Health Effects of Pesticide among Vegetable Farmers and the Adaptation Level of Integrated Pest Management Program in Nepal, 2014

Government of Nepal

Nepal Health Research Council

Health Effects of Pesticide among Vegetable Farmers and the Adaptation Level of Integrated Pest Management Program in Nepal, 2014

August 2016

Prepared by

Government of Nepal

Nepal Health Research Council

Ramshah Path, Kathmandu, Nepal

Health Effects of Pesticide among Vegetable Farmers and the Adaptation Level of Integrated Pest Management Program in Nepal, 2014

Authors

Krishna Kumar Aryal, Sushhama Neupane, Guna Raj Lohani, Erik Jors, Dinesh Neupane, Puspa Raj Khanal, Bijay Kumar Jha, Meghnath Dhimal, Baivab Man Shrestha, Bihungum Bista, Anil Poudyal, Khem Bahadur Karki

Recommended Citation

Aryal KK, Neupane S, Lohani GR, Jors E, Neupane D, Khanal PR,Jha BK, Dhimal M, Shrestha BM, Bista B, Poudyal A, Karki KB. Health Effects of Pesticide among Vegetable Farmers and the Adaptation Level of Integrated Pest Management Program in Nepal, 2014. Kathmandu, Nepal: Nepal Health Research Council, 2016.

Cover photo source Google Image

Acknowledgement

I would like to express my sincere thanks to all the team members of this study. I would like to sincerely acknowledge the role of Dr. Guna Raj Lohani, the then Executive Chief of the Nepal Health Research Council (NHRC) for his role in implementing this study. I am indebted to Ms.Sushhama Neupane, Research Officer and Project Coordinator of this study and Dr. Krishna Kumar Aryal, Research Officer for their valuable and remarkable contribution from beginning to end of this study. I acknowledge the contribution of Mr. Puspa Raj Khanal on the execution of the study and finalization of the report. Similarly, I would like to acknowledge the contribution of Dr. Erik Jors, from Occupational Health and Safety Clinic, Odense University Hospital, Denmark and Mr. Dinesh Neupane, Center for Global Health, Aarhus University, Denmark for their contribution in the study since the conception till finalization of the report. My immense thanks go to Dr. Krishna Adhikary, Chairman of NHRC for his contribution in this study. I also would like to thank Dr. Meghnath Dhimal, Senior Research Officer, Mr. Bihungum Bista and Mr. Anil Poudyal, Research Associates of NHRC for their contribution in the study. I would like to acknowledge Research Supervisors Mr. Baivab Man Shrestha and Mr. Anurag Singh Ghimire as well as other enumerators for smooth data collection and support in data editing and report writing process.

I am also thankful to Mr. Bijay Kumar Jha, Training Officer cum Field Coordinator for his contribution in the study. Similarly, I would like to acknowledge Mr. Nirbhay Kumar Sharma, Deputy Chief Admin Officer, Mr. Subodh Kumar Karna, Deputy Chief Finance Controller, and all the staffs of NHRC who helped us at different administrative and technical aspect to complete this study on time.

I would like to pay my gratitude to Government of Nepal for its financial support for this study. Last but not least, I would like to deliver my genuine admiration to all the participants of the study and to all the seen and unseen people who have contributed a lot to complete this study successfully and prepare this report on time.

Dr. Khem Bahadur Karki
Member Secretary (Executive Chief)
Nepal Health Research Council

Acronyms

AChE	Acetylcholinesterase
BMI	Body Mass Index
DADO	District Agriculture Development Office
DM	Diabetes Mellitus
FGD	Focus Group Discussion
Hb	Hemoglobin
IPM	Integrated Pest Management
JTA	Junior Technical Assistant
NHRC	Nepal Health Research Council
PPEs	Personal Protective Equipments
PPS	Probability Proportionate to Size
RBC	Red Blood Cell
SPSS	Statistical Package for Social Science
SSU	Secondary Sampling Unit
USA	United States of America
WHO	World Health Organization

Table of contents

List of table

Executive summary

Introduction

Exposure to pesticides has been growing as a major public health challenge in developing countries. Overuse and misuse of pesticides have several acute and chronic adverse health consequences. Government of Nepal has implemented Integrated Pest Management (IPM) program to minimize the use of pesticides over the country, however farmers misuse and overuse pesticides in an agriculture sector. Organophosphate insecticide is commonly used pesticide in Nepal which inhibits the neurotransmitter acetyl cholinesterase and affects the central and peripheral nervous system. Organophosphate and organochlorine affect the endocrine system which can lead to diabetes mellitus. Apart from the limited information available on pesticide exposure from small scale studies, there do not exist large scale population level studies. Also, limited information exists on health hazards of pesticides. This study was designed to assess pesticide exposure level and its health effects and further to assess the adaptation process of Integrated Pest Management in Nepal.

Materials & methods

A cross-sectional study was conducted during July 2013 to June 2014, with data collection spread from January 2014 to April 2014. Prior to data collection, ethical approval was sought from the independent Ethical Review Board of the Nepal Health Research Council. A sample size of 660 was calculated. Mix method (Qualitative and Quantitative) was used to collect data and two stage cluster sampling was applied using a mix of probability proportionate to size (PPS) and a simple random sampling using the sampling frame from the *Annual Progress Report of Potato, Vegetable and Masala Development Program 2011* to select the participants. Primary sampling unit of this study was vegetable program. There were a total of 168 vegetable programs running across 75 districts of Nepal. Out of the total 168 vegetable programs, 15 vegetable programs were selected using PPS sampling method. A vegetable program covers two to ten vegetable pockets. Vegetable pocket was considered as a secondary sampling unit (SSU) in this study. Two vegetable pockets were selected with simple random sampling. Eligible farmers working in selected vegetable pockets listed in alphabetical order and 22 farmers were selected from one vegetable pocket using simple random sampling.

Individual face to face interview was conducted using structured questionnaire. Physical and biological measurement was done to assess the health effect of pesticide among vegetable farmers of Nepal. Focus Group Discussion (FGD) was done among IPM trained farmers and structured questionnaires were applied with two key personnel of the District Health Office to assess the adaptation level of IPM based on Diffusion Theory of Innovation. The questionnaires covered information on demographic, pesticide practice, handling procedure and pesticide knowledge of participants. Physical measurements included height and weight, which was

measured by validated equipments. Biochemical measurements included blood glucose and AChE levels by dry method and ellmen method respectively. Quantitative data were analysed using the SPSS version 16.0. Qualitative data were analyzed using content analysis.

Results

Around two-fifths (38.4%) of participants were engaged in commercial farms for more than ten years. Less than one fourth of participants had not attended IPM training. Fungicide and insecticides were common pesticides used by vegetable farmers in Nepal. Nearly 60% of the participants used fungicides, 42.5% used organophosphate, and 27% used pyrethriod. Potato, tomatoes, cauliflowers, cabbage, beans, tomato, ladyfinger, bitter gourd, pumpkin, cucumber and bottle gourd are the top main cash crops in Nepal. The frequency of applying pesticides in these crops was about five applications per cropping season.

Around 97% participants had good knowledge regarding adverse health effects of the pesticides, however 12% did not use any types of Personal Protective Equipments (PPEs), on an average, farmers used two PPEs (non chemical resistant) while spraying the pesticides. Around 53% farmers did not follow the instruction written on the label and sprayed based on their previous experience. Two of the three participants knew about basic principle of IPM however, only one-fourth participants followed its principle and procedure during cultivation of crops. Around 83% participants keep pesticide in the general store where a child can easily reach. Nearly half of the participants throw the pesticide containers anywhere. Around 13% participants used to leak spray during application of pesticides. Half of the participants complained about the acute toxicity syndrome after spraying the pesticides. About 80% of them took rest after appearing such syndromes; very few participants (9%) went to the hospital or health center for treatment. The prevalence of self reported chronic disease was 10% and among them majority reported chronic neuropathic problem. Prevalence of diabetes, including those on medication was 4.5% among vegetable farmers of Nepal. Prevalence of low AChE level was 10.3%. The prevalence of anemia was 53.3% among female participants and 43.9% among male participants. No significant association was found between feeling of illness in the last month and use of PPEs with age category, history of engagement in agriculture, using IPM and sex. However, in multiple linear regression, age and sex was significantly associated with Acetyl cholinesterase. The perception among farmers and official personnel regarding IPM was satisfactory. In the reference of the Theory of Diffusion on Innovation, an adaptation process of IPM was found slow in Nepal.

Conclusion

The study demonstrates that the application of pesticide was observed to be widely applied in agricultural sectors of Nepal. Vegetable farmers had considerable knowledge regarding health impacts of pesticide. However, they did not adopt the safety precaution resulting higher risk of exposure with pesticide intoxication. Organophosphate exposures were not sufficiently observed in depressed AChE in Nepal. The prevalence of diabetes was also found high. Large numbers of farmers cultivated crops with traditional technique rather than Integrated Pest Management technique. Perception among farmers and official personnel regarding Integrated Pest Management was moderate. In the reference of the theory of diffusion on innovation, an adaptation process of Integrated Pest Management was found slow in Nepal. There is an urgent need to develop the proper mechanism to monitor the pesticide level in vegetables to reduce the health impact of pesticide among farmers and consumers.

Chapter 1
Introduction

1.1 Background

Nepal is an agricultural country(1). Agriculture continues to be the mainstay of the economy, providing livelihoods for over 75% of the population and generating around one-third (35%) of Gross Domestic Product (GDP)(1-4). The country is still struggling to be self sufficient in food supply to dense population due to loss of crops by pest attacks in the field and storage (5, 6). The hazards of pesticide are well documented, however use of pesticides can prevent or reduce agricultural losses to pests and so improve yield, as well as improving the quality of the produce in terms of cosmetic appeal, if pesticides are not used in agriculture, around 25% crops will be lost(6-9). Pesticides in the agricultural sector were introduced in Nepal in 1952 to protect plants from agricultural pests and improve the productivity of agriculture. Different brands of insecticides, fungicides and herbicides have been used in Nepal for growth and protection of crops, vegetables and fruits. Among those insecticide is commonly used in Nepal. Around 56% insecticide was imported in fiscal year 2011/12. Most common insecticides in Nepal are Organochlorine (chemical group: endosulfan), organophosphate (Dichlorovos, Malathion, Dimethoate, chloropyrifos), synthetic pyrethroids (cypermethrin) and carbamates (carbofuran) (10).In Nepal, pesticide imported and formulated in 1997/1998, was about 50 thousands kg which has soared to about 350 thousands kg in 2011/2012 which is more than 6 folds increase which shows the increasing dependency of vegetable growers upon the pesticide for increase in agriculter productivity (11).

The trend of pesticide use is increasing in Nepal by about 10-20% per year(12). Studies have shown that more than 90% of the total pesticides are used in vegetable farming(9). A study showed that chemical pesticides are used by 25% of Terai households, 9% of mid Hill households and 7% of Mountain households(13). In certain mid hill pockets close to urban markets, the pesticide use is considerably higher. In Nepal, organochlorine was more popular in the past and organophosphate at present.

Pesticides are designed to kill pest, but some pesticides can also cause health effects in people and damage ecosystem.Pesticide residues absorbed by inhalation, ingestion, and dermal contact can lead to acute and chronic toxicity(14). Such kinds of the toxicity depend on types of pesticides, port of entry, dose, metabolism, accumulation and so on. Acute toxicity is due to short-term exposure and happens within a relatively short period of time, whereas chronic toxicity is due to repeated or long-term exposure and happens over a longer period. Mainly it interrupts the metabolic and systemic functions of the human body. The chemical compound of pesticide disrupts the neurological function. It is injurious to the immune and endocrine systems as well (15-18). Wide use of these pesticides can cause both acute and chronic adverse health effects in human. Studies in the past have revealed the association of organochlorine and organophosphate with diabetes mellitus (19). Organophosphate inhibits the neurotransmitter acetyl cholinesterase and can affect the central and autonomic nervous system. Few leading symptoms related to the autonomic nervous system are abdominal cramps; nausea, diarrhea, salivation, miosis and symptoms related to the central nervous system are dizziness, tremor, anxiety, and confusion. Symptoms usually occur within hours of exposure and typically disappear within days or weeks as new cholinesterase is synthesized.

Nepal has different legal provisions related to use of pesticides. Pesticide Act and Rule 1991 and 1994 regulate the import, manufacture, sales, distribution and use of pesticides within the country with a view to prevent risks on human health, animals and foe matters connected herewith. Nepal ratified the Stockholm Convention, Basel Convention and Rotterdam Conventions to minimize environmental pollution and to manage agrochemicals, including pesticides. At present, Government of Nepal (GoN) has banned 14 chemicals (Chlorden, D.D.T, Dieldrin, Endrin, Aldrin, Heptachlor, Mirex, Toxaphen, B.H.C., Lindane, Phosphamidon, Organo-mercury fungicide, Methyl parathion, Monocrotophos) due to their toxicity, persistence, tendencies of accumulation and biomagnifications and long term serious threats to human and environment(20). GoN, Ministry of Agriculture and Co-operatives has also adopted Integrated Pest Management (IPM) approach since 1997 to support reduction of poverty, ensure food security and environment protection in a sustainable way (6). IPM field school has been conducting in 63 districts out of 75 to minimize the use of the pesticide and to protect the human health hazards and environment. Department of Food Technology and Quality Control monitors pesticide residues regularly in food products (21).

The GoN has taken several initiations to reduce health hazard and environment impact caused by the use of pesticides. However, various studies have revealed that farmers are misusing the pesticide and are not properly following the procedure during application(22, 23). Many of them handle it without using the Personal Protective Equipments (PPEs) and dispose waste materials in an improper way (24).

1.2 Rationale

There has been use of various types of pesticide products in the agricultural sector of Nepal since 1952. Pesticides will cause severe health hazards if not used properly. GoN has endorsed legal provisions in order to reduce an impact of pesticides on human health. Ministry of Agriculture has conducted the IPM training courses for farmers for reducing the pesticide risk to human health and environment. IPM embodies a combination of many environmental friendly techniques of managing the crops and the pests that help reduce crop losses due to pest and diseases and lead to sustainable agriculture. This approach has been given a top priority and emphasized equally. However, many studies have shown that farmers are misusing pesticides and are not properly following the procedure while mixing, spraying the pesticides in their farm. Various national and international studies showed that there is high incidence of the acute toxicity syndrome and chronic diseases among exposed groups compared to the general population. In Nepal, organophosphates are widely used in the agricultural sectors. Most of the farmers mix and spray these chemicals without wearing PPEs so there are a number of chances to see biomarkers (reduced Acetyl Cholinesterase level, AChE) of organophosphate and carbamate in human blood. As one of the first steps to detect the impacts of pesticides on human health, measuring AChE levels in human blood serum has been done only in very few studies and these studies have only been confined to small areas or population.

This study was carried out by the Nepal Health Research Council (NHRC) in the fiscal year 2070/71 in order to assess the impact of pesticide use on human health. This study aims to measure the health impact of the pesticides specifically by measuring the AChE level in the human blood samples. Along with this, we also aimed to find out the level of blood sugar among pesticide exposed vegetable farmers in Nepal. This study also measured the perceived effectiveness of IPM programs in Nepal through a qualitative approach. The finding of this study is thus expected to support, especially the Ministry of Health and Population and Ministry of Agriculture Development, to develop program and policy for the reduction of effects of pesticide use among agricultural pesticide users.

1.3 Objectives of the study

1.3.1 General objective

- To assess the health effects of pesticide among pesticides exposed farmers in Nepal

1.3.2 Specific objectives

- To measure the AChE level among pesticide exposed farmers
- To determine the prevalence of diabetes among pesticide exposed farmers
- To assess the self reported acute toxicity syndrome among farmers
- To assess knowledge and practice on pesticide and its use among the farmers
- To evaluate the IPM innovation based on the Theory of 'Diffusion of Innovation'

Chapter 2
Methodology

2.1 Study design
A cross sectional study design was used. A mix method (Qualitative and Quantitative) technique was used to assess the health effects of pesticide among vegetable farmers and find the adaptation level of IPM programs in Nepal.

2.2 Study area
The study was conducted in four selected districts of Nepal namely Kavrepalanchowk, Nawalparasi, Ilam and Rasuwa.

2.3 Study population
Farmers exposed to pesticides and resident of the study districts were the study population .

2.4 Study duration
The study duration was between July 2013 to June 2014. Data were collected from January 2014 to April 2014.

2.5 Sample size calculation
The sample size was calculated to represent the entire target population of Nepal. In order to achieve this statistical inference, the sample size calculator which is developed by WHO *(sample_size_calculator STEPS)* was used to derive a sample size of 634. The sample size of the present study was calculated using the prevalence of AChE level among farmers (12%)(25, 26).

Anticipated Prevalence of AChE (P) = 12%

Allowable error assuming absolute precision (d) = 4%

Design effect (deff) = 2

Non response (nr) =20%

Sample size (n)=(z^2 1-alpha/2 * p(100-q)/d^2 *deff* (1+nr)

= (4*12*88/4*4)*2*1.20

=634

A total of 660 samples was taken from vegetable farmers of Nepal.

2.6 Sampling technique

Probability Proportionate to Size (PPS) technique was applied in the sampling strategy to improve accuracy in the study estimates. Two stage cluster sampling was followed using a mix of PPS and a Simple Random Sampling using the sampling frame from the Annual Progress Report of Potato, Vegetable and Masala Development Program 2011 to select the participants. Primary sampling unit of this study was vegetable program. Around 168 vegetable programs were running across 75 districts of Nepal. Fifteen vegetable programs were selected using PPS sampling method. One vegetable program covered two to ten vegetable pockets. Vegetable pocket was considered as a Secondary Sampling Unit (SSU) in this study. Two vegetable pockets were selected using simple random sampling. Eligible farmers working with selected vegetable pockets were listed in alphabetical order and 22 farmers were selected from a vegetable pocket using systematic random sampling.

2.7 Study instruments (data collection tools)

Study was conducted using semi-structured questionnaires, physical and biological measurement to assess the health effect of pesticide among the vegetable farmers of Nepal. Focus Group Discussion (FGD) was done among IPM trained farmers and structured questionnaires were applied with two key personnel of the District Health Office (DHO) to assess the adaptation level of IPM in the reference to Diffusion Theory of Innovation.

2.7.1 Questionnaire

Questionnaire covered information on socio-demography, pesticide practice, handling procedure and pesticide knowledge of participants. Demographic information included age, sex, education and ethnicity. Pesticide practice included number of working hours in the field with pesticides, number of working days with pesticide per months, number of years of pesticide use, name of the most common pesticide used, pesticide preparation places, disposal of the empty pesticide containers and self reported toxicity syndromes associated with pesticide use. Likewise, some questions explored practice related to correct procedures adopted by vegetable farmers such as wearing protective clothes, reading and following label instruments, not eating or drinking or smoking during the use of pesticides, washing hands after pesticide use and washing contaminated clothes separately. In addition, it also included questions related to the knowledge on health impact of pesticides.

2.7.2 Physical measurement

Height and weight were measured and body mass index (BMI) was calculated. Height was measured with a portable standard stature scale. For the height measurement, participants were

asked to remove footwear (shoes, slippers, sandals) and any hat or hair ties. Participants stood on a flat surface facing the interviewer with their feet together and heels against the backboard with knees straight. They were asked to look straight ahead and not tilt their head up, making sure that their eyes were at the same level as their ears. Height was read in centimeter.
Weight was measured with a portable digital weighing scale (Seca, Germany). The instrument was placed on a firm, flat surface. Participants were requested to remove their footwear and socks, wear light clothes, stand on the scale with one foot on each side of the scale, face forward, place arms on the side and wait until asked to step off. Weight was recorded in kilogram.

2.7.3 Biological Measurement

Blood sugar, Acetylcholinesterase Level (AChE), and Haemoglobin (Hb %) was measured among participants.Participants were instructed to fast overnight for 8 hours and diabetic patients on medication were reminded to bring their medicine/insulin with them and take their medicine after providing the blood sample. Fasting whole blood glucose concentration was measured by the dry method. Capillary blood sample (a drop) from the tip of index finger was taken using a lancet with aseptic technique in 8 hours fasting state and blood sugar level measured by WHO recommended HemoCue 201 DM. The diagnosis of Diabetes Mellitus (DM) was defined by fasting blood glucose concentration ≥6.1 mmol/L (≥110 mg/dl)(27).

A venous blood sample (1 ml of blood) was taken using a flashback needle with an aseptic technique and kept in plain tubes. Those samples were stored under the temperature of 8-30 degree centigrade. AChE level, Hb% and haemoglobin adjusted AChE (Q) was measured in the study site by using the Test-mate ChE photometric analyzer model 400 (USA). AChE assay kit model 460 (USA) was used in the device to determine the cholinesterase in RBC to monitor the pesticide exposure by following WHO recommended Ellmen method. AChE level was measured in U/ml, Q in U/g and haemoglobin in g/dL.

Questionnaires for Key personnel of District Agricultural Development Office (DADO)

Question based on the theory of 'Diffusion of Innovation' was asked to key informant of DADO to assess the adaptation level of IPM program.
Question covered the following areas of innovation -IPM

- **Relative advantage** – It included economic advantage, social prestige, convenience or satisfaction. The greater the perceived relative advantage of an innovation more rapid the adaptation in community.
- **Compatibility** – If innovation is compatible with existing values, norms and practices, it will be adopted rapidly and more practical .
- **Complexity** – If innovation is simple, not too technical to understand and use, it will be adopted rapidly.

- **Triability** – If innovation is easy and not too costly in time and money to try out, it will be adopted fast.
- **Observability** – If innovation has immediate positive and visible effects, it is adopted rapidly.
- **Reinvention** – If innovation has improvements possible and allowed with this new method - are users becoming partners and reinventing/adapting this new method, which will be adopted rapidly.
- **Peer-peer conversations and peer networks –**It is a key to change. If it is able to establish good relations with peers and key persons who can promote the innovation, it will be adopted fast.
- **Communication** – Message of a new idea/an innovation involves active creation and sharing of information among people to reach mutual understanding then innovation will be adopted easily in the community.

2.7.4 Focus group Discussion

FGD was conducted in different four study sites based on the theory of diffusion of innovation to assess the perception of vegetable farmers towards new innovation-IPM program. Two FGDs were conducted in two Hilly districts (Kavrepalanchowk and Ilam) one in Terai districts (Nawalparasi) and one in Mountain district (Rasuwa). FGD guideline was prepared incorporating the following themes 1) pesticide use in vegetable farm 2) Farmers' perception regarding IPM program and 3) Farmers' achievement from IPM program 4) comparing IPM with existing technique. Focus group discussion was performed by research team who were trained in FGD techniques. FGD was performed for 45 minutes at convenient, private and quiet place such as a primary health care unit and the community leader's office. Total participant for a FGD were 10-12 vegetable farmers, comprising an equal number of male and female. All participated farmers had joined the IPM school.

Moderator and note taker conducted the Focus Group Discussion. Moderator played key role to lead the FGD. She/he started the session by welcoming the participants, giving an overview of topic and ground rules of discussion.She/he allowed to each person to respond prior tasking the predetermined questions. She/he gave clues to recall specific features or details if necessary**.** At the end of session, she/he asked participants to offer their opinions and reflect on the discussion**.** Note taker ensured that all the informationwere captured. She/he was responsible for recording information using a tape recorder and/or written notes.

2.8 Data collection procedure

2.8.1 Training for data collection team

Prior to data collection, two days training was organised in NHRC. Training by the local investigator team was focused on providing details of interview techniques and questionnaire, sampling process, selecting individuals, handling of different kinds of templates and forms, proper way of measuring height and weight, and proper handling of laboratory equipments.

2.8.2 Data collection technique

Data were collected by the trained data collectors. Prior to data collection, supervisor developed a sampling frame for the SSU (vegetable pocket) by obtaining an updated list of vegetable farmers and selected the participants using systematic random sampling. Selected participants were followed up at least twice in case of unavailability of the respondent on the first visit. Participants who could not be contacted even after the second attempt was counted as a non-response.

Data collection was spread over three phases, namely, initial contact with the participant, completing the questionnaire and taking physical measurements, and collecting blood samples for biological measurement. The well-informed participants about the purpose of study,were requested to provide 30 minutes of their time for completion of questionnaires and physical measurement and an additional 5 minutes for collecting the blood sample after obtaining consent from them.

Data collection on a selected participant was completed in 2-3 days. On the first day, all eligible vegetable farmers were listed out to create a sampling frame and 22 participants were selected through systematic random sampling method. If a selected participant was available on the first visit, she/he was requested to participate in this study and asked for consent. Once the consent was obtained, the questionnaire and physical measurement were completed. If she/he was not at home, a second visit was done to complete questionnaire and physical measurement. After completing the questionnaire and physical measurement a clinic card was provided to every participant for biological measurement with fasting instruction. This card contained the appointment date, time and place for blood sample collection. On next day as mentioned on clinical card, the laboratory technician/enumerators drew blood samples from the participants and biological measurement was done in the field setting. After completing the biological measurement, participants were given a feedback form. This form included information on their height, weight, haemoglobin , AChE and blood sugar level.

2.9 Field management

The field team for data collection comprised 6 individuals that consisted of one field supervisor, one laboratory technician and four enumerators. Enumerators had an academic background either in nursing, general medicine or public health. Their major responsibility was to interview participants and fill out the questionnaires, carry out physical measurements and collect blood samples. The laboratory technicians measured the glucose and haemoglobin level and the value of AChE as well as the recorded and reported of biological measurements. The field supervisor led the team and was responsiblefor overall field management and to coordinate with respective authorities at the field level, ensure completion of sampling frames, and select 22 vegetable farmers from each vegetable pocket as per the sample design. Furthermore, field supervisors also carried out on-the-spot checks of information collected by enumerators to ensure the quality of data. The field supervisors were also responsible for data entry of completed questionnaires.

2.10 Quality control

Semi structured questionnaire was developed referring other study reports and articles. English version of the instrument was translated into Nepali and back translated to English. Before finalization of Nepali version of the tools, pre-testing was done in Kavrepalanchok district with 10 people from a wide range of socio-demographic backgrounds. At the end of data collection, participants' feedback was obtained and all the comments compiled into a single report and used to refine the instrument. The revised instrument in Nepali was endorsed by the Steering Committee prior to using in the field.

Physical measurement was done using validated equipment. Height was measured using a portable standard stature scale and waist and hip circumference were measured with a constant tension tape (Seca, Germany).

Similarly, blood sugar level was measured by dry method for which a WHO recommended Hemocue 2.1 dm was used. AChE and haemoglobin level were measured by Test-mate ChE Cholinesterase Test system (Model 400) for which AChE Erythrocyte Cholinesterase Assay Kit (Model 460) USA Company was used. WHO recommended Ellmen method was used for the measurement. The Executive chief of NHRC, the consultant pathologist of the study team, investigators, and representatives of NHRC visited the field to monitor and supervise the data collection to ensure that standard quality procedures were followed.

2.11 Data processing and analysis

Data were taken from the participants using paper and pencil method and entered in Epi Data 3.1 after checking the collected data in the field itself. The entered data were checked for completeness and 10% of the entry was checked by the investigators. Once the final dataset with completely and thoroughly cleaned data from all the study sites was ready, team of investigator analysed the data. SPSS 16.0 was used for the analysis. Results were obtained by the frequency distribution and cross tabulation of the variables. Univariate , bivariate and multivariate analysis were used. Bivariate analyses was used to analyze two variables by cross-tabulations. Additionally multiple linear regression model was fitted to adjust for confounding variables and to better interpret results. Results were considered to be statistically significant at 5% level of significant, unless otherwise stated.

Frequencies and percentages were used for socio-demographic information. Mean and standard deviation were used for scoring knowledge and behaviours related to pesticide exposure. For qualitative data content analysis was done .

2.12 Inclusion criteria

- Both men and women aged 18–59 years who had been working as vegetable farmer and exposed to pesticides.

2.13 Exclusion criteria

- Those involved in another profession.
- Those who did not handle/ were not exposed to pesticides.
- Those diagnosed as anemia and/or who were taking medicine for treatment of anemia.

2.14 Ethical consideration

This study was approved by an independent Ethical Review Board of the NHRC. Further approval was taken from the concerned authorities in the selected districts (District Agriculture Development Office and District Health Office).

Written informed consent was obtained from all the research participants. The objectives of the research were explained in simple language and participants were also provided with an information sheet containing the research objectives, data collection method, roles of participants, and personal and community benefits, as well as any probable harm to the participant. A participant feedback form was also provided to all participants after taking their physical and biological measurements. The confidentiality of the information gathered was maintained.

In addition, waste generated during the laboratory procedures was properly disinfected using aseptic techniques and safely disposed. All blood samples were discarded after completing the biological measurements.

Chapter 3

Results

3.1 Socio-demographic characteristics

The table shows the distribution of the participants by sex and age, literacy level, marital status and their of engagement years in the vegetable farming. In this study, there were 628 participants,of which 64.2% were male and 35.8%were female. Nearly half of the participants (46.8%) were in the age group 31-45 years. Most of the participants (97%) were literate (able to write and read) and very few participants (3%) were illiterate. Most of the participants (94.3%) were married at the time of data collection. About 5.4% of the participants were unmarried and very negligible participants (0.3%) were separated/divorced/widow. Among the total participants, 38.4% were engaged in commercial farming for more than 10 years; 36.6% were engaged for about 5-10 years and 25% were engaged for less than 5 years in commercial farming.

Table 1: Socio-demographic characteristics of research participants

Variables	Catagories	Frequency (n=628)	Percentage(%)
Sex	Male	403	64.2
	Female	225	35.8
Age	18-30 years	123	19.6
	31-45 years	294	46.8
	46-59 years	211	33.6
Literacy	Literate	609	97.0
	Illiterate	19	3.0
Marital status	Unmarried	34	5.4
	Married	592	94.3
	Separated/ Divorced/ Widow	2	0.3
Years of engagement in commercial farms	<5 years	157	25.0
	5-10 years	230	36.6
	>10 years	241	38.4

Behavioral and physical factors

More than one-third (35.5%) of participants were current smokers and 23.2% were alcohol users. Around 11% were underweight (BMI less than 18.5) and 17.8% of participants were overweight (BMI more than 25).

Table 2: Behavioral and physical determinants

Variables	Frequency (n=628)	Percentage(%)
Current Smokers	223	35.5
Current alcohol users	146	23.2
Underweight (<18.5)	69	11.0
Overweight (>25)	112	17.8

Pesticide Use and Practices

Median years of involvement in commercial vegetable farming, years of pesticide use, hour of pesticide use in the last week and frequency of pesticide use in the last month with Interquartile range (IQR) is shown in the given table. Median years of involvement of farmers in commercial farm was 10 years. All vegetable farmers had used the chemical pesticide in their farm. Median hour of pesticide used by farmers in the last week was 1 hour and frequency of pesticide use in the last month was 2 times.

Table 3: Frequency, years and hours of pesticide use

Variables	Median	Interquartile range (IQR)
Median years of involvement in commercial vegetable farming	10	5.2-15.0
Median years of pesticides use	9	5.0-14.0
Median hours of pesticide use in the last week	1	0.0-2.0
Median frequency of pesticide use in the last month (no of times used)	2	0.0-3.0

Purpose of Pesticides uses

Apart from using the pesticides for vegetables, two-thirds of participants (67%) used pesticides to kill pest in the house, followed by livestock against pests 64.4%. Similarly, 56.2% and 52.8% of the respondent used pesticides for seed preservation and for other crops respectively. About 4.6% used to treat the skin infection of human.

Table 4: Purpose of pesticide use (n=628)

Variables	Frequency(n)	Percentage(%)
Using for cereals and other crops	322	52.9
Spraying to kill pests in the house	421	67.0
Preserve seed	353	56.2
Treat skin infection on person	29	4.6
Livestock against pests	405	64.5

Multiple response *

Use of Personal Protective Equipments

Use of PPE was assessed by asking the questions to participants. In this study, spectacles, masks, hats, gloves, long sleeved shirt, overall cover dress, trousers were considered as a major PPEs. Nearly 12% participants did not use any types of PPE while spraying the pesticides in the field. About 41% participants used two different types of PPEs to protect themselves from the adverse effects of pesticide (Annex table 1). The most popular PPEs were trousers 78.3% and long sleeved shirt 75.3% made of cotton and silk. Third popular PPE was cotton general masks (60.8%). Around 21% farmers wore hat to protect from the sun rather than to protect from pesticide exposure. Less than one tenth of the participants used the spectacles, gloves and overall cover dress. All farmers had used the chemical non-resistant PPEs which does not prevent completely from pesticide from entering the body .

Table 5: Percentage of participants using Personal Protective Equipments (n=628)

Variables	Frequency(n)	Percentage(%)
Spectacles	37	5.9
Masks	382	60.8
Hat	131	20.9
Gloves	61	9.7
Long sleeved shirt	473	75.3
Overall cover	32	5.1
Trousers	490	78.0

Multiple response*

Precautionary measures while handling pesticides

Most of the participants applied the precaution measures while handling pesticides. About 96.6% of the participants washed their hand before eating, 94.2% of the participants washed their hands after spraying. More than three- fourth of participants (77.8%) washed their hands after mixing the pesticides. More than two third of participants (71.5%) showered their whole body. Around 76% farmers changed their clothes after spraying the pesticides. Less than half of the participants (47.1%) followed product label during spraying pesticides.

Table 6: Precautionary measures while handling the pesticides (n=628)

Variables	Frequency(n)	Percentage(%)
Wash hand after mixing	489	77.9
Wash hand after spraying	592	94.3
Wash hand before eating	607	96.7
Wash hand before smoking	117	52.5
Wash whole body	449	71.5
Change clothes	479	76.3
Follow product label	296	47.1

Multiple response*

Training on Integrated Pest Management

Out of the total 628 participants, only 62.9% of the participants had heard about IPM; among them only 27.2% followed the principle and procedure of IPM in their vegetable farm. Only 22% of the Participants were trained on IPM. Out of them 94.2% received the training/instruction on IPM from Junior Technical Assistant (JTA). Very few participants took instruction from fellow farmers, family members and pesticide retailers. Regarding pesticide purchase shop, most of the participants purchased pesticides from agrovetor pesticide shop and very few farmers purchased it from other shops.

Storage of pesticide in house

Pesticide storage place of all participants was observed to assess the pesticide storage practice in Nepal. Around four fifth of the participants (83.0%) had stored pesticides in an unlocked place/room where children easily reach where as 12.7% participants had kept pesticides in locked in a store or boxes. However, 1.8 % of the participants had kept in kitchen or grocery store and equal number of participants (1.8%) bought and used it immediately. Negligible proportion (0.8%) had stored it in the field. Almost all participants (99.5%) kept pesticide in original box rather than other containers (Annex table 2).

Table 7: Storage of pesticide in house

Variables	Frequency (n)	Percentage (%)
Locked in a store/box	80	12.7
Left Unlocked in a place where children can reach	521	83.0
In a kitchen/storage room	11	1.8
In the field	5	0.8
Buy and use it immediately	11	1.8
Total	628	100.0

Condition of Knap sack Sprayer

Condition of Knap sack sprayers was also observed. Nearly 87.1% participants had used none leaked knap sack sprayer whereas 12.9% of the participants use leaked sprayer (Annex table 3).

Availability of personal protective equipments in house

Availability of PPEs was observed in the house of research participants. More than four fifth (80.5%) of the participants had long sleeved shirt in their house to escape from risk of pesticides hazards during spraying. Around 61.1% participants had simple cotton masks, 20% had simple hat, and 15.1% had boots. Less than one tenth of participants had gloves, glasses and overall wear in their house. Most of the farmers had kept the PPE in the same place where the pesticide was stored.

Table 8: Availability of personal protection

Variables	Frequency (n)	Percentage(%)
Gloves	62	9.8
Mask	384	61.1
Long sleeved shirt	506	80.5
Glasses	41	6.5
Boots	95	15.1
Hat	126	20.0
Overall wear	29	4.6

Ten most Common pesticides used by farmers

Potato, tomatoes, cauliflowers, cabbage, beans, ladyfinger, bitter gourd, pumpkin, cucumber and bottle gourd are main cash crops in Nepal. The frequency of applying pesticides in these crops was about five applications per cropping season. Fungicide and Insecticides were common pesticides used by vegetable farmers in Nepal. These are group into 1) Organophosphate – Dichlorvos (Ib), Chloropyrifos (II), acephate (II), Dimethoate (II),Malathion (II) 2) Synthetic pyrethriod- Alphametrin (II), Cypermetrin, (II) Deltametrin (II) 3) Fungicide - Mancozeb (U) Carbendazin(U). Nearly 60% of the participants used fungicide, 42.5% used the organophosphate and 27% used the pyrethriod in their vegetable farm (Annex Table 4). Most of the farmers commonly used the fungicides (not insecticides) in potato. Insecticides and fungicide mixture was common in other vegetables. Mancozeb was most common found pesticide in Nepal which was used by 38% participants. Dichlovos was second common pesticide which was used by 18.4% similarly cypermetrin was third common pesticide used by 13% participants. Very nominal percentage of participantswere used the NICOTINOID –Imidacloprid (2.1%),and Avermectin -emamectin benzoate (2.9%) in Nepal.

Table 9: Top 10 Common pesticides used by farmers

Common Name	Chemical Name	WHO category	Frequency(n)	Percentage(%)
Dichlorvos	Organophosphate	Ib	175	18.4
Alphametrin	Synthetic Pyrethriod	II	45	4.7
Carbendazin	Fungicide	NH	45	4.7
Cypermetrin	Synthetic Pyrethriod	II	124	13.0
Chloropyrifos	Organophosphate	II	104	10.9
Mancozeb	Fungicide	NH	362	38.0
Imidacloprid	NICOTINOID		20	2.1
Dimethoate	Organophosphate	II	39	4.1
Malathion	Organophosphate	II	11	1.2
emamectin benzoate	Avermectin	II	28	2.9

Disposal of used pesticide containers/boxes

More than two fifth (41.7%) of the participants threw used pesticides container and boxes anywhere in the surrounding like any other wastes which may cause harm to the environment. Around 30% of the participants disposed by burning, 21% disposed by burial method, 3.2% kept in local waste container and very few of participants used for food and seed preservation.

Table 10: Disposal of used pesticide containers/boxes

Variables	Frequency(n)	Percentage(%)
Local waste containers	20	3.2
Burning	188	29.9
Burial	131	20.9
Use to store food and seed	2	0.3
Throw anywhere	262	41.7
Give to rag pickers	21	3.3
Do nothing	4	0.6
Total	628	100.0

Knowledge on health impact of Pesticides

Knowledge of participants was assessed by asking nine questions related to the health impact of pesticides. The knowledge level was divided into two levels, according to knowledge score. Participants who gave five or more correct answers was categorized in having good knowledge and participants who were unable to give more than four correct answers was categorized in having poor knowledge. Among participants 97% had good knowledge and 3% had poor knowledge about the health impacts of the pesticides (Annex Table 5). More than 97% of farmers were agreed that pesticide use can affect the human health, nearly 95% were agreed pesticide use can affect to livestock and environment. About 92% of farmers were aware to care wind direction and raining time while spraying the pesticides. More than 94% participants were aware on the route of pesticide entry in the human body.

Table 11: Knowledge on health impact of pesticide (n=628)

Variables	Frequency(n)	Percentage(%)
Affect human health	611	97.3
Affect livestock	593	94.4
Affect environment	601	95.7
Care wind direction while Spraying	578	92.0
Time for application during raining	579	92.2
Enter into body by inhalation	601	95.7
Enter into body by skin	590	93.9
Enter into body by mouth	600	95.5
Enter into body by eye	587	93.5

Multiple response *

Acute Toxicity Syndrome

Eighteen sign and syndrome of pesticide poisoning were asked to all farmers. Out of 628 partcipants, 317 participants 50.5% complained about discomfort immediately after spraying pesticides. About 43.7% of the participants complained headache, followed by blurred vision 25.4%, back pain 24.3%, dizziness and nausea 19.7%. More than one tenth of the participants complained of dry mouth, skin irritation and muscular illness and less than one tenth of participants suffered from extreme tiredness, loss of appetite, respiratory difficulties and speech difficulty.

Table 12: Acute Toxicity Syndrome among farmers

Variables	Frequency (n=317)	Percentage(%)
Back pain	153	24.3
Blurred vision	160	25.4
Dizziness	124	19.7
Dry mouth	76	12.1
Extreme tiredness	53	8.4
Headache	275	43.7
loss of appetite	48	7.6
Muscular weakness	71	11.3
Nausea	124	19.7
Respiratory difficulties	40	6.3
Skin irritation	95	15.1
Speech difficulty	38	6.0

Health seeking behaviors

Health seeking behaviours of participant having acute toxicity syndrome was assessed. Among 317 participants most of the participants 81% took rest, one fourth of participants (25.8%) used self medication, only 9.4% visited to health centers /hospital and very few participants (1.8%) did not do anything when they were ill.

Table 13: Health seeking Behaviors of farmers

Variables	Frequency (n=317)	Percentage(%)
Used self medication	82	25.8
Went to health center/hospital	30	9.4
Take rest	257	81.0
Do nothing	6	1.8

Multiple response*

Chronic diseases among farmers

Self reported chronic disease was explored among the participants at the time of interview. Among total participants, one tenth of the participants 9.9% reported having chronic diseases. Among them chronic neuropathic 24.2% was most common disease followed by arthritis 19.4%, cardiovascular diseases 17.7% and diabetes 16.1%.

Table 14 : Chronic diseases among farmers

Variables	Frequency (n=628)	Percentage(%)
Diabetes	10	16.1
Cancer	1	1.6
Cardiovascular diseases	11	17.7
Chronic neuropathic	15	24.2
Arthritis	12	19.4
Thyroid hormone imbalance	2	3.2
Others	11	17.7
Total	62	100.0

Prevalence of Diabetes, Low AChE and anemia

Prevalence of diabetes based on capillary whole blood glucose value ≥ 110 mg/dl and including those on medication was 4.5% among vegetable farmers of Nepal. Prevalence of low AChE level based on reference range 2.77-5.57U/ml was 10.3%. Out of total participants, only 265 (42.5%) were exposed to organophosphate. The proportion of low AChE among organophosphate exposed farmers was 12.1%. Prevalence of anemia using the criteria of <11mg/dl was 53.3% among female participants. Likewise, using the criteria of <12mg/dl was 43.9% among male participants.

Table 15: Prevalence of Diabetes, LowAChE and Anemia

Variables	Frequency(n)	Percentage(%)
Diabetes (>110mg/dl)(n=624)	28	4.5
Low AchE (n=624)	64	10.3
Low AChEamong OP exposure (n=265)	32	12.1
Anemia (<11mg/dl) in Female (n=624)	120	53.3
Anemia (<12 mg/dl) in Male (n=624)	175	43.9

3.2 Finding on Integrated Pest Management

Evaluation diffusion of innovation - Integrated Pest management (IPM)

IPM is a sustainable approach to managing the pests by combining biological, cultural, physical/mechanical and chemical management tools in a way that minimizes economic, health and environmental risks. This innovation was introduced in Nepal since 1997 with the aim to support reduction of poverty, ensure food security and environmental protection in a sustainable way. Farmers field school approach has been adopted to implement and gradually up –scale participatory IPM in Nepal. This study was concentrating on the perception of vegetable farmers and District Agriculture Development Office regarding new innovation (IPM) to assess the adoption level of IPM. Some questions relating to theory of diffusion on innovation were added and asked to two key personals of district agriculture offices.

Relative advantage of IPM

Question on relative advantage was asked to key personnel to assess their perception regarding IPM in terms of economic advantage, social prestige, convenience or satisfaction. Nearly two third of key personnel said IPM has a medium relative advantage in terms of economic advantage, social prestige, convenience or satisfaction. One third of them (33%) said it has high the relative advantage than existing method. Very nominal key personnel expressed low relative advantage of IPM.

Table 16: Relative advantage of IPM

Relative advantage	Frequency(n)	Percent(%)
Very high	10	33.33
Medium	19	63.33
Low	1	3.33
Total	30	100

Compatibility of IPM

Regarding question related to the compatibility of IPM with existing method (norms, value and practice) to measure the perception of key personnel. Around 93% key personnel responded, IPM is medium compatible with existing values, norms and practices. None of participant said it is highly compatible.(If an innovation is compatible with existing norms, value and practice will be adopted rapidly and if it is incompatible it won'tbe adopted rapidly).

Table 17: Compatibility of IPM

Compatibility	Frequency(n)	Percent(%)
High	0	0.0
Medium	28	93.3
Low	2	6.6
Total	30	100

Complexity

Regarding perception about the complexity of IPM among key personnel, 80% participants said IPM is neither easy nor difficult to understand. But 20% key personnel said it is difficult to understand. (If innovation is easy to understand, it will be adopted quickly.)

Table 18: Complexity of IPM

Complex	Frequency	Percent
Medium	24	80
Low	6	20
Total	30	100

Triability

Key personnel perception regarding triability (easiness to try out in terms of money and time) was assessed by asking the question. Nearly one third (66%) key participants said that IPM is neither easy nor difficultand not too costly, but it may take a time to adopt. Equal proportion (17%) of key personnel expressed that it is easy to try out and difficult to try out. (If an innovation is easy to try out in terms of money and time, it will be adopted very fast).

Table 19: Triability of IPM

Triability	Frequency(n)	Percent(%)
Easy to try out	5	16.67
Medium	20	66.67
Difficult	5	16.67
Total	30	100

Observable results

Key personnel were asked to assess the visible effects of IPM innovation. About 80% key personnel said that IPM has medium positive effects and visible effects. No one participant said IPM has high positive effects (less uncertainty) and remaining 20% said it is rarely hard to observe the positive effects of IPM. (If innovation has less uncertainty, it stimulates peer discussion and improves visual positive effect then innovation will adapt fast in the community).

Table 20: Observable results of IPM

Observable results	Frequency(n)	Percent(%)
Medium	24	80
Difficult	6	20
Total	30	100

Reinvention

Most of the key personnel (93%) mentioned that farmers were not much satisfied with these innovations; improvement is possible but need more exercise on it; not so easy to add own ideas and experiences to reinventing / adopting this new method. Very nominal (6.7%) personnel said it is hard to improve and adopt in the community. (If innovation is able to meet the demand of the community in an effective way, that it will be adopted quickly).

Table 21: Reinvention of IPM

Reinvention	Frequency(n)	Percent(%)
Medium	28	93.3
Difficult	2	6.7
Total	30	100

Peer-peer conversations and peer networks

Most of the key personnel (90%) said that they shared the message of IPM to key farmers and farmers network when theygo to field visit and they had organized IPM training in few community where vegetables are produced. About 10% participants said that they extensively shared the message to all farmers through personal contact. (If the people are satisfied with innovation, information will rapidly flow and adopt in the community very fast).

Table 22 : Peer-peer conversations and peer networks of IPM

Peer-peer conversations and peer networks	Frequency(n)	Percent(%)
High extent	3	10
Medium extent	27	90
Total	30	100

Communication

All participants mentioned that they shared the information and conduct training to groups of the farmers. Furthermore, they responded that they communicated the information with their house, neighborhood and friends to adopt IPM technique. However, the communication was on medium level. (If an innovation has less ambiguity and low risk, it makes people more satisfy and spread of information flow rapid and it will be adopted fast in the community).

Table 23: Communication of IPM

Communication	Frequency(n)	Percent(%)
Medium extent	30	100

3.3 Inferential findings

Table 24: Feeling of illness according to age category

Age category	Felt illness in the last month		p value
	Yes	No	
18-30 years	8(6.5%) [2.746,14.63]	115(93.5%)[85.37,97.25]	0.365
31-45 years	20 (6.8%) [3.818,11.83]	274(93.2%) [88.17,96.18]	
46-59 years	8(3.8%) [1.558,8.936]	203(96.2%)[91.06,98.44]	
Total	36 (5.7%) [3.383,9.554]	592(94.3%)[90.45,96.62]	

Table 24 shows the percentage of participants who reported to have felt illness within one month period in different age categories. Among those who felt illness within one month, the proportion were higher (6.8% ,CI, 3.818-11.83) in the age group 31-45 years followed by 18-30 years and 46-59 years. However, these associations were not statistically significant.

Table 25: Feeling of illness in previous month according to the history of engagement in farming

Years of engagement	Felt illness in the last month		p value
	Yes	No	
<5 years	6(3.8%) [1.781,8.01]	151(96.2%)[91.99,98.22]	0.393
5-10 years	13(5.7%) [2.906,10.71]	217(94.3%)[89.29,97.09]	
>10 years	17 (7.1%) [3.437,13.93]	224(92.9%) [86.07,96.56]	
Total	36(5.7%) [3.383,9.554]	592(94.3%) [90.45,96.62]	

Table 25 shows the relationship between felt illness in the last month and years of involvement in farming. Among the participants who felt illness within previous month, the proportion was higher (7.1 %,CI, 3.437-13.93) in those involved in agriculture sector for more than 10 years as compared to those who had involvement of 5-10 years and less than five years.

Table 26: Feeling of illness in previous month according to the use of IPM

Using IPM	Felt illness in the last month		p value
	Yes	No	
Yes	7(5.1%) [2.26,10.99]	131(94.9%)[89.01,97.74]	0.668
No	29(5.9) [3.423,10.04]	461(94.1%) [89.96,96.58]	
Total	36(5.7%) [3.383,9.554]	592(94.3%) [90.45,96.62]	

A higher percentage of participants who had felt illness in the last month and were not using IPM were (5.9 %, CI, 3.423-10.04) compared with using IPM at (5.1% CI, 3.4-10.04). (Table 26)

Table 27: Feeling of illness in previous month according to the sex

Sex	Felt illness in the last month		p value
	Yes	No	
Male	20(5.0%) [2.645,9.12]	383(95.0%) [90.88,97.35]	0.337
Female	16(7.1%)[3.587,13.61]	209 (92.89%) [90.88,97.35]	
Total	36(5.7%) [3.383,9.554]	592(94.3%) [90.45,96.62]	

The proportion of felt illness in the last month was higher in female (7.1 %, CI , 3.58- 13.61) with no significant difference between the sexes.

Table 28: Use of Personnel Protective Equipment (PPE) according to age categories

Agecategory	Use of Personnel Protective Equipment		p value
	No	Yes	
18-30 years	54(43.9%)[31.79,56.78]	69 (56.1%)[43.22,68.21]	0.559
31-45 years	113(38.4%) [30.56,46.96]	181(61.6%)[53.04,69.44]	
46-59 years	90(42.7%) [33.15,52.73]	121(57.3%)[47.27,66.85]	
Total	257(40.9%) [33.68,48.58]	371(59.1%) [51.42,66.32]	

In regard to use of PPE by age group, for both sexes the age group less likely have used PPE is 18-30 years(56.1%, CI, 43.22-68.21) while the age group 31-45 years had the highest percentage (61.6%, CI, 53.04-69.44)of using PPE (Table28). However, there was no significant difference by age group.

Table 29: Use of Personal Protective Equipment(PPE) according to the history in farming

Years of involvement in agriculture sector	Use of Personnel Protective Equipment		p value
	No	Yes	
< 5 years	65(41.4%)[30.86,52.79]	92 (58.6 %) [47.21,69.14]	0.912
5-10 years	96(41.7%) [33.6-,50.35]	134(58.3%) [49.65,66.4]	
> 10 years	96(39.8%)[30.14,50.39]	145(60.2%) [49.61,69.86]	
Total	257(40.9%) [33.68,48.58]	371(59.1%) [51.42,66.32]	

The table 29 shows the relationship between trends of using PPE by years of involvement. The percentage of use of personal protective equipment among three different age group is almost similar; < 5 years (58.6 %, CI, 47.21-69.14), 5-10 years, (58.3%, CI, 49.65-66.4) and > 10 years (60.2%, CI, 49.61-69.86) with no significant difference between them.

Table 30: Use of personnel protective equipment according to IPM training received

Receive IPM training	Use of Personnel Protective Equipment		p value
	No	Yes	
Yes	52(37.7%) [29.14,47.06]	86(62.3%) [52.94,70.86]	0.486
No	205(41.8%) [33.22,50.98]	285(58.2%) [49.02,66.78]	
Total	257(40.9%)[33.68,48.58]	371(59.1%)[51.42,66.32]	

Table 30 indicates the relationship between use of PPE and receiving IPM. The higher percentage of participants receiving IPM training was using PPE (62.3%, CI, 52.94-70.86) than their counterpart (58.3%, CI, 49.02-66.78). However, there was no significant difference between them.

Table 31: Use of Personnel Protective Equipment according to sex of the participants

Sex	Use of Personnel Protective Equipment		p value
	No	Yes	
Male	160 (39.7%)[31.64,48.37]	243(60.3%)[51.63,68.36]	0.503
Female	97(43.1%)[33.7,53.04]	128(56.1%) [46.96,66.3]	
Total	257(40.9%) [33.68,48.58]	371(59.1%)[51.42,66.32]	

Higher proportion of men currently using PPE were (60.3%, CI, 51.63-68.36) compared with (56.1% ,CI, 46.9-66.3) percent of women in the same age group with no significant difference between sexes.

Table 32: Multiple linear regression with acetylcholinesterase

Variable	Coefficient	95 % CI		p value
		Upper	Lower	
Age	0.064	0.029	0.099	0.001
Years in farming	0.015	-0.038	0.069	0.566
Received IPM training	0.034	-0.737	0.806	0.930
Sex	-0.948	-1.642	-0.253	0.008
Dependent variable: acetylcholinesterase		R- Squared: 0.046		

Adjusted multiple linear regression showed that AChE level was found decreased on an average by 0.948 (R^2= 0.046, P=0.008) in male as compared to female , keeping all covariates constant, which is significant at 5% level of significance. Similarly with each one year increase in age AChE level found increased on an average by 0.064 (R^2=0.046, P=0.001) which is significant at 5% level of significance. With each one year increase in agriculture farming, the AChE level found increases on an average by 0.015 (R^2= 0.046, p=0.56) which is not significant at 5% level of significance.

Interestingly, the AChE level was found to increase on an average by 0.034 on those who received the IPM training as compared to those who hadnot received any training (R^2= 0.046, p= 0.930) with keeping all covariate constant , which is not significant at 5% level of significance.

3.4 Findings from qualitative study - Focus group discussion

FGD was conducted among IPM trained farmers in four districts of Nepal namely -Kavre, Ilam, Nawalparasi and Rasuwa. Altogether 12 farmers (equal number of male and female) were actively participated in each FGD. FGD was conducted under the guiding question to assess the effectiveness (adaptation level) of the IPM program in Nepal.

Major Vegetables and use of pesticides in the community

The main vegetables grown by the farmer were potato, tomato, chili, cucumber, cabbage, beans, brinjal, bitter ground, pumpkin, and lady finger. Most of the farmers who participated in FGD had taken IPM training. They had grown vegetables with applying IPM and traditional technique. All farmers reported that they used yellow and green labeled pesticides only; however the rate of spraying pesticide had decreased compared to previous years. Regarding PPE use, they said they didn't use all PPEs during handling the pesticides. However, they usually wore caps, mask, trouser and full shelves shirt to protect from pesticide hazards.

We spray the pesticides in all vegetables, maximum 10 times or minimum 8 times from cultivating to harvesting of vegetables depending upon the situation of the pest. If we do not spray pesticides , then the economic damage occurs due to pest attack.(FGD Kavre)

We spray the pesticides in all vegetables only two times from cultivating to harvesting of vegetables, but we spray 12 times in tomato for properly manage the pest .(FGD Ilam)

In the month of January and February , we commonly spray the fungicide in potato to control the fungi. Fungicide and insecticide mixture is used for all types of vegetables. (FGD Nawalparasi)

We use pesticide occasionally in potato, more frequently in cabbage, cauliflower and tomato, infrequently in cucumber but we use vitamin in cucumber. If we don't put the pesticides, our vegetables go to loss from pest attack (FGD Rasuwa)

One of the member of FGD said, the government is responsible to promote the pesticides in Nepal. In the beginning they teach us to usein the farm, they freely distributed pesticide to motivate us, now our mud quality is getting poor, pest develop the resistant so we are forced to use pesticide in our farm. (FGD Rasuwa)

Good aspect of IPM

Farmers were aware about health hazard of pesticides. So, they were minimizing the frequency of pesticide use in the farm. They are motivated to use less hazardous pesticide and wear PPEs while spraying the pesticide. Farmers were found more aware about health hazard of pesticides, so, they were motivated to use less harmful pesticide and wear PPEs while spraying. Furthermore, they also minimized the frequencies of pesticides. Above mentioned fact can be supported with below listed verbatim:

Before IPM training, we did not care about quality of seed, distance of plantation, amount of pesticide, time for pesticide and frequency of pesticide, but after getting training we are aware of these things. That training has helped us to reduce the investment cost. (FGD Kavre)

After getting IPM training, we are able to minimize the pesticide use, encouraged to use less hazardous pesticides - yellow and green label pesticides (if necessary) and to spray it less frequently (FGD Ilam).

We are able to distinguish between helpful and harmful insect, able to protect helpful insect. (FGD Nawalparasi)

A member of FGD said, we are able to produce healthy vegetable, utilize the cow dung (animal manure), improve the quality of mudand protect environment.(FGD Rasuwa)

Before IPM training, we used maximum pesticides (more than necessary) without PPE but now after getting IPM training, we have minimized the pesticide use and applied the cap, mask, full shelve shirts and trousers while handling the pesticide. (FGD Rasuwa)

I feel less health effects (headache, weakness, dizziness) while doing the cultivation with this technique. (FGD Nawalparasi)

In the past, we store hazardous pesticides inside the common store where children easily reach, there is so many chances of accidental poisoning but now we don't store in big amount. (FGD Nawalparasi)

Before IPM training, we spray hazardous pesticides more than enough, but after getting training we are more conscious with our health and environment and spray less hazardous pesticides in need base only, but the media always say, farmers of Kavre spray pesticides more frequently in maximum amount said by all farmers. (FGD Kavre)

A member of FGD said, I had sprayed the pesticidefor 20 years without using the PPE. But now, *I stoppedspraying it after experiencing difficulties in my tongue. I experience stiffness in my tongue and there is no moist when I wake up in morning. I couldn't able to speak and swallow water. I put water inside the mouth for an hour,then my tongue started to get moist and will come back to normal form only after 2 hours. He said, this problem is a direct result of using pesticides without any caution for a longer time period. Now I have taken the IPM training and work as a resource person for IPM training, I communicate all farmers about the hazardous effects of pesticides and its preventive measures. (50 years, Male participant of FGD Kavre)*

Shortcoming of the program

Desipte the positive aspect of IPM , some of the participants mentioned shortcoming of the program which are low production , no separate market for IPM and lenghty crop production time. Above mentioned fact can be supported below listed verbatim.

In spite of positive aspects, we need to give more time in the farm to observe the pest, leaf and product of the vegetables. This technique is more tedious than traditional techniques. (FGD Karve)

Production with IPM technique is very low compare to a traditional technique. The size of the vegetable product is comparatively low; its appearance is not good so people do not want to pay more money for such products and we are forced to sell vegetables at low cost so it is really hard to get financial benefits through this technique. (FGD Kavre)

A member of FGD said, there isno separate market for IPM product and no proper mechanism for monitoring the pesticide level in the country. System is not properly functioned, it will be meaningless to produce IPM product. (FGD Nawalparasi)

Integrated Pest Management technique is not practical, not economically benefited, no social prestige; it has long process and is more tedious. (FGD Ilam)

A member of FGD said, I have adopted IPM technique in my farm, but my neighbors have adopted the traditional technique, they used hard types of pesticides in big amount. Then I couldn't control pests by using only organic pesticides and forced to use the yellow, blue and green level pesticides. (FGD Ilam)

Few members of IPM said, we have planted the vegetable with both techniques, we will see the production of both techniques, calculate the financial benefit. If financial benefit is equal we will adopt IPM otherwise we will go back traditional method, but we will minimize the pesticide use. (FGD Kavre)

Recommendation from vegetable farmers

During FGD session, the farmer had recommended over some of issues like practice of regular monitoring, farmer insurance system, separate market and community awareness. Below are some of representatives verbatim transcribed:

All farmers should be trained on IPM and regular monitoring from the government side is essential for sustainability of the program, said all farmers. (FGD Rasuwa)

Sometimes we may not make economic gain from agriculture, for example last year 75% crops were damaged. In such case,farmer insurance system should be initiated and strengthen from the government side. (FGD Kavre)

There should establish a separated market for IPM productswith reasonable price and strengthen the pesticide monitoring mechanismto distinguish the product of traditional technique and IPM technique. (FGD Kavre)

It is essential to develop the strong supply channel of the organic pesticide to meet the high demand of farmer community and to sustain the IPM program. (FGD Rasuwa)

Community awareness program is essential to promote the consumption level of IPM product in the community. (FGD Nawalparasi)

Subsidy in seed and manure is essential to farmers from the government side. (FGD, Ilam)

Chapter 4

Conclusion and recommendation

The application of pesticides were observed to be widely applied in agriculture sector of Nepal. Farmer had considerable knowledge regarding health impacts of pesticide, however, they did not adopt the safety precaution resulting higher risk of exposure with pesticide intoxication. As a result, nearly 51% farmers experienced an acute toxicity syndrome of pesticides and one of ten farmers reported several kinds of chronic diseases of which 24% farmers had chronic neuropathic diseases. Exposures of organophosphate significantly depress the AChE activity, but the number of organophosphate exposures was not sufficient and observed low prevalence of depressed AChE (10.3%) in Nepal. However, the prevalence of diabetes was high.

Farmers who don't read instructions written on the label and followed have chances of overuse and misuse of the pesticides. They commonly stored the pesticide in the place where children can easily reach putting them in danger of accidental poisoning of pesticide Nearly 42% farmers throw the pesticide waste container anywhere resulting higher risk of environment to be contaminated. Around 13% participants used leaked knapsack sprayer is chance to entry pesticide through the skin.

Fungicide was most common pesticide rather than organophosphate in Nepal. Organochlorine is banned in Nepal however, very few farmers still used it. Large numbers of farmers cultivated crops with traditional technique rather than IPM technique. However, they claimed the application of minimum amount of the pesticide in farm. Perception among farmers and official personnel regarding IPM was not so good or not so bad. In the reference of the theory of Diffusion on Innovation, an adaptation process of IPM was found slow in Nepal. Based on the findings, following recommendations are made:

- Despite considerable knowledge, farmers did not use the PPE properly; threw the pesticide container anywhere, stored the pesticide inside where child can reach easily. So, it is required to organize the continuous refresher training on pesticide use, handling and disposal to transfer their knowledge into practice in Nepal.
- In Nepal, farmers commonly used the general PPE due to unavailability of chemical resistant PPE so such kind of PPE should be available in the market for the safety of farmers.
- There is an urgent need to develop the proper mechanism to monitor the pesticide level in vegetables to reduce the health impact of pesticide among farmers and consumers.
- More efforts from concerned agencies are essential for sustainability of IPM, multiple strategies focusing on public awareness on IPM, a separate market for IPM product,

subsidy for farmers in seed and manure, reasonable cost for IPM product, give continuity on pesticide monitoring on vegetables and strong monitoring and supervision mechanism (based on FGD finding).

- Only organophosphate exposure level is detected by AChE test, which is unable to describe the chronic health impact in detail, so retrospective cohort study is recommended to establish the cause and effect relationship between pesticide exposure and adverse health effects.

Reference

1. Koirala P, Tamrakar A, editors. Analytical capability on pesticide analysis in food in Nepal. Proceedings of 5th National Seminar Nepal Academy of Science and Technology; 2008.
2. Gautam R, Baral S, Herat S. Biogas as a sustainable energy source in Nepal: Present status and future challenges. Renewable and Sustainable Energy Reviews. 2009;13(1):248-52.
3. CBS, National Population and Housing Census-2011. Government of Nepal, National Planning Commission Secretariat, Kathmandu, Nepal; 2011.
4. NARC, NARC's strategic vision for agricultural research (2011-2030). Nepal Agricultural Research Council, Kathmandu, Nepal; 2010.
5. PPD. Annual report 2065/66. Harihar Bhawan Lalitpur, Nepal:Plant Protection Directorate
6. PPD. National IPM programme in Nepal: Ministry of Agriculture development 2008.
7. Cooper J, Dobson H. The benefits of pesticides to mankind and the environment. Crop Protection. 2007;26(9):1337-48.
8. Aktar W, Sengupta D, Chowdhury A. Impact of pesticides use in agriculture: their benefits and hazards. Interdisciplinary toxicology. 2009;2(1):1-12.
9. Atreya K, Sitaula BK. Mancozeb: growing risk for agricultural communities? Himalayan Journal of Sciences. 2011;6(8):9-10.
10. CBS. Agriculture Census Nepal 2001/02: National Planning Commission Secretariat CBoS, Kathmandu, Nepal 2006.
11. Dhital RD, Tripathee L, Sigdel S. R. A Review on Status of Pesticides Use in Nepal. Research Journal of Agriculture and Forestry Sciences. 2015 March; 3 (3): 26-29.
12. Diwakar J PT, Pant SR, Jayana BL. Study on major pesticides and fertilizers used in Nepal. Scientific World. 2008;6(6):76-80.
13. CBS. National Sample Census of Agriculture N, 2001/2002 highlights: Central Bureau of Statistics, Kathmandu, Nepal2003.
14. Vega S. Note on the toxicity of pesticides used in tropical crops. Ciencias Ambientales. 1994;11:181.
15. Karalliedde L, Senanayake N. Organophosphorus insecticide poisoning. British journal of anaesthesia. 1989;63(6):736-50.
16. Brown SK, Ames RG, Mengle DC. Occupational illnesses from cholinesterase-inhibiting pesticides among agricultural applicators in California, 1982–1985. Archives of Environmental Health: An International Journal. 1989;44(1):34-9.
17. Chambers HW. Organophosphorus compounds: an overview. Organophosphates: Chemistry, fate, and effects. 1992:3-17.
18. Arlien-Soberg P SN, CRC Press 1992.

19. Montgomery M, Kamel F, Saldana T, Alavanja M, Sandler D. Incident diabetes and pesticide exposure among licensed pesticide applicators: Agricultural Health Study, 1993–2003. American journal of epidemiology. 2008;167(10):1235-46.
20. MoEST. Nepal National Implementation Plan for the Stockholm convention on persistent organic pollutants (POPs) Moesat.
21. Yadav SK, Lian KK. Management of Persistent Organic Pollutant Pesticides in Nepal, The. Macquarie J Int'l & Comp Envtl L. 2009;6:217.
22. Sharma D, editor. Status of pesticides and relevant information of Nepal. Coonsultative Workshop on SAARC Pesticide Information Sharing Network (SPINet) Candi, Sri Lanka; 2011.
23. Shrestha P, Koirala P, Tamrakar A. Knowledge, practice and use of pesticides among commercial vegetable growers of Dhading district, Nepal. Journal of Agriculture and Environment. 2010;11:95-100.
24. Karmacharya S. Pesticide use in agriculture and its socio-economic contexts, A case study of Panchkhal area, Kavre, Nepal. International Journal of Scientific and Technology Research. 2012;1(9):17-20.
25. Neupane D, Jørs E, Brandt L. Pesticide use, erythrocyte acetylcholinesterase level and self-reported acute intoxication symptoms among vegetable farmers in Nepal: a cross-sectional study. Environmental Health. 2014;13(1):1.
26. Atreya K. Probabilistic assessment of acute health symptoms related to pesticide use under intensified Nepalese agriculture. International journal of environmental health research. 2008;18(3):187-208.
27. WHO. Expert committee on biological standardization. World Health Organization, WHO Headquarters, Geneva; 2013.

Annex 1

Data Tables

Use of PPE

Variables	Frequency	Percentage
None	75	11.9
one PPE	158	25.2
Two PPE	258	41.1
Three PPE	87	13.9
Four PPE	35	5.6
Five PPE	11	1.8
Six PPE	4	.6
Total	628	100.0

Pesticide storage box

Variables	Frequency	Percentage
In origional boxes	625	99.5
In decant into other containers	3	.5
Total	628	100.0

Condition of sprayer

Variables	Frequency	Percentage
Leaked	81	12.9
no leaked	547	87.1
Total	628	100.0

Classification of pesticides

Variables	Frequency (n=628)	Percentage
Fungicide used	371	59%
Synthesis pyrethriod	169	27%
OP	267	42.5%

Knowledge regarding health effects of pesticides

Variables	Frequency	Percentage
Good Knowledge (≥5 score)	609	97.0
Poor Knowledge (≤4 score0	19	3.0
Total	628	100.0

Annex 2

Questionnaires

Location and Date		Response	Code
1	Vegetable program code	└─┴─┘	I1
2	Vegetable pocket code	└─┴─┘	I2
3	Interviewer ID	└─┴─┘	I3
4	Date of completion of the instrument	└─┴─┘ └─┴─┘ └─┴─┴─┴─┘ dd mm year	I4

Participant Id Number └─┴─┘└─┴─┘└─┴─┘

Consent, Interview Language and Name		Response	Code
5	Consent has been read and obtained	Yes 1 No 2 **If NO, END**	I5
6	Interview Language	English 1 Nepali 2	I6
7	Time of interview (24 hour clock)	└─┴─┘└─┴─┘	I7
8	Family Surname		I8
9	First Name		I9
Additional Information that may be helpful			
10	Contact phone number where possible		I10

Demographic Information				
Question		Response		Code
11	Sex (*Record Male / Female as observed)*	Man Woman	1 2	D1
12	How old are you?	Years	└─┴─┘	D2
13	Literacy status	Literate Illiterate	1 2	D3

14	What is the highest level of education you have completed?	No formal schooling Less than primary school Primary school completed Secondary school completed Higher secondary (10+2)/ PCL completed Refused	1 2 3 4 5 88	D4
15	What is your ethnic background? (USE CASTE CLASSIFICATION CARD)	Dalit Disadvantaged Janajatis Disadvantaged non dalit Tarai caste groups Religious minorities Relatively advantaged Janajatis Upper caste groups Refused	1 2 3 4 5 6 88	D5
16	What is your marital status?	Never married Currently married Separated/ Divorced Widowed Cohabitating	1 2 3 4 5	

Demographic Information continued			
Question		Response	Code
17	How many people are living in your household?	Number of people └─┴─┘	D7
18	Area covered by commercial farm	Biga └─┴─┘ Kathha └─┴─┘	D8
19	Years of engagement in commercial vegetable farmers (in years)	└─┴─┘	D10
20	Do you currently smoke any tobacco products such as cigarette, cigars, pipes, bidi, hukah or Tamakhu? (in past 30days)	Yes 1 No 2	D11
21	Have you consumed an alcoholic drink within the past 30days?	Yes 1 No 2	D12

22	Are you pregnant? (Only for women)	Yes 1 No 2	D13
23	Have you using any method of the temporary family planning? (Only for women)	Yes 1 No 2	D14
24	Weight	└─┴─┴─┘ Kg	D15
25	Height	└─┴─┴─┘ Cm	D16

Pesticide Use and practices			
Now I am going to ask you some questions relating to pesticide use and practices			
Question		**Response**	**Code**
26	Do you use the pesticides (insecticides, fungicides, herbicides etc) in your vegetable farming?	Yes 1 No 2	P1
27	Do you use pesticide (insecticides, fungicides, herbicides etc) for other purpose? (RECORD FOR EACH)		
	Using for cereals and other crops	Yes 1 No 2	P1a
	Spraying to kill pests in the house	Yes 1 No 2	P1b
	Use to preserve seed	Yes 1 No 2	P1c
	Use to treat skin infections on persons	Yes 1 No 2	P1d
	Use on livestock against pests	Yes 1 No 2	P1e
	Others	Yes 1 No 2	P1f
	Others (please specify)	└─┴─┴─┴─┴─┘	P1fother
28	How long have you been using pesticides? (Years)	Number of years Don't know 777	P2
29	How many times have you sprayed in the last month?	Number of times Don't know 777	P3
30	How many hours did you spray in last week? (hour/week	Number of hours └─┴─┘ Don't know 777	P4
31	Do you use knap sack sprayer while using pesticides?	Yes 1 No 2	P5

32	Do you use knap sack sprayer while using pesticides?(RECORD FOR EACH)		
	Spectacles	Yes 1 No 2	P6a
	Masks	Yes 1 No 2	P6b
	Hat	Yes 1 No 2	P6c
	Gloves	Yes 1 No 2	P6d
	Long- sleeved shirt	Yes 1 No 2	P6e
	Overall cover	Yes 1 No 2	P6f
	Trousers	Yes 1 No 2	P6g
	Others	Yes 1 No 2	P6h
	Others (please specify)	|__|__|__|__|__|	P6 other
33	Do you use any precautionary measures while handling pesticides in your field?		
	Wash hands immediately after mixing	Yes 1 No 2	P7a
	Wash hands immediately after spraying	Yes 1 No 2	P7b
	Wash hands before eating during spraying pesticides	Yes 1 No 2	P7c
	Wash hands before smoking when spraying pesticides	Yes 1 No 2	P7d
	Wash whole body immediately after spraying pesticides	Yes 1 No 2	P7e
	Change clothes after spraying	Yes 1 No 2	P7f
	Follow the product label	Yes 1 No 2	P7g
	Others	Yes 1 No 2	P7h
	Others (please specify)	|__|__|__|__|__|	P7other
34	Have you heard about IPM	Yes 1 No 2	P8

35	Have you received pesticide management trainings?	Yes 1 No 2	P9
36	If yes, by whom did you receive training/ instructions on how and what to use?	Fellow farmers 1 Family members 2 Pesticide retailers 3 Junior technical assistant/gov workers 4 Others 5	P10
37	Do you follow the principle and main procedure of IPM	Yes 1 No 2	P11
38	From where do you buy pesticides?	Pesticide shop 1 Other shop 2	P12

Storage of pesticides (observation)			
Question		Response	Code
39	Where are the pesticides stored?	Locked in a store/box 1 Left unlocked in a place where children can reach 2 Together with food 3 In a kitchen/storage room 4 In the field 5 Buy and use it immediately 6 Others 7 Others (please specify) __|__|__|__	P11
40	How they are stored?	In original boxes 1 In decant into other containers 2	P12
41	Does the knapsack sprayer leak?	yes 1 no 2	P13
42	What protective equipments are present in the house?		
	Gloves	yes 1 no 2	P14a
	Protective mask	yes 1 no 2	P14b
	Long sleeved shirt	yes 1 no 2	P14c
	Glasses	yes 1 no 2	P14d
	Boots	yes 1 no 2	P14e
	Hat	yes 1 no 2	P14f
	Overall wear	yes 1 no 2	P14g

43	How do you dispose used pesticide containers?	Local waste containers 1 Burning 2 Burial 3 use to store food and seed 4 Throw anywhere 5 Give to rag pickers 6 Do nothing 7	P15

44. Amount of Pesticide in vegetables						
S.N.	Major crops	Trade name of common pesticides used	Common name of common pesticides used	Frequency of total spray per crop	Total time to spray per crop	
1.						
2.						
3.						
4.						
5.						
6.						
8						
9						

45 Stock of pesticides (for observation)				
SN	Trade name	Common name	Date of expiry(1=yes, 0=no)	WHO classification

Knowledge on health impact of pesticides

Question		Response	Code
46	Does pesticide affect human health	Yes 1 No 2	K1
47	Does pesticide affect livestock	Yes 1 No 2	K2
48	Does pesticides affect the environment	Yes 1 No 2	K3
49	Do you care the wind direction while spraying pesticides	Yes 1 No 2	K4
50	Do you chose the time for application during raining time	Yes 1 No 2	K5
51	Can pesticide enter into body by inhalation	Yes 1 No 2	K6
52	Can pesticide enter into body by Skin	Yes 1 No 2	K7
53	Can pesticide enter into body by mouth	Yes 1 No 2	K8
54	Can pesticide enter into body by eye	Yes 1 No 2	K9

Self reported health effects				
Questions		Response		Code
55	Have you felt any illness in the last month?	Yes	1	H1
		No	2	

			No. of time	When	
56	How many times did you suffer from following symptoms in last month (Do not prompt)		No. of time	When	
		Nausea	└─┴─┘	└─┴─┘	H2a
		Blurred vision	└─┴─┘	└─┴─┘	H2b
		Dizziness	└─┴─┘	└─┴─┘	H2c
		Skin irritation	└─┴─┘	└─┴─┘	H2d
		Salivation	└─┴─┘	└─┴─┘	H2e
		Muscular weakness	└─┴─┘	└─┴─┘	H2f
		Headache	└─┴─┘	└─┴─┘	H2g
		Trembling hands	└─┴─┘	└─┴─┘	H2h
		respiratory difficulties	└─┴─┘	└─┴─┘	H2i
		Extreme tiredness	└─┴─┘	└─┴─┘	H2j
		Vomiting	└─┴─┘	└─┴─┘	H2k
		Abdominal pain	└─┴─┘	└─┴─┘	H2l
		Loss of appetite	└─┴─┘	└─┴─┘	H2m
		Lack of coordination	└─┴─┘	└─┴─┘	H2n
		Excessive sweating	└─┴─┘	└─┴─┘	H2o
		Speech difficulty	└─┴─┘	└─┴─┘	H2p
		Dry mouth	└─┴─┘	└─┴─┘	H2q
		Back pain	└─┴─┘	└─┴─┘	H2r
		Other	└─┴─┘	└─┴─┘	H2 other
		Other (please specify)	└─┴─┴─┴─┴─┘		H2
57	Have you ever felt ill immediately after handling pesticides?	Yes	1		H3
		No	2		

58	Which of the following symptoms did you suffer?	Nausea	Yes	1	H4a
			No	2	
		Blurred vision	Yes	1	H4b
			No	2	
		Dizziness	Yes	1	H4c
			No	2	
		Skin irritation	Yes	1	H4d
			No	2	
		Salivation	Yes	1	H4e
			No	2	
		Muscular weakness	Yes	1	H4f
			No	2	
		Headache	Yes	1	H4g
			No	2	
		Trembling hands	Yes	1	H4h
			No	2	
		Respiratory difficulties	Yes	1	H4i
			No	2	
		Extreme tiredness	Yes	1	H4j
			No	2	
		Vomiting	Yes	1	H4k
			No	2	
		Abdominal pain	Yes	1	H4l
			No	2	
		Loss of appetite	Yes	1	H4m
			No	2	
		Lack of coordination	Yes	1	H4n
			No	2	
		Excessive sweating	Yes	1	H4o
			No	2	
		Speech difficulty	Yes	1	H4p
			No	2	
		Dry mouth	Yes	1	H4q
			No	2	
		Back pain	Yes	1	H4r
			No	2	
		Other	Yes	1	H4 other
			No	2	
		Other (please specify)	|__|__|__|__|__|		

59	What did you do to address the above problems?	Used self-medication	Yes	1	H5a
			No	2	
		Went to health center/ hospital/FCHV/SHP/ HP/PHC	Yes	1	H5b
			No	2	
		Take rest	Yes	1	H5c
			No	2	
		Do nothings	Yes	1	H5d
			No	2	
60	Do you know any pesticide poisonings in your village or family that happened during last year?	Suicide	Yes	1	H6a
			No	2	
			Don't know	77	
		Accident	Yes	1	H6b
			No	2	
			Don't know	77	
		Occupation	Yes	1	H6c
			No	2	
			Don't know	77	
		Other	Yes	1	H6d
			No	2	
			Don't know	77	
		Other (please specify)		└─┴─┴─┘	
61	Have you been told or diagnosed as a any kind of chronic diaseses?		Yes	1	**H7**
			No	2	
62	Have you been told or diagnosed as one or more of the following chronic diseases?		Diabetes	1	H8
			Cancer	2	
			Structural or Functional abnormalities of new born	3	
			Cardiovascular diseases	4	
			Chronic neuropathic	5	
			Arthritis	6	
			Thyroid hormone imbalance	7	
			Others	8	
		Other (please specify)		└─┴─┴─┘	
Laboratory Measurement					
63	Fasting blood sugar	mg/dl └─┴─┴─┘.└─┘			B1

64	Acetyl cholinesterase (AChE)	U/ml └─┴─┴─┘ . └─┘		B2
65	Hemoglobin	mg/dl └─┴─┴─┘ . └─┘		B3
66	Haemoglobin adjusted erythrocyte acetylcholinesterase (Q)	U/g └─┴─┴─┘ . └─┘		B4
67	Room Temperature			B5

Nepal Health Research Council (NHRC)
Ramshah Path, Kathmandu, Nepal
Tel : +977 1 4254220
Fax : +977 1 4262469
E-mail : nhrc@nhrc.org.np
Website : www.nhrc.org.np