Mabaera and S. Rusakaniko. 2011. Health effects of agrochemicals among farm workers in commercial farms of Kwekwe District, Zimbabwe. *Pan Afr. Med. J.*, 9: 26. <https://doi.org/10.4314/pamj.v9i1.71201>
- Mahantesh, N., and A. Singh. 2009. A study on farmers' knowledge, perception and intensity of pesticide use in vegetable cultivation in western Uttar Pradesh. *Pusa Agric. Sci.*, 32: 63-69.
- Mahmood, N., M. Arshad, H. Kaechele, H. Ma, A. Ullah and K. Müller. 2019. Wheat yield response to input and socioeconomic factors under changing climate: Evidence from rainfed environments of Pakistan. *Sci. Total Environ.*, 688: 1275-1285. <https://doi.org/10.1016/j.scitotenv.2019.06.266>
- Mubshar, M., F.O. Aldosari, M.B. Baig, B.M. Alotaibi and A.Q. Khan. 2019. Assessment of farmers on their knowledge regarding pesticide usage and biosafety. *Saudi J. Biol. Sci.*, 26: 1903-1910. <https://doi.org/10.1016/j.sjbs.2019.03.001>
- Mustafa, K., M. Shah, N. Khan, R. Khan and I. Khan. 2007. Resource degradation and environmental concerns in Pakistan's agriculture. *Sarhad J. Agric.*, 23(4): 1159-1168.
- Nafees, M., M. Jan and H. Khan. 2008. Pesticide use in Swat valley, Pakistan. *Mount. Res. Dev.*, 28(3): 201-204. <https://doi.org/10.1659/mrd.1042>
- Naidoo, S., L. London, H.A. Rother, A. Burdorf and R.N. Naidoo. 2010. Pesticide safety training and practices in women working in small-scale agriculture in South Africa. *Occup. Environ. Med.*, <https://doi.org/10.1136/oem.2010.055863>
- Rasheed, B., 2007. Country report on international code of conduct on the distribution and use of pesticide. Department of plant protection, Ministry of Food, Agriculture and Livestock, Government of Pakistan.
- Salam, A. and A. Hameed. 2022. Technical efficiency in production of major food grains in Punjab, Pakistan. *Asian Dev. Rev.*, 39(2): 201-222. <https://doi.org/10.1142/S0116110522500160>
- SDPI, 2018. Risk management practices of small farmers: A feasibility study for introducing R4 rural resilience initiative in Punjab. Sustainable Development Policy Institute (SDPI), Islamabad, Pakistan.
- Sekiyama, M., M. Tanaka and B. Gunawan. 2007. Pesticide usage and its association with health symptoms among farmers in rural villages in west Java, Indonesia. *Environ. Sci.*, 14(Suppl): 23-33.
- Tech Sci Research, 2018. Global pesticides market by type (Synthetic pesticides and bio pesticides), by application (cereal, fruits, plantation crops, vegetables and others), by formulation (dry and liquid), by region, competition forecast and opportunities, 2013 - 2023. Report July 2018.
- Tudi, M., H.D. Ruan, L. Wang, J. Lyu, R. Sadler, D. Connell and D.T. Phung. 2021. Agriculture development, pesticide application and its impact on the environment. *Int. J. Environ. Res. Publ. Hlth.*, 18(3): 1112. <https://doi.org/10.3390/ijerph18031112>
- WHO, 2016. Sound management of hazardous wastes from health care and from agriculture. Jakarta Indonesia.
- Yassin, M.M., T.A. Mourad and J.M. Safi. 2002. Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. *Occup. Environ. Med.*, 59: 387-393. <https://doi.org/10.1136/oem.59.6.387>
- Ullah, R. and K. Nawab. 2019. Association of precautionary measures of pesticides use with health concerns. *Pakistan J. Agric. Res.*, 32(2): 287-292.