HEALTH COST OF FARMERS FROM PESTICIDES USE IN APPLE ZONE: A CASE STUDY OF ZIARAT DISTRICT (BALOCHISTAN)

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CERTIFICATE

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بسم الله الرحمن الرحيم

Dedicated to my parents and my whole family,

Who always encouraged me to seek

the light of knowledge.

DECLARATION

It is stated that the work contained in thesis entitled “Health cost of farmers from pesticides use in apple zone: A case study of Ziarat district (Balochistan)” has been done by me under the supervision of Dr Iftikhar Ahmad.

I also hereby assert that this thesis has not been submitted elsewhere for any degree. Five copies of this thesis are submitted for further processing.

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Abstracts

The study investigates the pesticides use in apple production zone of Ziarat (Balochistan). The primary data was collected from the same group of applicator and farm workers. The study only focuses on the short term health impairment and cost. Regression result from probit and ordinary least square suggests that types of pesticide, personal habits, exposure and toxicity level have significant effects on health. The higher the exposure to most and higher toxic chemical (D-Red and D-Yellow) bigger was the health impairment and cost. The average estimated health cost from the exposure to pesticides is Rs 1065 per season. The policy recommends restricting the most hazardous chemical through taxation, awareness in the consumers and adaptation of international policies can reduce the health cost**.**

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Abbreviation

WHO.....World Health Organization

UNE**P**……...…….…..……...United Nation Environment Program

FAO…….…….Food Agriculture Organization

IPPC…….……..…Intergovernmental Panel on Climate Change

WTP…….…….….Willingness To Pay

WTA……...…….…….…Willingness To Accept

D-Red……...……Dose Of Red Category

D-Yellow……...……...……...Dose Of Yellow Category

D-Blue……...……...…..…….Dose Of Blue Category

D-Green……...…..…Dose Of Green Category

BMI……...……...…Body Mass Index

LD……..……....…….Lethal Dose

DRM…….….Dose Response Model

CHAPTER 1: INTRODUCTION

1. 1: Introduction

After green revolution, production of global food was increased from two to three times between 1960 and 2000 (Gollin, 2003). To sustain high level agriculture production, pesticides play essential role for this purpose. Despite of the popularity of pesticides use, it is harmful to human health and poses serious risk to its exposure. During mixing and applying to the fields, the pesticides particles get mixed with food and drinking water. These cause serious risks to the farm workers and surrounding population. Both in short and long run major health costs are arising from the routine usage of pesticides. Every pesticide has certain toxicity level because it is made for killing harmful organisms. Within this context, pesticides pose serious threat to human health, wildlife and to the whole ecosystem.

There is a perception that the pesticides use has enhanced the agriculture production, but put both the ecosystem and human health at risk. More than Three million of death cases were reported from the use of pesticides across the globe (WHO, 1990). Most of the pesticides cases were reported from developing countries. Jeyaratnam (1999) estimated that twenty five million agriculture workers suffered from pesticides poisoning in developing countries annually. Farmers are highly at risk in developing countries, because they are exposed to more hazardous chemicals which are restricted in developed countries. Risks in developing countries are also high because of inappropriate use of technique, poor spraying equipment and inadequate storage practices. These types of exposure to pesticides have posed serious threat to human health and particularly to the agriculture farm workers.

The hidden health cost of impairment and environmental degradation are significant as well and needs to be considered while discussing the increase in returns from pesticides crops due to pesticides use. For the past sixty years, pesticides are being used as an important tool for preventing crops from losses. Approximately two billion people are engaged in agriculture, and most of them use toxic chemicals to protect their crops. Pimentel (1980) estimated that the direct cost of pesticides for United State was $4.1 billion each year which purchase five hundred thousand tons of pesticides. This was the estimated direct costs that result in saving $16 billion of worth crops each year. But indirect cost of pesticides was estimated at $8 billion annually from the use of pesticides that included the health cost around $787 million.

Domestic animals loss, Honeybee and pollination losses are also linked with the pesticides use. These losses include honeybee colonies, honey wax, potential for honey production and rental bees for pollination. The annual implicit cost of honeybee losses were $320 million while $30 million were related to domestic animals losses. In addition, the wild birds are also subject to be adversely effected by the use of pesticides. The bird's losses were estimated as $2.1 billion (Pimentel, 2005). Nevertheless, several other indirect costs are associated with pesticides use.

In this given content, this study analyzes this topic for Pakistan. Pakistan is an agrarian economy and farmers use pesticides in order to get benefits in terms of better productivity. However, there is a need to assess the hidden cost of pesticides born by them in terms of health loss to the farmers and their household. This study aims to fill this gap by analyzing the situation of Balochistan.

1.2: Area of the study and literature gap

Balochistan is the largest province in size while smallest in population. The province covered 347,190 square kilometers which is 44% of total land area of Pakistan. The province is divided into six divisions and thirty two districts for administrative purpose. The preliminary census records highlighted the Balochistan population as 13.1 million (khan, 2012). Balochistan is representing 6.85 percent of the total population of the country.

The economy of Balochistan mostly depends upon the production of natural gas, minerals, livestock and agriculture. Like other provinces, Balochistan is also rich in agriculture and agriculture is considered as dominant sector of the economy. It is the main source of income of the province which provides 60 percent employment to its total population. Despite the fact that out of 34.73 million hectares only 2.11 million hectares are cultivated land (Akhtar et al, 2015).

Because of two reasons, the cultivated portion of land is too small. First, 80 percent of the province consists of mountainous land and 20 percent is plain area. Second, there are large diversities in topography of the region as well as climate. Fundamentally, the Balochistan land is dry and barren due to little rainfall. It is not easy to grow more crops in the region. Large part of the land is covered by bushes and shrubs. However, some part of the province is blessed with fertile land and moderate temperature. The rich soil and moderate temperature are ideal for the growth of agricultural productivity. Being largest province in area while smallest in population, it produces a wide range variety of fruits and in surplus.

The major fruits of province that are grown include apple, cherries, almonds, apricots, dates, peach, olives, grapes, pomegranate, plums and pistachios. For that reason, Balochistan is named "the fruit basket of Pakistan". With four agro ecological zones, it is blessed with ideal

environment for the production of great variety and quality of fruits. The province produces 98.24 percent almonds, 52.52 percent plum, 30.31 percent peach, 98.24 percent grapes, 43.94 percent dates, 91.87 percents apricots, 71.37 percent pomegranates, 96.60 percent almond and 69.49 percent apple of the total production of the country (Wasim, 2011). The province has dissimilar climatic behaviors ranges from temperate to subtropical and tropical as it produces variety of fruits. Peach, cherry, apricot and apple are high delta fruits of the province. While grape, pomegranate, olive and pistachio are low delta fruits of the province. The date and palm are the subtropical fruits.

With such dissimilar climatic conditions, the province has the largest area under fruit cultivation comparing with the other provinces. It is producing one million tons of fruit annually from 0.23 million hectares. The total share in the country fruits area is 32 percent while in production is 17.4 percent respectively. The apple production in Balochistan has special significance among the other fruits cultivated. The environmental condition is relatively more suitable for apple production than other provinces (Shah et al,.2011). Therefore, apple is the most planted fruit in the province. It is grown in high landed area of the province covering 0.101 million of hectares and produces 0.224 million tons. The *tur-kulu* and *gaja* are the famous varieties for their color and taste throughout the country. The areas famous for apple production are Ziarat, Zhob, Pishin, killa Saifullah, Kalat, Mustung, Khuzdar districts.

Ziarat fall in the cold agro ecological zone and located at above 6000 altitude. Its total population according to 1998 census was 34 thousand. The total agriculture area is 8,015 hectares, which is approximately 2.4 percent of total geographical area of the district (Agriculture Statistics, 2009). Major fruits of the district are almonds, grapes, cherry, apricot, pear, pistachio, apple, pomegranate, plum and peaches. District is ranked as the third major producer of apple in

Balochistan. The area for the cultivation of fruit production has dominating position for apple. It contributes more than 78 percent in total production of fruits.*Tur-kulu*, *shin-kulu* and *gaja* are the famous varieties produced in the district. The quality, taste and color are famous throughout the market.

The constraints faced by fruits production are water shortage, disease attack and insects, expensive inputs, low price return, shortage of technical knowledge, shortage of capital, electricity shortfall, poor infrastructure and poor quality of pesticides. These problems are particularly faced by apple production zone. After the water scarcity, poor quality and miss use of pesticides is the second biggest problem.

The extensive use of poor quality pesticides badly damage human health and environment. The pesticides users calculate the cost of pesticides at market price while they ignore the indirect cost of pesticides. This study analyzed all direct and indirect cost of pesticides that incurred from pesticides use. There is vast literature available on environmental and health cost of pesticides from the world. Commendable works have been done regarding the estimation of health cost. In Pakistan pesticides cost are very huge, yet limited work has been done in this regard. It is very important to know the possible consequences of pesticides to measure the exact magnitude of pesticides negative externality.

1.3: Objective of the study

1 The study investigates the impacts of pesticides on the health of farmer in Ziarat zone

2 Examine the types of health impairments caused to field workers from pesticides use.

3 Estimate the direct and indirect cost due to health impairment from pesticides exposure in monetary terms.

CHAPTER 2: LITERATURE REVIEW

This chapter presented the selected work assessing the problem of health impairment and health cost from pesticides use around the world. The chapter discusses the general background and empirical evidence relating to pesticides impact on health and its cost. First part discus the general background and the second part explain the empirical literature.

2.1: General background of the effects of pesticides

The net benefit of pesticides is usually over estimated and this perception leads to the misuse of pesticides. This misuse of pesticides adversely affects the society as a whole directly and indirectly. However, here we are concerned about those people who are directly exposed to pesticides i.e. farmers. The repeated exposure to pesticides gives birth to both acute and chronic illnesses. The mismanagement uses of pesticides results in acute illnesses are stomach pain, vomiting, respiratory problems, skin rashes, headaches, sneezing and eye irritations. While long term diseases included disruption, reproductive birth defects, cancer, asthma, dysfunctions, neuron behavioral disorders and dermatitis (Pingali, 1994).

Initially, the cost of pesticides was only measured with market prices of items. Later on, new research suggested the inclusion of the cost of environmental degradation and human health impairments. Thus, the cost was obviously much greater than the market prices. The farmers suffer various kinds of diseases and face the number of costs that arises from the adverse effects of pesticides use not only the cost of purchase that has been faced. Indirect costs such as loss working days due to illness and payment to the alternative employees. These costs are associated with pesticides use, and are excluded from the total costs beard by the farmers. In this regard,

some studies were conducted in late 1970s to estimate the total cost of pesticides on human health but those did not get much importance.

The potential cost of pesticides always remained under estimated. Farmers were only concerned about their private cost of pesticides. They want to get maximum level of output, and do not care for the external effect of their activity. They are less concerned with the deterioration of future environmental and health risks. It is assumed by the farmers that they are not accounted for the external cost of pesticides, and this notion motivates them for the excess use of toxic chemicals. This exhibits the problems like lack of awareness and absence of property rights from environmental goods like atmosphere.

Waibel (2000) estimated the total cost endured by the farmers while including both direct and indirect costs of pesticides consumption. The direct costs were included as fee to doctor, medicine cost, transportation cost, loss of utility, payment to traditional healer and care taken while staying at home. The indirect costs were suggested as opportunity cost to the farmers (the time required for recovery plus the payment made to another labor). The ratio of health deterioration of individual farmer was measured by the cost of treatment suggested by medical team, and plus the opportunity cost of the farmers (time required for recuperation). The health cost was also added as the disutility from deteriorating health, cost of advertisement, loss of leisure time and life expectancy. But on the account of deficiency of data the complete cost was underestimated. It was because of absence of integration between market and non-market elements.

The Pimentel (2005) estimated the health costs (pesticides use) that lead to cancer in US. The private cost of pesticides was $1.5 billion, however with the cancer cost included; the cost

increased ten times ($15 billion) in United State. Another study from Pakistan was conducted by Iqbal (2002) in the cotton zone of the Punjab. He estimated the direct costs and indirect costs for chemicals plus spray as Rs7044 and Rs11567 million respectively. The total cost reached Rs18611 million annually. This unplanned use of pesticides led to decreasing economic returns and costly investment for the farmers.

In addition to health cost, pesticides have also posed serious costs for environment and livestock. Thousands of animals are poisoned each year by pesticides use. These toxic chemicals kill beneficial insects, birds, mammals, amphibians, honey bee, cattle and other wildlife animals. These elements play a significant role in the improvement of environment. The vast usage of pesticides has adversely affected these environmental goods.

For pollination of fruits, vegetables and honey production, wild bees and honeybees are equally important. Pimentel (1997) estimated that US agriculture is benefited about $40 billion by bees every year. However, the indiscriminate use of pesticides has disappeared bees from the ecosystem because most of insecticides used for agricultural purposes are hazardous to both bees and general population. Mayer (1990) estimated that pesticides have adverse impacts on 20% of honeybee colonies around the world. He further estimated that 5% of the US honey bee colonies are affected by exposure to pesticides. The other 15% of honeybees are confronted to serious losses.

In addition to the direct losses of both bees and their production, majority of crops were affected due to the lack of pollination. California approximately rented out a one million colonies of honey bee at the cost of $55 per colony which increases the natural pollination of almond, melons and other fruits (Burgett, 2000).

The destruction of pesticides is not limited to honeybees, it has also affected the birds particularly those birds living in high temperature zone such as owls, eagles etc. They are mostly vulnerable from pesticides use. Pesticides have used also killed cereal and plant eating birds. The population of insects eaten by birds is also decreased because of pesticides use. This threatened some species. Some causes that are linked with birds killing have resulted from the extensive use of pesticides while including insecticides (diazinons and carbofuran), and which killed the birds in many parts of the world (Kegley, 1999).

Livestock is also vulnerable because of its exposure to pesticides. Pesticides contaminants enter into their bodies in number of ways through open water stocks, toxic grass and air. Therefore, livestock have more chance to be affected by pesticides as compared to other animals. This toxic chemical kills thousands of animal which have worth of billions of dollars each year. Pimentel (2005) estimated that 0.04% to 0.05% of the animals' deaths were caused by pesticides poisoning while having a worth of $21.3 million approximately each year in USA.

Hence, the literature has highlighted both the positive and negative consequences drawn from the pesticides use. Thus this study is needed to know the ground realities of Pakistan, particularly focusing on Ziarat district of Balochistan.

2.2: Empirical literature

2.2.1: Literature highlighting the positive effects of pesticides use

There are ample benefits of the use of pesticides like the high quality and quantity yield of crops. The high yield of crops results in high revenue generation, and enables the economy for the provision of welfare needs which leads to living a standardized life. There are number of secondary benefits of pesticides use, and are recognized as protection for the basic needs of the people and for biodiversity.

Without pesticides, there will be less than potential yield of crops while pesticides use result in increase in yields and revenue (Webster et al,. 1999). Pesticides have positive relationship with agriculture output, as the increased quantity of this input resulted in greater output (UNEP, 1991). The emergence of hybrid varieties increased the productivity in 1960s and in early period of 1970s. However, the production of vegetable, Paddy, cereal corps and other cash corps increased with pesticides use later on (FAO, 1961-1998). Particularly, the use of pesticides is productive for the growth of livestock and crops.

New plan have caused pesticides the improvement in human life by killing those organisms which cause diseases (Donsbson, 2007). The only way for controlling the fatal diseases and reducing the morbidity rate is killing the insects that are causing infections. Lethal diseases such as malaria resulted in an estimated 5000 deaths per day (Muhammad Salman, 2015). Malaria has been termed as the major cause of death in developing countries and serious health problem in India (Dobson et al, 2007). Diseases control plan is also essential for livestock protection.

The benefits of diet of having fresh fruit and vegetables are relatively far greater than the risk caused by the residues of pesticides in developed countries (Trewavas, 2004). It is also experienced that using fresh fruits and vegetables on every day bases control a lot of diseases like heart diseases, diabetes, stroke and blood pressure and other chronic diseases (Koshiet al,.2006). The diets containing the nutrients of apple and blueberries has large amount of antioxidants which avoid the risks of cancer and heart diseases (Cooper. 2007).

Utilization of pesticides has also positive effects on agriculture. There are several insects and invasive species that damage the agriculture. The pesticides are effective tools to protect the agriculture against these harmful insects. Emphasizing on provisional management practices including pesticides and stress on the use of plant resistance biological and cultural tactics to reduce the hazards to ecosystem. Pesticides are strong tools against attacking species that cause greater threats to local indigenous ecologies (Van, 2000). When rats were introduced in islands which were previously free of pesticides, they have worse impacts on animal kingdom in particular on species of birds, marine, mammals, insects, molluscs, spiders, frogs and reptiles. The existence of certain ecosphere used for production purpose, has significant contribution in the international trade (IPPC, 1997). In environment, majority of the pesticides experienced photochemical transformation to occur metabolisms that are comparatively not harmful to both human life and the environment (Veena, 2015).

2.2: Literature highlighting the negative effects of pesticides use

Pesticides have positive impacts on economic growth relating to food production and helps in eliminating the vector born diseases. While on other hand, it has adverse impacts on human health, wildlife and environment as a whole. The tradeoff phenomena exist between pesticides

use and health. The pesticides contaminate mixes with food and our environments have worse impacts on human health. Annually millions of cases of pesticides poisoning are reported from worldwide (Richter, 2002). The largest numbers of deaths from hazardous chemicals have occurred in developing countries (Wilson, 2005). The repeated exposures to toxic chemical by farmers are common practices in the developing countries (Swinton, 2003).

Science confirmed that the repeated exposure to pesticides results in both acute and chronic illnesses. The acute illnesses are stomach pain, vomiting, respiratory problems, skin rashes, headaches, and coma, sneezing and eye irritations (Pingali, 1994). The chronic illnesses include endocrine disruption, reproductive dysfunctions, immune mediated toxicity, neuron behavioral disorders, birth defects, cancer, asthma and dermatitis (Burger, 1997). Some evidences found that pesticides are also responsible for learning impairment and memory loss (Pimentel, 2002).

Health problems caused by pesticides pose serious threat to development and can reduce the gains made from agriculture growth (Townsend, 2000). Pesticides have positive effects on production, while negative impact on farmer health. Impair health have reverse effect on productivity (John et al,.1994). In addition to it, another study also highlighted that pesticide have positive effect on productivity and negative effect on health (Donald et al,.1994). However, the incorrect use of pesticides resulted in having worse impact on environment and farmers health, when the amount of pesticides used was far greater than the maximum required (Shende et al,. 2013). Most of pesticides not only eliminates the pest but also kills the non-hazardous insects and animals as well. Thus, pesticides containments are mixed to soil, water, turf and vegetation which pollute the entire environment.

Pesticide does not only kill the targeted insects, it also poisons the other organisms including the birds, fish, beneficial insects and non-targeted plants. The insecticides and herbicides both are most toxic pesticides harmful for non-targeted organisms. The natural and agriculture ecosphere have many species. It helps to protect crops from hostile insects especially, predators and parasites play significant role in this regard. The natural species enable the ecosystems to remain green, by keeping predators and parasites (plant- feeding) at minimum level. Thus, only small numbers of plants biomass are damaged by insect population in each growing season (Pimentel, 1988).

The population of beneficial pest organisms and biodiversity are badly damaged by toxic chemicals (Pimentel et al,.1993). Pesticides kill the honeybees which play significant role in pollination. Moreover, the mechanism of colony collapse also results in the disappearance of working bees from a beehive (Zacharia, 2011). Wild and Honey bees are used as important agent for the pollination of fruits, vegetables and many other crops as well. They play important role in production process, approximately one third of the US crops results from bees. It brings the advantage of around $40 billion per year to the US agriculture (Pimentel et al,. 1997). The loss of predator's species resulted in the situation called as secondary bother gateway. The predators and parasites were not that much destructive species as compare to their benefits (Daly et al,.1998).

The report of UNEP (1979) mentioned the use of toxic chemicals is considered as one of the top four environmental problems around the world. The pesticides cause negative impacts upon environmental elements like soil, water and air contamination. It has also harmful impacts on non-targeted organisms (Burger et al. 2008). The toxicity of pesticides was also present in both rain and ground water. The British government proved in some studies by taking the samples of river water and ground water for drinking. It showed that the concentration of pesticides

exceeded than threshold level (Bingham, 2007). The health and environment are badly affected by pesticides contaminates due to lack of information, awareness and knowledge. The misuse of the hazardous poisons and harmful practices are the basic reasons for health and environmental damage (Khan, 2010).

To sum up, it is true the pesticides have positive impacts on crops productivity as well as on the environment as a whole. There are numerous insects and pests that can decrease production and damage different environmental components. Pesticides can help to some extent to avert these losses. Nevertheless, they have negative impacts on farmer health that extended different diseases which most of the time causes death to human beings. Pesticides also have degraded the environmental components i.e. soil, air and water contamination, and hazardous impacts on non-targeted organisms. These hazardous chemicals kill a large amount of birds, honey bee, livestock and other animals. These potential costs arising from pesticides use to society are considerable and this study therefore measured its impacts on human health.

CHAPTER 3: METHODOLOGY

This chapter discusses the methodology of the study applied for the describing data. First part explained the methods used for data analyses while second part of the study discussed the specification of econometric model description of the variables and data

3.1: Data and Methods

To measure the economic effects of pesticides on human health we need two kinds of information. Firstly, to identify the impacts of pesticides exposure on human health and secondly, the health costs linked to pesticides exposure in (monetary terms) are also estimated. In this study we used dose response function to measure the impacts of pesticides on human health and to find the impact of different factors on chances of getting ill. Then the health cost function used for evaluating the illness cost. The unit of analyses in this study is farmers/pesticides applicators who are directly involved in field.

3.2: Hypothesis

Hence, the hypothesis of the study can be mentioned as blow

H_0: Exposure to pesticides dose not causes sickness of applicator

H_1: Exposure to pesticides spray causes sickness of applicator

The effect of pesticides in this study is measured with toxicity level, duration of exposure and precautionary measures adopted during the spray events.

3.3: Dose Response Function

Cropper (1991) suggested three methods for estimating the economic costs of health impairment which are stated preferences, market base and dose response function. Stated preference method is the most widely used measure for the value environmental goods directly by asking for their

preferences for environmental goods. However, the issues linked with this approach are cannot neglected. First hypothetical biasness, the difference between what is actually paid and willingness to pay revealed in questionnaire survey. In market, the purchasers face real cost while in survey they do not face it. Second information biasness, is due to the lack of awareness about environmental goods. Third choice response mode, open ended and close question most the time excludes income constraints. Forth, there are large variation between WTP and WTA.

Market based method also have some serious constraints. First, market data are only available for few ecological goods and services. Second, the actual economic value does not fully cover in market transaction because of imperfect market. Third, the market price does not include the market value of other resources available in ecosystem; hence this may overstated the benefits.
Dose response is indirect method which measures the environmental cost and benefits. Dose means the causes of agent while response means the effects of agents. Increase in the dose of injurious agent, results in the proportional increase in adverse effect on population. The dose response model is used where the majority population is unaware the adverse effects of the pollution. It is mostly used in developing countries where the lack of data problem exists.

The dose response model is applied for this study. It measures the effects of polluted particles, combined with other factors, to assess its impact on health. Here we calculated the probability of falling sick after the episode of pesticides spray.

Pindira Dive (2007) has used the dose-response model which was applied on Kuttanad's paddy crop near the coast of Kerala (India). This special type of paddy crop that grows in Kuttanad is also called "the rice bowl of India". There were number of pesticides poisoning cases reported in Kerala which had resulted from the extensive use of pesticides on paddy crop. He collected the

primary data and applied dose-response model. Hence, this study is also based on dose-response model for analyzing the case of Ziarat district (Balochistan).

Probit model applied to study the factors affecting the probability of getting sick. The dependent variables used to estimate the probability of getting sick (Y), where (Y) is the function of independent variables (Xi) which are the factors that influences the probability of sickness. The expected signs of the model that the study used as independent variables are given in the Table 3.1. Sickness symptoms are used for health damages that were caused from pesticides exposure. These symptoms included eye irritation, nausea, giddiness, shortness of breath, fever, dehydration, vomiting, cramps, itching, convulsion, burnt feel, skin irritation, diarrhea, excessive salvation, blurred vision, tremor and others.

Table 3.1: Factors of Health Damage and Dose Response Model

S.NO	Variables	Extension	Explanation	Expected sign
Dependent Variable				
1	Y	Sick or Not Sick	0=Not sick, 1= sick	NA
Independent Variables				
1	D red	Dose of Red category chemical	The quality of pesticides applied	Positive (+)
2	D yellow	Dose of yellow category chemical	The quality of pesticides applied	Positive (+)
3	D blue	Dose of blue category chemical	The quality of pesticides applied	Positive (+)
4	D green	Dose of green category chemical	The quality of pesticides applied	Positive (+)
5	DURATION	Total time of expose to chemicals	Total time of expose in minutes for all kind of chemicals	Positive (+)
7	SMOKING	Smoking habit during the work	0=if not smoking, 1= if smoking during the field work	Positive (+)
8	TEA	Tea habit during the field work	0= if not drinking tea, 1= if drinking tea during the field work	Positive(+)

9	BMI	Body Mass Index	Wight/height x 100	Negative (-)
10	ILLITERATE	Illiterate	Illiterate	Positive (+)
11	EDUCATION 1	Education level	05 + years of schooling	Negative (-)
13	EDUCATION 2	Education level	10 + years of schooling	Negative (-)
14	AGE	Age of the spray applicators	Age in years	Negative (-)
15	LAND	Land hold for the crop	Total Land hold in hectares	positive (+)
16	AVEBEH	Averting behavior	1= if they adopt personal protective gadgets, 0= if they don't	Negative(-)

1) Pesticides dose: this variable captures the thinning of spray fluid and toxicity of the pesticides use. WHO has set a color code for pesticides based on their toxicity level. The (LD_{50}) lethal dose is the quantity needs to kill 50% of the targeted organisms. The toxicity level depends upon the value of pesticides. If the value is lower that chemicals are more hazardous. If the value of a chemical is less than fifty then it is the most toxic and named as red LD_{50}. On second number, the highly toxic chemicals are named as yellow and the LD_{50} value rank is 50 to 500. The moderate toxic chemicals are Blue with LD_{50} 500 to 5000. The slightly toxic chemicals are Green because LD_{50} value is greater than 5000. These variables showed the effect of the thinness of spray fluid. It is the function of pesticides quantity and the amount of water used. These four variables Dose of RED category, Dose of YELLOW category, Dose of BLUE category and Dose of GREEN category are considered harmful for health according to their LD values. We expected a positive sign but with different magnitude for all the variables.
2) Exposure Duration: This variable show the total time taken for preparing the spray and applying it to the field by the workers. The variable is expected with a positive sign.

3) Personal habits: Smoking and taking tea are considered as the major habits in the field. These two habits pose serious threats to the health of the field workers. Positive sign due to health risks are expected for these variables.
4) Body Mass Index: This variable measure the overall health status of the individual. If the value remain in the range of 18.5 and 25 then the value is desirable. The value below the desirable range represents malnutrition and higher value show obesity. The expected sign for this variable is negative.
5) Education: Negative sign is expected for education. More education in field work is expected to result in less risk. We categorize the respondent in three groups according to their education level. The education level 5^{th} and 8^{th} are included into Primary while the 10^{th} and above the 10^{th} are included into Matric. The third one is illiterate have positive impacts on sickness.
6) Age: Negative sign is expected for age. As the age increase the applicators get experience to avoid the risk.
7) Averting behavior: Use of personal protective gadget is effective tool for defending the hazardous impacts of pesticides up to some extent. The expected sign for this variable is negative.

3.4: The Cost of Illness

The second model to be estimated in this study is cost of illness model. This method is mostly applied in economic studies. It depends upon the perception that cost can be averted by preventing illness. It measures all direct and indirect cost of the illness. The direct cost includes the medical expense, while indirect cost is the losses of working days due to ill health, time spent for treatment and loss of efficiency.

This study collected data by frequency and severity of illness, and by assessing the costs in terms of doctor fee, medicines purchased, laboratory tests, transportation expenditures, hospital fee and dietary expenses. The study also tried to gather the data on the losses occurred due to lost working days, poor work efficiency and productivity loss. Thus, the cost of illness in this study is representing the direct cost of illness only because the respondents failed to report credible data for indirect cost of illness. The cost of illness is regressed on set of independent variables to get the factors influencing health costs, especially the influence of the pesticides use. The linear regression model is use with health cost in logarithmic form. The dependent and independent variables are given below.

3.5: Variables

Y= Health Cost (Logarithmic form)

D red= Dose of red category pesticides

D yellow= Dose of yellow category pesticides

D blue= Dose of blue category pesticides

D green= Dose of green category pesticides

DUR= Duration of exposure

SMOKE= Smoking Habit (0, 1)

TEA=Tea Habit (0, 1)

BMI= Body mass index ((wt (kg))/ht^2 (mts)) x 100

EDU1= Education up to 5th class

EDU2= Education up to 10th class

AGE= Age in years

LAND= Land holding in hectares

AVEBEH= Averting behavior (0, 1)

3.6: Sample size and Respondents

The objective of this study collected the pesticides information from pesticides applicators through a selected sample. The sample population is selected randomly from 9 union councils of the district Ziarat. The observation unit of this study was pesticides applicators/farm workers. Pesticides applicators are those who are/were directly involved in pesticides spray practices. They are having special skills for such sorts of work the data was collected from apple Orchards.

Data collection was made through survey structured questionnaire (Appendix-1). Data was of both quantitative and qualitative nature. Only those applicators were included who at least did spray in apple orchard three times in a week during the season. As the total population for farmers engaged in Apple farming are not known therefore sample size selected for this study is 200.

There are second group which will consists only those labors who are/were not involved in the pesticides spray. But worker work in the same field for agricultural activities. The data set collected for this group was 200.

CHAPTER 4: RESULTS AND DISCUSSION

4.1: Introduction:

This section is divided into following two sub sections. Section one the factors considered for the description the Dose Response Model (DRM); discussing the probability of getting sick. While, Section two is about the health cost model and factors involved in it. Detailed explanation is provided for both sections.

4.2: SECTION 1: Analysis of the Probability of Sickness

4.2.1: Regression analysis

DRM is used to show the effects of independent variables on sickness that occurred due to pesticides use. Probit Model is used for estimation because the dependent variable is binary in nature (Sick=1, Not sick=0). Results confirmed the expected signs of the variables. According to result the Doses of D-red, D-yellow and D-blue category pesticides, Tea, Body of Mass Index and Area in acres appeared with significant influence on dependent variable. The rest of variables though confirmed the expected signs but remained statistically insignificant as shown in Table 4.1. For regression results the analysis of the data is made by using Stata SE 12 software.

Table 4.1: Regression results

	Sickness after spray	(dy/dx) Marginal Effects	Standard Errors	P>z
Code of the pesticides	**D-Red**	**.5525932*** **	**.08629**	**0.000**
	D-Yellow	**.6153601*** **	**.08405**	**0.000**
	D-Blue	**.2425226*** **	**.06654**	**0.000**
	Age	-.0016779	.00278	0.547
Education of the applicators	Primary	.0179273	.05773	0.756
	Matric	-.0353016	.06587	0.592
Personal habits during the spray	**Tea**	**.2579224** **	**.07876**	**0.001**
	Smoke .	.0402295	.06289	0.522
	Exposure	.000116	.00038	0.761
	Area in acre	**.0527415** **	**.02657**	**0.047**
	Protection gear	-.007236	.06187	0.907
	BMI	**-.0122168** **	**.00533**	**0.022**

*** = 1% level of significance

** = 5% level of significance

Prob > Chi^2	0.0000
Log likelihood	-38.9189
LR Chi^2 (12)	163.02
Pseudo R^2	0.6768

The data showed in Table 4.1 the percentage change in independent variables due to one unit change in independent variable. The regression result shows if the dose of D-Red chemicals was

used instead of D-Green the probability of sickness increased to 55%. The D-Red is the most toxic chemical which has great impacts on health. At the same way, the D-Yellow has also worsened impacts on health. If the D-Yellow was applied instead of D-Green it resulted 62% increased in the probability of sickness. In addition to it, the D-Blue has relatively less impact on independent variable as compared to D-Red and D-Yellow. It caused 24% increased in the probability of sickness. All three variable D-Red, D-Yellow and D-Blue have shown positive and significant relationship with the dependent variable i.e. sickness.

The probability of sickness was also sensitive to personal characteristics of the applicators. Personal habits such are taking tea and smoking during the application of spray. Both smoking and tea has shown positive sign as expected. However, smoking was statistically insignificant while tea had significant by positive impacts on illness. Taking tea during spray increased the probability of sickness 25%. The study also showed that the firm area had influenced the probability of sickness. If the area in acre increased by 1 unit it resulted 5% increased in the probability of sickness. According to the regression results, area in hector show a positive and significant relationship with dependent variable i.e. sickness. The BMI had negative relation with probability of sickness as expected The BMI show a statistically significant and negative positive impact on sickness. However, the rest of variables had shown the expected sign but statically insignificant.

4.2.2: Descriptive analysis

Table 4.2 Descriptive statistics of the variables

Variable	Obs	Mean	Standard Errors	Min	Max
D-Red	73	.365	.4826383	0	1
D-Yellow	44	.22	.4152858	0	1
D-Blue	39	.195	.3971949	0	1
D-Green*	44			0	1
Age	200	34.53	9.2328	18	70
Primary	42	.21	.4083303	0	1
Matric	64	.32	.4676467	0	1
Illiterate**	94		0		1
Smoke	119	.595	.4921239	0	1
Tea	135	.675	.4695502	0	1
Exposures hour	200	231.32	72.84938	96	432
Area in acre	200	2.9675	1.098283	1	10
Protection gear	81	.405	.4921239	0	1
BMI	200	26.25	3.92	17.47	43.33

*D-Green bass category
** Illiterate base category

Three types of infestation i.e. harmful insects, apple cancer and dust were generally observed in the study area. The harmful insect was of most dangerous nature and frequently reported during

the survey. Apple cancer was new disease that emerged during the last three years. Dust was also old type of infestation, but it was observed to be of less hazardous nature. All the three types of infestation were treated with different chemicals to control them. D- Red and D-Yellow were used to control harmful insects and apple cancer. While, D-Blue and D-Green were used for controlling the dust disease. Where the D-Blue was used in extreme case and D-Green was used in normal situation.

The extremely toxic chemicals marked, D-Red was used by respondents as 73 sprayed events were reported in the study area. The frequency of relatively less toxic chemical, D-Yellow, were repeatedly used 44 times, in sprays events in season. The moderate chemicals are marked D-Blue that were recorded 39 times in the survey. While, the rest are D-Green considered safe chemicals report 44 times in the survey. The toxicity levels are not agreed upon among the spray worker and majority of the spray applicators considered the toxicity level less than actual level. A small numbers of spray workers read and were able to understand the label of bottle. They used greater quantity than recommended level in most cases that normally resulted in severe cases of diseases. Most of the respondents were not aware about the adverse impacts of pesticides. Farmer assumed more chemical can protect their crops in better way.

The average age of the respondents in sample area was 34 years. The minmum age of the applicators are 18 and maximum 70 year. During the field servey it was observed that average age of the agriculture workers were usually higher as compared to spray workers. It indicates that more risky job was handled by young workers. The young applicators were effected more after spray due to lack of experience as compared to old age workers.

The education of the respondents was divided into three categories, Illiterate, Primary and Metric level. The spray applicators studied up to Primary level were 42, while the applicators studied up to Metric class were 64 respectively. The remaining 94 respondents were having no formal education. According to regression results, Primary education shown positive sign, which was against the expectation. The applicators studied to Metric level confirmed negative sign to health impairment. The reason in contraditionary results can highlighted the fact that most of the respondents got pravite education, where as education standard of private institutions were very poor. They could not even read the instruction label of the pesticides. For this resoans, the education variable might have failed to indicate its effectiveness against getting sick.

Smoking and drinking tea were the two common habits of the spray applicators during the field spray. Those respondents who were taking tea during the farm spray were 135 and smokers were 119 respectively. During field spray, pesticides contaminants have more chances to get mixed with tea as compared to cigarette smoking.

The spray workers are working less than other agricultural workers. The average works of the spray worker were 7.7 hours daily which are shorter than the average work of others agriculture workers. The maximum and minimum working time of the spray worker was 10 hours and 5 hours per day. Although, exposure hours to pesticides shown positive signs to dependent variable but results were statistically insignificant for duration of exposure. Although this result is surprising but it might be indicating towards other factor like toxicity level, precautionary measures adopted, to have played more important role than exposure duration.

There were two factors that decided the amount of spray to be applied to the apple orchard i.e. area in hector and plant size, which depended on the age of farm. Apple orchards were with different plant size at age of 10 to 12 year, having larger tree size. The orchards at the age of 5 to

6 years had small tree size. The plant with more age required longer time to spray as compare to small size tree. The average size of orchard sprayed by spray applicators was 2.97 hectors per day. The maximum and minimum sizes sprayed were 10 and 1 hectors per day respectively.

Some of the respondents were using protective measures during application of spray. However, they did not utilize the suggested protective gears which include head cover, robber glow, face mask and proper boots due to three reasons. First, the cost of items which made the respondent reluctant to used proper protective gears, hence they opted for cheaper substitute. Second, the applicators faced some discomfort by using the proper protective gears during application of spray. Third, most of the respondents underestimated the hazardous impacts of pesticides. Therefore, no proper mechanism existed to ensure the use of protective gadgets. Yet, some respondents were using protective gadgets covering the body parts during the spray. Nevertheless, the adopted methods were unscientific and failed to provide the desired protection. The numbers of respondents using protection gear was 81 applicators in the study area.

The Body Mass Index value measures the general health status of the worker. The value reported within range 18.5 and 25 are desirable value. The value outside the recommended rang are undesirable. According to the regression results, the minimum value was 17.47 and maximum value was 43.33 where the average value was 26.25. The problem of obesity was found in the pesticides applicators. But the average value was closed to reported range.

4.3: SECTION 2: Analyses of cost of illness

4.3.1: Cost of illness

The potential health damage after spray consists of different acute symptoms. The skin, inching and eye irritation were the most frequent and common problems reported. These were considered minor ailments and managed by workers themselves. Home remedies were sorted for such types of situation and reportedly symptoms were relived within 5 to 6 hours. However the Allopathic treatments were used for more serious cases like breathing problem, dehydration, vomiting, diarrhea and stomach cramps etc. These types of diseases were considered more life threatening which remained for several hours (28 hours on average). Thus, formal medical advice was required for such cases. The costs associated with formal health treatment were high as compared to treatment by farmers themselves at home. The average direct consultant costs reported by the spray workers were Rs 1065 of the pesticides applicators per season. While indirect cost included the amounts they did not earned due to illness plus crop damage because of absence of proper monitoring therefore the average indirect cost were higher i.e. Rs 2532. The average cost of home remedies that incurred at home for health recovery in case of illness was Rs 222.35.

Table 4.3: Descriptive statistics of total cost caused from pesticides

Variable	Obs	Mean	Standard Error	Min	Max
Health cost	200	1.918345	1.556412	0	3.6902
Symptom last	200	28.395	31.47112	0	144
Total loss	200	2532	3229.387	0	15200
cost of home remedies	200	222.35	237.9392	0	1200

4.3.2: Wage structure of the pesticides applicators

For pesticides applicators the reason for accepting this risky type of work reason was wage structure. The pesticides worker received more wage than normal agriculture worker. The average wage of the spray workers were Rs 795 per day, on other hand agriculture labors received Rs 500 per day. The works taken by spray applicators are comparatively skilled work as compared to non-pesticides labors. The maximum and minimum wage of the pesticides applicators were 1000 and 500 per day respectively depending on their experience. The maximum and minimum wages of non-spray worker were 500 and 400 per day.

4.3.3: Regression analysis

In this section the cost of health impairment was regressed on explanatory variables to get the factor influencing cost of illness. Linear regression model was used with health cost (in logarithmic form) as dependent variable. The similar sets of variables as DRM are used. The independent variables such as d-red, d-yellow, d-blue, tea, land size and BMI have statistically significant influence on the dependent variable as well its coefficients come up with expected signs. The result of the independent variables like age, education, personal habit smoke, exposure and protective gears remained statistically insignificant. Nevertheless, exposure, education and protective gear coefficients confirmed the expected signs. The coefficients of age and smoke were against the expectation. For regression results the analysis of the data is made by using Stata SE 12 software. The regression results are presented in Table 4.4.

Table 4.4: Regression result of health cost

Health costln	dy/dx Marginal effects	Std. Err.	P>z
D-Red	**1.950219**	**.2828**	**0.000*** **
D-Yellow	**1.741871**	**.27545**	**0.000*** **
D-Blue	**.7589118**	**.21806**	**0.001*** **
Age	-.0058405	.00912	0.522
Primary	.0042348	.18919	0.982
Metric	-.0897269	.21586	0.678
Tea	**.7005289**	**.25813**	**0.007** **
Smoke	-.053313	.20609	0.796
Exposures	.0012505	.00125	0.317
Area in acre	**.1719451**	**.08707**	**0.048** **
Protection gear	-.2534363	.20276	0.211
BMI	**-.0299928**	**.01746**	**0.086***

*** = 1% level of significance

** = 5% level of significance

*= 10% level of significance

Prob > F	0.0000
Root MSE	.90297
F (12, 187)	33.69
R^2	0.6634

The data presented in the above table shows the percentage change in the dependent variable if there is a unit change in the independent variables. The regression result shows that if the dose of d-red chemicals was used instead of d-green the health cost increased by 195%. This variable has a great influence on health cost. In addition to it, the dose of d-yellow also has great impacts on

health cost. If the d-yellow was applied instead of d-green it resulted in 174% increase in health cost. However, the dose of d-blue has relatively less impact on dependent variable than d-red and d-yellow. Yet the use of d-blue caused 75% increase in health cost.

The health cost was also sensitive to personal characteristics of applicators. Personal habit such as taking tea during the application of spray caused 70% increase in health cost. BMI had a negative relation with the cost as expected because greater the value of BMI (up to an extent) healthier the person is. The study also showed that farm area had significant impact on the health cost. If the area in acre increased by 1 unit it resulted 17% increase in health cost. This result is according to expectation because as the farm area increases the applicators risk increases which is ultimately reflected in health cost.

CHAPTER 5: Conclusion and policy Recommendation

5.1: Conclusion

The total population of Ziarat District was reported as 32,000 (according to 1998 Census), only male workers are engaged in the spray and field work. The average exposure of the applicators to pesticides is 231.32 hours per season. The study showed that more exposure to pesticides have increased health impairment and cost. The estimated average health cost of the applicator was Rs 1064 per season. Where, the average estimated loss and health cost that occurred at home of the applicator reported as Rs 2532 and Rs 222 respectively. Mostly, these costs resulted from using highly toxic pesticides. The applicators were not aware about the scientific use of toxic chemicals as well as its consequences.

The exposure to toxic chemicals is common practice in the agriculture workers of the study area. Applicators select hazardous chemicals (d-red, d-yellow) and used that chemical more than recommended quantity. In handling the pesticides, the pesticides were mixed and sprayed in traditional way and no any scientific tools were used in the field. In averting behavior, the use of protective gears was completely inappropriate, while in many cases the protection gates were neglected. Thus, these kinds of behavior resulted in serious health issue. However, these precautionary measures were often neglected due to poverty and lack of awareness and education. This study discovered that the individual's probability of getting sick depend on toxicity and dose of the pesticides after spray. It also finds that health cost can be decreased by reducing the quantity of toxic chemicals or replaced by safe chemicals.

5.2: Policy Recommendation

1: Internalizing the external cost

When the external cost of pesticides use link with their sale prices it become less economical. Its use will be decreased up to some extent. The pesticides tax is the most effective tool in this regard. It will help to reduce the externalities of pesticides use. The tax should be charge according to the toxicity level. The revenue that generate from tax should be spent on monitoring cost and promote alternative activities. Two steps should be taken for minimizing the pesticides use. First, the pesticides that receiving subsidies like low taxation it should be remove. Second, the price elasticity of demand is inelastic tax should be increase where it affects the demand for pesticides. This could be possible by introducing pesticides tax politically.

2: International Policies:

The international policies, commissions and advisory bodies have significant role for crop protection and pesticide regulation. By the approval of international convention the government can get instruction to include that into national policies. The national policies most set two conditions for pursuing international policies. First, the international policies instruments most reduce pesticides use. Second, the roles of government to reduce the use of pesticide without effecting yield level. The government should arrange the policy instruments to maintain balance. The law should be made for proper regulation and registration on the use of pesticides. The harmful products should be banned of the certain crops in market.

3: Increase the demand for low pesticides product:

Media campaign can play a vital role to motivate consumers for safe products. The consumers can bring the attention of supplier's for safe crops practices. Through supply chain management

they can reduce safety risk and demand the product which pursues pesticide management policies. This could done through programs for awareness.

4: funds for labor welfare programs

There are public funds for agriculture sector in developing countries. The study showed that there are increasing trend in the health damage in these countries. A reduction in the health impairment can achieve through program awareness. The special funds should spend for awareness creation and provide protective tools to farm workers.

5.3 Future study:

The information founded in the study pesticides has worsened impacts on the health of applicators. To further elaborate this relationship for future studies need to perform in fallowing areas.

Comparative studied on environment cost:

Same types of studies should be done on environmental impacts and cost. To obtain more insight into relation between pesticides impacts on environment and its cost to the environment. For such studies it will important to know all the crops on which the pesticides are use.

Intervention studies:

To study the effects of pesticide on the health of farmers in apple production zone, the intervention studies should also be done others crops production and vegetable zone, where the pesticides spray are using.

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Pakistan Institute Development Economics Islamabad

Economic Evaluation of pesticides health cost and its impacts on farmer health

Survey questionnaire (2016)

Date of interview			**2016**
Questionnaire NO			
Province	**Balochistan**		
District	**Ziarat**		
Union Council			
Village			

Interviewer Name	
Supervisor Name	**Dr. Iftikhar Ahmad**

Survey Questionnaire:

This survey is being conducted as part of an M Phil degree at the Department of Environmental Economics at PIDE, Islamabad and is mainly concerned with the Economic Valuation of pesticides in your locality. The following questions are thus purely for academic purposes and mainly concerned with pesticides impact on health of farmer and also estimation of all direct and indirect health cost arising from pesticide use. Your input is highly valued and I will be grateful if you could please take few minutes out to express your views in this regard. This information and identity of respondent will be kept confidential. The information will only be used for this research and not for any other purpose. Your cooperation is highly appreciated

Personal information of the pesticides applicator:

1 How many years you are old?	in year				
2 what is your height?	in inch				
3 What is your weight?	Kg				
4 what is your education level?	Illiterate	Primary	Middle	secondary	Any other
5 Did you smoke any cigarettes during farm spray?	Y=1		NO=0		
5(i) if Y=1 then how many cigarettes do you smoke?	No				
6 Did you drink any tea during farm spray?	Y=1		NO=0		
7 What is your average wage rate per day?	Rs				
8 How many hour you are work in the day?	In hours				
9 How many days do you work in week?	In days				
10 How many months do you work in peak season of work?	In months				

Use of pesticides for apple crop:

1a. How much Area is Covered by apple orchard?	In acre		
2a.Which variety of the apples is producing in area?	*Tor-Kolu*	*Gaja-Kolu*	Any Other
3a. status of the sprayer worker?	self=1	Hired=2	
4a. What is the type of infestation?	*		

5a. What type of pesticide is used?	**		
6a. What is the amount toxicity level of pesticides?	1=Low	2=Medium	3=High
7a. What is the source do you used for purchasing of pesticides?	Private=1	Dealer=2	Others=3
8a. How much Quantity of pesticide you used to purchased?	In Liter		
9a. What is the cost of pesticide?	Rs		
10a. Who purchased the pesticide?	Applicators=1	Owner=2	Other=3

*

** 1-Dimecran, 2-Ekulex, 3-Metacid. 4-Nunuyacron, 5-Bayistim, 6-Himosam, 7-Other (Specify)

Spray Detail:

1b.What is the source of sprayer?	Hired=1	Self=2	
2b.If the source of sprayer is hired, what is the charge for episode of pesticides spray?	Rs		
3b.How much time sprayer spends for preparing the pesticide?	Hrs		
4b. How much water does you used for per liter of the pesticides?	In Liter		
5b.What is the source of water used for pesticide?			
6b.What is the method of mixing pesticide?	Mixed in sprayed container and pour into the sprayer	Mixed by the sprayer himself with hand	
7b.Is there any one, who assists you in spray?	Y=1	N=0	
8b. If Y=1 then what is the type of assistance?	For mixing only=1	For spraying=2	For both=3
9b. What is the duration of spray?	Hrs		
10b. How much wage the assistant received for pesticide spray?	Rs		

Mitigation behavior:

1c. Did you use any protection gear?	Y=1	N=0
2c. If Y=1 what type of protection gear you used during the spray?	*	
3c. What is the source of protection gear	Free=1	Purchased=2

4c. If source of purchase=2, then what is the total cost of purchase?	Rs

* 0=nothing, 1=leg care: boots/shoes/other, 2=head cover: hat, helmet, other, 3=eye-care: glasses, others, 4=body cover: full sleeved shirt, mask, others 5=hand care: glove, other, 6=face care: mask, other, 7=leg care: full length trousers, other, 8=others (specify)

Health Effect and Health cost:

1d. Did you feel any discomfort in past in ordinary life?	Y=1		NO=2	
2d. If Y=1 than what is the types of discomfort?				
3d. Is this type of discomfort is hereditary one?	Y=1		NO=2	
4d. Did you feel any discomfort after your spraying?	Y=1		N=2	
5d. If Y=1 then what are the types of discomfort?	*			
6d. How long did symptoms last?	In Hrs			
7d. Did you adopt any treatment for that?	Y=1		NO=2	
8d. If Y=1 what type of medicine you is use?	Allopathic	Ayurvedic	Unani	Home Remedies
9d. Is the treatment taken place in hospital?	Y=1	NO=2		
10d. If Y=1 then how many days you spent in hospital?	In days			
11d. What was the fee of doctor?	In Rs			
12d. How much you spent on medicine?	In Rs			
13d. How much you spent on lab test?	In Rs			
14d. How much amount you pay for hospital registration?	In Rs			

*. 1 Eye irritation, 2 Nausea, 3 Giddiness, 4 shortness of breath, 5 Fever, Dehydration, 7 vomiting, 8 cramps, 9 itching, 10 convulsion, 11burnt feel, 12 skin irritation, 13 diarrhea, 14 Excessive salivation, 15 Blurred vision, 16 Tremor, 17 others

Health cost:

1e. How much amount did you pay for traveling costs to attain health facilities?	In Rs	
2e. What are other related dietary expenses?	In Rs	
3e. In case of illness, how much amount did you loss of that you earned during working days?	In Rs	

4e. Did you Substitute any family member in case illness?	Y=1	NO=0	
4e.(i) if Y=1 then how much time he spent?	In hours		
5e. How much income loss by family member due work in spray field?	In Rs		
6e. How much crop damage due to lack of supervision?	In Rs		
7e. What is the total loss due your illness?	Estimated loss	Any other loss	

Health cost in case of home remedies:

1f. What items do you used for health recovery at home?		
2f. What fuels do you used for cooking?		
3f. What is the market price of goods that you used at home for health recovery?	In Rs	
4f. How much time you spent for preparing home materials?	Hrs	
5f. What is the total cost of homemade materials?	In Rs	
6f. What is the fee of desi doctor from you, if any?	In Rs	

Second part of the questionnaire:

This part of the questionnaire will be use to collect information regarding the agriculture labor, who work in same field. But agriculture labor does not involve in the pesticides spray.
Name of the respondent

Employment detail:

1 Which type work you have practicing in the farm?		
2 What is the total duration of work?	In hours	
3 What is the average wage rate per month?		
4 When do you start work in farm after the spray?	In hours	
	In days	

Health Effect and Health cost:

1a.Did you feel any types of discomfort in ordinary life?	Y=1		NO=2	
2a.If Y=1 than what are the types of discomfort?				
3a.Is this types of discomfort hereditary one?	Y=1		NO=2	
4a. Did you feel any discomfort after spraying?	Y=1		N=2	
5a. If Y=1 then what are the types of discomfort?	*			
6a. How long did symptoms last?	In Hrs			
7a. Did you adopt any treatment for that?	Y=1		NO=0	
8a. If Y=1 what type of medicine you is use?	Allopathic	Ayurvedic	Unani	Home Remedies
9a. Is the treatment taken place in hospital?	Y=1	NO=2		
10a. If Y=1 then how many days you spent in hospital?	In days			
11a. What was the fee of doctor?	In Rs			
12a. How much you spent on medicine?	In Rs			
13a. How much you spent on lab test?	In Rs			
14a. How much amount you pay for the hospital registration?	In Rs			

*. 1 Eye irritation, 2 Nausea, 3 Giddiness, 4 shortness of breath, 5 Fever, Dehydration, 7 vomiting, 8 cramps, 9 itching, 10 convulsion, 11burnt feel, 12 skin irritation, 13 diarrhea, 14 Excessive salivation, 15 Blurred vision, 16 Tremor, 17 others

Health cost:

1b. How much amount you pay for traveling costs to attain health facilities?	In Rs	
2b. What are other related dietary expenses?	In Rs	
3b. In case of illness, how much time you loss of the working days?	In Rs	
4b. Did you substitute any family member in case illness?	Y=1	NO=0
4b (i) Y=1 how much he spent?	In hour	
5b. How much income loss by family member due work in spray field?	In Rs	
6b. How much crop damage due to lack of supervision?	In Rs	
7b. What is the total loss due your illness?	Estimated loss	Any other loss

Health cost in case of home remedies:

1c. What items do you used for health recovery at home?		
2c. What fuel do you used for cooking?		
3c. What is the market price of goods that you used at home for health recovery?	In Rs	
4c. How much time you spent for preparing home materials?	Hrs	
5c. What is the total cost of homemade materials?	In Rs	
6c. What is the fee of desi doctor from you, if any?	In Rs	