FINAL REPORT

on

Study on National Pesticide Consumption Statistics in Nepal

Submitted to:

Government of Nepal

Ministry of Agriculture Development

Department of Agriculture

Plant Protection Directorate

Pesticide Registration and Management Section

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Acknowledgements

On behalf of Mount Digit Technology (P.) Ltd., we would like to extend our sincere gratitude to the Plant Protection Directorate (PPD) and Pesticide Registration and Management Division (PRMD) of Department of Agriculture for providing us opportunity to carry out "Study on National Pesticide Consumption Statistics in Nepal". In particular, we would like to thank Mr. Dilli Ram Sharma, Program Director, PPD and Mr. Achyut Prasad Dhakal, Chief, National Plant Quarantine Program and former Pesticide Registrar, PRMD for their profound support and encouragement in making this study a reality. We are also very grateful to Mr. Kaman Singh Thapa, Pesticide Registrar, PRMD, all staffs of the PRMD for their support throughout the study and sharing the information on pesticides.

Many experts from different disciplines contributed through their comments, and sharing insights and experience in preparation of this report. The support from Central Bureau of Statistics especially by Mr. Uttam Narayan Malla, former Director General, Mr. Suman Aryal, Deputy Director General (DDG) and Mr. Ambika Bashyal, Director of Agriculture Section for designing sampling framework and analytical procedure need acknowledged gratefully. Similarly, the contribution of Prof. Purusottam Singh, Chairman (Senior Statistical Expert), Citizen College and Mr. Hem Raj Regime, Senior Statistician, Ministry of Agriculture Development (MoAD), Mr. Raju Chaudhary and Mr. Min Raj Dangol of National Agriculture Research Council (NARC) is highly appreciated and acknowledged. We would like to thank also the technical staffs of District Agriculture Development office (DADO) of all 19 districts for their support that help us to complete this study. Thanks are due to all the farmers who cooperated willingly with the survey and provided the detailed information needed to prepare this report. Thanks are also due to Ms. Neeru Dahal, Program Director of Crop Development Directorate of DoA for sharing relevant pesticide usage information of different districts.

Finally, thanks are due to the study team members, Dr. Bhimsen KC, Team Leader, Mr. Ganesh Kumar KC, Mr. Bhakta Raj Palikhe, and Mr. Keshav Prasad Shrestha, members for their hard work in conducting the field study, data analysis and preparation of final report.

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Acronyms and Abbreviations

a.i.	Active ingredient
AChE:	Acetylchlorine Esterase
ANOVA:	Analysis of Variance
Bt:	*Bacillus thuringiensis*
CAC:	Codex Alimentarius Commissions
CBS:	Central Bureau of Statistics
CDR:	Central Development Region
CF:	Commercial Formulation
CMs:	Carbamates
CoP:	Conference of Party
CPPI:	Crop Production Program Initiatives
CTEVT:	Council for Technical Education and Vocational Training
DADO:	District Agriculture Development Office
DDT:	Dichloro-Diphenyl-Trichloroethane
DEPs:	Date-expired Pesticides
DFTQC:	Department of Food Technology and Quality Control
DoA:	Department of Agriculture
EDR:	Eastern Development Region
EPA:	Environmental Protection Agency
EU:	European Union
FAO:	Food Agriculture Organization
FWDR:	Far-west Development Region
GAP:	Good Agricultural Practice
GoN:	Government of Nepal
ha:	hactare
HH:	Household
HKR:	Hindukush Region
IA:	Extremely hazardous
IAAS:	Institute of Agriculture and Animal Science
IB:	Highly hazardous
IPM:	Integrated Pest Management
KFVM:	Kalimati Fruits and Vegetables Market
kg:	Kilogram

MoAD:	Ministry of Agriculture Development
MRLs:	Maximum Residue Limits
MWDR:	Mid- west Development Region
NARC:	National Agricultural Research Council
NC:	Not Calculated
NGO:	Non-Governmental Organization
NH:	Non-hazardous
NPV:	Nucleopolyhedrosis virus
OPs:	Organophosphates
PAN:	Pesticide Association of Nepal
PIC:	Prior Informed Consent
POPs:	Persistent Organic Pollutants
PPD:	Plant Protection Directorate
PPE:	Personal Protective Equipment
PRMD:	Pesticide Registration and Management Division
PUS:	Pesticide Usage Survey
RBPR:	Rapid Bioassay of Pesticide Residues
SAARC:	South Asian Association for Regional Cooperation
SMS:	Subject Matter Specialist
SPS:	Sanitary Phytosanitary
SPSS:	Statistical Package for Social Sciences
TL:	Team Leader
TOR:	Terms of Reference
UN:	United Nations
USA:	United States of America
WDR:	Western Development Region
WHO:	World Health Organization
WRI:	World Resources Institute
WTO:	World Trade Organization

Executive Summary

Worldwide, chemical pesticides use is still a common practice for the control of pests and Nepal is no exception. It has been widely accepted that pesticides are main causal agents' for continuing morbidity and mortality in developing countries, though total amount of pesticides used in the world is proportionately less in quantity than in developed countries, but much of morbidity and mortality associated with these agents occur in developing countries. In Nepal, it is estimated that 25-35 percent yield loss is caused by insect pests and diseases (Plant Protection Directorate 2013). The chemical pesticide use in Nepal is comparatively low, but the impact due to misuse and over use of pesticides is especially alarming in commercial production pockets. This has alerted many consumers. In comparison to other countries in the Asia Pacific Region, the use of chemical pesticides in Nepal is one of the lowest. Average pesticides use in Nepal is 142 gm. /ha (Dahal, 1995; Sharma, 2013). The pesticide misuse is further aggravated by the limited knowledge among the users on safe practice, toxicological and chemical properties of these substances. Many farmers are unaware of the long term and indirect effects of pesticides on food production systems, health of the farmers, consumers and the environment indicating urgent need to take necessary strategies to minimize the use and misuse of pesticides. Often data on pesticide usages are based from the information collected from farmers and pesticide dealers and this information seems obsolete and need updating the actual amount of pesticide use in agricultural area in the country. To this effect a survey on pesticide use was carried out in 19 districts to determine the pesticide consumption per ha, level of farmers' knowledge, attitude and perception about pesticide use, harmful effects of pesticides on food, environment and farmers.

The survey results showed that educational interventions such as on the spot training and demonstration and mass awareness program are crucial for promoting safety measures during all phases of pesticide handling. The farmers have very little knowledge on pesticides and also the pesticide regulations have not been enforced effectually. For improving this situation, the awareness on pesticide use, their alternatives such as IPM approach and administering the regulation from the government agencies for benefit of farmers, pesticide dealers and other concern stakeholders need to be applied in large scale. Study report shows that fungicides used in the greatest quantity, 60.40 percent of the weight of active ingredients applied followed by Insecticides with 37.13percent of the total weight of active ingredients applied. Most control products contain higher percentages of active ingredients and typically have II WHO Class. Similarly, it was observed that farmers have difficulty identifying pesticide products they use it. There are also continued concerns about the ability of pesticide users to read the label and correctly identify information. The data analysis revealed that the national average weight of pesticide active ingredients applied per hectare is **0.396 kg,** which is higher than the corresponding old value 142 gm. reported in 1995 but is lower than world average **0.50** a.i.kg/ha. Based on the study findings, there should be an integrated effort from

governmental and non-governmental organizations that focus on the awareness rising of farmers on proper pesticide management and related issues and an intensive advocacy is recommended on the enforcement of Pesticide Act and Rules especially in relation to the use of green pesticides for Agriculture. Research and development on the use of bio-pesticides and eco-friendly measures are highly recommended to minimize the use of hazardous pesticides. The finding of this study is oriented to the following recommendation: the need for awareness, education and training on the uses of pesticides to the farmers and effective monitoring program for pesticide residues in vegetables.

1. Introduction

1.1 Study Background

Worldwide, in most developing countries strategies to increase production and productivity with high chemical input use to fulfill the demands of a growing population has resulted in the widespread use of pesticides with little attention paid to environmental degradation and human health effects. Some of these pesticides are highly persistent and can last for many years before breaking down. These substances are capable of bio-accumulation and can travel globally. As there is little scope for easy expansion of agricultural land experts believe that with the use of pesticides, the production of crops can be increased up 35 percent. Majority of the farmers are unaware of pesticide types, level of poisoning, safety precautions to be taken while applying the pesticide and also the long term potential hazards on health and environment. In Nepal, the average crop losses in the country due to various pests range from 25 to 35 percent (PPD, 2012) and thereby contributing to food insecurity.

Many consumers are now concerned with safe and healthy food products and cleaner and safer natural habitat. Further, in this line the publication of Rachel Carson's Silent Spring in 1962, which is highlighted the risks from continuous use of chemical pesticides that produces significant negative externalities that have been broadly documented in the scientific literature (Pimentel et. al., 1992; Pimentel and Greiner, 1997). Pesticide misuse and overuse causes harmful effects on non-target organisms and adding extra burden to Nepalese society in terms of pesticide related health expenses, environment pollution, crop losses due to pest resurgence and spending extra costs both to farmer and country as whole (Thapa, 2003). Pesticide laws and regulations need to be execute defectively with timely updates. At the same time as alternatives to chemical pesticide Integrated Pest Management (IPM) approach need to be implemented covering wider areas and commodities as it has been successful in introducing the agro-ecosystem friendly technology for agriculture commercialization making farmers learn and apply ecological principle to manage their crops in better way and has been accepted as a helpful tool for the farmers producing safe food (KC., 2010).

Compared to other countries in the region, the use of chemical pesticides in Nepal is low (142 gm/ha). But, the pesticide use is more in commercial farming areas of vegetables, tea, and cotton (Table 7). The trend of pesticide use is increasing in Nepal by about 10-20 percent per year and it has been considered as one of the major factors for increasing the cost of fruits and vegetables (Jasmine et.al, 2008). Studies have shown that more than 90 percent of the total pesticides imported in the country are used in vegetable farming (Atreya and Sitaula, 2010) and here misuse is common. Unregistered and illegal products, open air sales, sales of banned products, cases of decanting and reweighing, fake products using counterfeit labels, sales of date expired products with modified expiry dates are some of the example of misuse

cases that have been reported in Nepal (Palikhe, 1998). This study report summarizes the information on pesticide use as reported by the farmers surveyed.

1.2 Statement of the Problem

The challenge of providing enough food is and will remain one of the most pressing and urgent need of Nepalese economy. This situation undoubtedly calls for an integrated approach towards increasing food production, productivity, and protection of food losses both in the pre and post-harvest operation without hampering the public health and the environment.

Most commercialized farmers rely heavily on the use of synthetic pesticides for pest control. These days though many of them are aware that pesticides are dangerous chemicals that can be hazardous to their health but, they seem to ignore this fact and handle the chemicals as if these are harmless, consequently farmers face acute health effects from periodic exposure to hazardous pesticide. It is mainly because of lack of awareness and knowledge on safe handling on chemical pesticides. The use of pesticides is much more intensive in areas that have greater access to markets especially in vegetable production. The use is higher in areas where commercial farming of vegetables, fruits, tea, rice and cotton is widespread. All types of pesticides are repeatedly used indicating poor knowledge and awareness on pesticide related issues among farmers as well as the consumers. Similarly, Pesticide Registration and Management Division (PRMD) of Plant protection Directorate (PPD) also depend on certification of the product and its quality as recommended by the foreign manufacturer. This division is not adequately equipped to verify the claims as submitted by the applicants and there is no regular system of collection of data on pesticides in terms of a.i consumption/ha. Due to inadequate capacity in regular monitoring of pesticide use and consumption pattern, there is gap in the availability of authentic data on per ha pesticide usage. No systematic studies have so far been made on pesticides consumption and there is lack of database for agricultural pesticides usage in order to evaluate pesticide use and pesticide consumption information at national level. Similarly, farmer's education and training to provide best estimates of the pesticide use is also weak to ensure data quality.

1.3 Rationale

Annual Pesticide sales data can provide overall information on the quantities of plant protection materials placed on the market. However, such data are not sufficient to assess the pesticide consumption status. Information on the crops treated, the amounts and types of products applied in each crop is required for proper assessment of the consumption and degree of risk. In past there has been little or no study done on the actual pesticide use, applications patterns and crop wise pesticide consumption patterns. Reliable information on use can only be obtained by means of regular, systematic surveys. It is high time to identify the need for detailed, harmonized and up-to-date statistics on sales and use of pesticides. This information not only helps to know the national statistics on pesticide use but also it

strengthens the national capacity and facilitates agricultural trade. To address these issues and enhance agricultural trade it requires appropriate studies in the field and on some important policy issues in line with the SPS/WTO agreement and other International Conventions/Treaties/Bilateral Agreements.

In this context, in depth research study, on monitoring and survey of pesticide use are critically needed in Nepal. The data and information generated will provide critical baseline information for use in assessing consumption of pesticides per ha at national level, the impact of pesticide use and over time period it will provide valuable information on pesticide use trends. This study, therefore, aimed at assessing the pesticide use, practice and hazards by rural communities in the target districts. The findings of the study are expected to provide insights on the trend of pesticide use, the frequency of use, its impacts on public health and the environment and quantification or estimation on pesticide consumption a.i. per ha. The Pesticide use survey (PUS) is a survey of a representative sample of agricultural, horticultural and other crops. The existing pesticide consumption data i.e. 142 gm/ha need to revise because this data is very old and do not reveal for crop specific, season specific and location specific. Therefore, intensive survey or study at national level is desired. At the same time, the status of pesticide use and misuse on the crop-wise and district-wise would be advantageous too.

1.4 Objectives of the study

General objective

To estimate an average national consumption of pesticide in Nepal in a.i. (in gm. or kg) per ha.

Specific objectives

The specific objectives of the study comprised the following:

- To calculate/estimate annual county level agricultural pesticide use
- To assess pesticide consumption on development regional basis
- To estimate pesticides consumption in a.i. (in kg) per ha/year in major crops in Terai, hills, valley and high hills
- To assess the pesticide related knowledge and perception of farmers.
- To assess safety precautions taken in pesticide application
- To address the pesticide related problems and support to formulate the programs and policy

1.5 Expected Outputs and Scope of the Work

The primary focus of the study was on assessing the pesticide consumption/ha in gm or kg a.i. conducting the field survey, field visit, data analysis and report writing.

Following outputs are expected to be achieved through this work:

- Output-1: Pesticides consumption in a.i. (in kg) per ha/year estimated
- Output-2: Farmer's perception in pesticide use and safety precautions taken in pesticide application identified
- Output-3: Report of the survey with recommendations produced

The assessment study attempts to assess tasks in the following areas

- Undertake a review of the existing and recent literature on pesticide usage statistics in Nepal so as to prepare a state of art report on "National Statistics on Pesticide Consumption" in Nepal
- Estimate pesticides consumption in a.i. (kg) per ha/year in major crops
- Assess the pesticide utilization practices of the farmers
- Assess the pesticide related knowledge and perception of farmers
- Assess safety precautions taken in pesticide application
- Review of institutional and regulatory mechanisms in pesticide management

1.6 Composition of Team Members for the Assignment

A team of four members carried out this consultancy work. The team comprises of Team Leader (TL) to coordinate the overall study and liaise with PPD and PRMD of DoA and relevant stakeholders; and two other members having wide expertise in pesticide management and one having economics and, statistician and/or data analyst background. There was a technical advisory team consisting of statisticians and toxicologist. Adequate number of Field Researchers (19), deployed and supervised by the study team members, supported to collect field information. The team was fully supported by adequate number of Field Researchers (19) who were deployed and supervised by the study teams to collect field information. The selected field researchers were having adequate field experience in such activities. They were given a half a day orientation training on data collection. Supervision of the fieldwork and quality (reliability and validity) of the data/information collected from the field were done in the middle of the ongoing survey and immediately after completion of survey. The study team worked closely with the PPD and PRMD personnel. The pesticide team working at district and central level were constantly consulted and relevant suggestions in each and every steps and process were provided.

1.7 Role of Usage Statistics

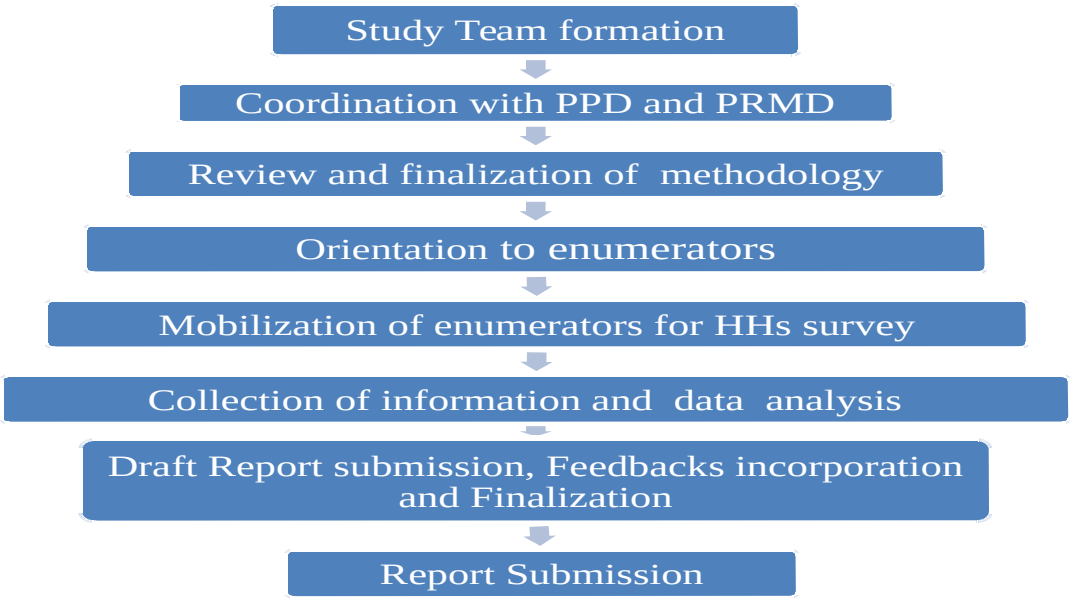
Usage statistics provide information on national and regional levels of pesticide use including the crop, the total amount of any one pesticide used annually, together with the areas treated and the range of crops to which it has been applied. Additionally, information on the total inputs of all pesticides to any one crop would also be available. The collection of a reliable

set of usage statistics has value in many areas of research, legislation and agricultural support, and should be seen as more than a simple statistical exercise in its own right.

2 Approach and Methodology

2.1 Approach

An inception workshop was held in PPD where the concept, scope, study approach, methodology and field mobilization plan were all discussed finalized. The study was differentiated into three parts: a) desk Study, b) field Study and c) analysis of collected information. During the desk study, various literatures, books and research papers were reviewed to understand and update the information regarding pesticide use. Initially, a literature review and consultation with stakeholders was conducted for detail planning. Two sets of questionnaires, one for farmers and one for pesticide traders, were developed to obtain household level data. Field study was carried out in the selected sites to collect the information on crop wise pesticide use and safety measures taken by the farmers. This information is used as the primary data for the estimation of national figure. The study approach has been participatory and result-oriented which involved all the relevant stakeholders in the process through using various tools and technique combined with conventional survey instrument such as household survey for generating the qualitative and quantitative information. To meet the objectives of the study, information was collected from both the secondary as well as primary sources. The methodological approach to address the accomplished outputs of the study is primarily “empirical research” as a substantial amount of data required for the study have been collected from the selected respondents, with supplementary information by secondary data, collected from various sources. The information has been gathered from several different sources and used as cross-reference as well. Both quantitative and qualitative data have been obtained for the analysis. A general approach adopted is as follow;



General Approach Adopted for the Study

2.2 Area and Crops of Study

2.2.1 Identification of the Surveyed Project Area

Districts representing different geographical areas and crops were identified, and data were collected to find the pesticide use in mountain, hill, Terai and valley representing ecological zones and development regions. The target districts for this study are given in Table 1.

Table 1: Target Districts for Questionnaire Survey

Ecological Zone	Development Region				
	Far West	**Mid-West**	**Western**	**Rautahat**	**Eastern**
Mountain	Darchula	Jumla	Mustang	Dolakha	Taplejung
Hill	Dadeldhura	Kalikot Salyan,	Gulmi	Kavre	Dhankuta
Terai Valley	Kailali	Banke Dang	Kapilvastu Kaski	Rautahat Chitwan	Jhapa

2.2.2 Crops Surveyed

Based on the arable land use the major crops were chosen for detailed study within regions/eco belts based on the regional and national significance (Table 2)

Table 2: Land Use Categories

S.N.	Arable Land use categories	Crops
1	Cereal	• Paddy (Spring and main season) • Maize (Winter, spring and rainy season) • Wheat (Winter and spring)-High hill • Finger Millet
2	Vegetables	• Cole crops • Cucurbits • Brinjal/Eggplant • Tomato • Potato • Legumes • Leafy Vegetable • Root Vegetable
3	Fruits	• Apple • Mango • Banana • Citrus
4	Cash Crops	• Sugarcane • Cotton • Tobacco • Tea • Coffee • Large Cardamom

S.N.	Arable Land use categories	Crops
5	Pulse Crops	• Pigeon pea • Gram • Lentil • Black gram • Horse gram
6	Oilseed	• Rayo (Tora) • Mustard • Rapeseed • Sunflower
7	Commercial Pocket Area and Off-season Vegetables in non-commercial area	Vegetables
8	Stored Cereals	Cereals

2.3 Sample Size

The sample size for the study was determined during the inception meeting and also conducting consultation meeting with the concerned officials in PPD, PRMD and NARC. A sample size of 1596 households was fixed considering the purpose of the study as well as available resources, and time for the study. Majority of the participant in the inception meeting agreed the proposed methodology to be objectively representative. The sample was further divided into two group based on the types of farming system; (1) 798 farmers in commercial production sites and (2) 798 in non-commercial production sites. The sample households for the survey were randomly selected from the list of households covered by crop production program initiative (CPPI) in each district. Basically, it is a "cross-sectional survey", based on a one-time survey of the situation in a farm community.

Eighty-four households (42 from commercial farming and 42 from non- commercial farming) from one target district were taken. Altogether, sample size was 1596 HHs in 19 target districts. Besides, 5-10 numbers of pesticide retailers were also added for the interview in each district.

2.4 Sampling Procedures

Simple random sampling technique was used to select 42 farmers from two wards of commercial farming area and 42 farmers from two wards of non-commercial farming area.

2.5 Methodology

2.5.1 Primary Information Collection

2.5.1.1 **Study area and commodities**

Study was carried out in mountain, hill, Terai and valley representing ecological zones and development regions of Nepal. Selected districts are given in Table 1. A range of land uses for different commodities/crops were chosen for detailed study within regions/eco belts based on the regional and national significance.

2.5.1.2 **Preparation of questionnaire**

Questionnaire for household survey (Annexes 5, 6, 7, 8) was prepared and discussed in the inception workshop for comments and feedback before the start of the field survey. The survey tools were finalized incorporating the comments and suggestions from the PPD and PRMD. The questionnaire was first developed in Nepali and translated into English for data entry. The questionnaire was pre-tested with 20 farmers (1.32percent of the sample size) to check the clarity, after the pretest, some corrections were made in the questionnaire. These farmers were not included in the main data collection process. The questionnaire was designed to collect pesticide data for major and minor crops. Pesticide usage data included the active ingredient used and area treated. Interviews, observations, stakeholders' consultations/meetings, sharing and validation workshops were conducted to gather information. The survey questionnaires comprise the following details:

Section	Number of questions	Details of each section
Section 1	21	Household information
Section 2	2	Sources of information
Section 3	18	Pesticide knowledge and perception of farmers
Section 4	5	Precautionary measures/safety and awareness about health
Section 5	13	Agro-vets/Pesticide retailers
Section 6	Quantitative information	Type of pesticides, actual quantity/volume of pesticides used, and National average estimation

2.5.1.3 **Selection and orientation of enumerators**

Enumerators with some past experience and educational background on relevant work and were recruited for household level data collection. They had work experience in educational, research and extension institutions. An orientation training of enumerators was organized for a day in Mount Digit Technology, Ekantakuna, Lalitpur. The training was facilitated by the Team Leader and other study team members. During the training, the enumerators were given orientation about objectives and scope of the study, sampling and survey procedure, content of the questionnaire including their duties and responsibilities during the field survey period.

2.5.1.4 **Method of primary data collection**

From the questionnaire, assessment methodology the data obtained was largely quantitative data. However, the questionnaire method was used to collect information in the sampled key locations supplementing the qualitative information also. Most of the quantitative information was concerned with pesticide use, application or frequency of pesticide and pesticide consumption in gm. or ml a.i. demographic variables such as farming area, education level, perception and knowledge of pesticide use, health related problems and safety measures. Primary data were collected through a semi-structured questionnaire survey method as described below in details:

2.5.1.5 **Household survey**

Household survey was carried out by administering semi-structured questionnaire of the randomly selected HHs. Through semi-structural interviews both qualitative and quantitative information were collected, the prime focus was on collection of quantitative data to allow quantification of socio-demographic, and pesticides consumption in a.i. (in kg) per ha/year in major crops, including pesticide utilization practices, pesticide related knowledge and perception of farmers and safety precautions taken in pesticide application.

Data on all inputs to the crop, till the harvest time were collected covering a period of previous 12 months. The total area surveyed is the sum of the areas cultivated with the crop in question for all the farms or fields covered by the survey. When the data are grossed-up at national/regional level, the total area surveyed corresponded to the area cultivated with the crop at country level. The total area surveyed is that which is represented by the survey.

2.5.2 Collection of Secondary Information

For secondary information, review of data and information were collected and analyzed from annual reports, research study report, published articles, research papers and records of governmental and NGOs.

2.6 Data Processing and Analysis

2.6.1 Data Analysis

Collected data was entered and analysis was conducted with SPSS software and Excel as per need of the available data and other information. Frequency distribution and percentages were used to describe the findings according to each specific objective. ANOVA was used to determine the significant differences between the averages of different region or between districts. For data entry dummy tables and variables were provided with coding.

The collected data is analyzed systematically in order to obtain the objective of the study. The data was analyzed through various methods. First, analysis was done by classifying the information belonging to one theme, then sub-themes, and later data was organized in a logical manner. All quantifiable data was arranged in tabular form in the form of ratios, frequencies and percentages. In the case of non-quantifiable data, content analysis was applied.

All results from the questionnaire were included in the summary tables. Qualitative data of the study is summarized and presented in a descriptive form in the report. Tables, figures and graphs are also used to present the data. Pesticide usage data included the active ingredient used and crops treated with number of applications. The baseline for calculating the consumption of pesticides per hectare was total agricultural land area under treated crop. Pesticide use, kilograms per ha, was calculated by dividing the total pesticide consumption, measured in kilograms of active ingredients, by the total hectare cultivated cropland.

2.6.2 Average quantity of pesticide applied per total (Surveyed) cultivated area

Average quantity applied per total surveyed cultivated area is the total quantity of active substances applied divided by surveyed area cultivated (kg/ha). Information on the use of pesticides on cultivated crops is collected from the previous year harvest. The survey was based on a sample of 1596 holdings, stratified by region and size and chosen to be representative of the main cultivated crops.

The following information related to pesticide use was considered important:

- crop treated
- area of crop grown
- product used
- amount used or rate of application (kg/ha)
- area of crop treated
- any biological control methods used

2.6.3 Producing National Estimates

Pesticide use, kilograms per hectare, is calculated based on the methodology from World Resources Institute (WRI), which is done by dividing the total pesticide consumption, measured in kilograms of active ingredients, by the total ha of cultivated cropland. Essentially, a statistically valid random sample will give an average use per hectare for each pesticide on each crop (within each region). Multiplying this by the total area grown (within each region) gives the total use.

3. Present Situations and Trend of Pesticide Use

3.1 Pesticide Management and Registration System

To promote environmentally sound management of chemicals, Nepal has got a pesticide registration system. The Pesticide Act,1991 and the Pesticide Rules,1993 cover measures to regulate import, manufacture, sale, storage, transport, distribution and use of pesticides. It is mandatory that any pesticide before distribution and importation should be first registered in accordance with the registration procedure adopted by the Pesticide Committee. Pesticides other than notified ones are not to be imported, exported, produced, used or distributed. The regulations also prohibit the sale of any pesticide, which is imported for scientific or research purposes. Government of Nepal shall, on the recommendation of the Pesticide Committee, publish the list with names of the registered pesticides in the Nepal Gazette. The licensing

control of hazardous chemicals prevents unauthorized persons from handling such chemicals. Reseller and importer license issued are valid for 3 years and 5 years respectively. The Pesticide Committee may cancel a license if the terms and conditions of that license are not followed. The authorities of Pesticide Inspectors are set out in the Pesticide Act and Regulations, which gives authority to the Pesticide Committee to prepare and enforce any guidelines on the matters relating to pesticides for the effective implementation of the Pesticide Act.

3.2 Review of the History of Chemical Pesticide Use

History of chemical pesticide use in Nepal is not old. Like any other country in the world, Nepal is confronted with the problems of extensive pesticide use and food security (Baker and Gyawali 1994; Palikhe 2002; Upadhyaya 2002). According to Dahal (1995), chemical pesticides were introduced into this country as early as 1955 when Paris green, Gamaxone, and nicotine sulfates were imported from the United States of America (USA) for malaria control. Dichlor-Diphenyl-Trichlorethane (DDT) made its first impact in Nepal in 1956. This was soon followed by a variety of other organo chlorine pesticides in the 1950s, organo phosphorous pesticides in the 1960s, carbamates in the 1970s, and synthetic pyrethroids in the 1980s. The most commonly used pesticides in Nepal are Malathion, chloropyriphos, methyl, cypermethrin, deltametrin, mancozeb, parathion-methyl, fenvelarate, dichlorvos, endosulfan sulphate, dimethoate and carbendazim (Palikhe 2001). Many cases misuses have been reported generally from farmers who do not realize the extent to which pesticides are poisonous and hazardous to humans and the environment. Farmers and retailers of pesticides do not have adequate knowledge regarding pesticide use and health safety (Giri 1998; Baker and Gyawali 1994; Dahal 1995). Furthermore, there are weak government control mechanisms to control the purchase, trading, import and export of pesticides.

In Nepal, the number of farmers using chemical pesticides has been increasing. Due to public perception, a large number of farmers still recognize pesticides as medicine, a notion implanted in the mind of the farmers. Unfortunately, many farmers and extension agents lack the technical skills for proper and effective use of pesticides. This has had many unfortunate consequences, including human and livestock exposure to pesticide poisoning, crop injuries, soil degradation, and environmental pollution.

Compared with other countries the use of chemical pesticides in Nepal is very low (142 gm a.i. /ha). Pesticide use, however, is much more in areas with intensive commercial farming of vegetables, tea, and cotton. The trend of pesticide use is increasing in Nepal by about 10-20 percent per year and expenses on pesticide in market oriented vegetables and fruit production has been a major cost factor (Jasmine *et al*., 2008). Studies have shown that more than 90percent of the total pesticides are used in vegetable farming (Atreya and Sitaula, 2010). A study showed that chemical pesticides are used by 25 percent of Terai households, 9percent

of mid hill households and 7percent of mountain households (CBS, 2003). In certain mid hill pockets close to urban markets, the pesticide use is considerably high (Sharma *et al*., 2012).

Pesticide misuse is an increasing problem in developing countries and, therefore, also in countries of Hindu Kush Himalayan (HKH) region (Neupane, 2002) and in Nepal (Baker and Gyawali 1994, Dahal 1995, Kansakar *et al*. 2002, Palikhe 2002, Uphadhyaya 2002, Neupane, 2002). It may cause yield reduction as a result of combined resistance, resurgence and secondary pest outbreaks, and damage of environmental resources like water and soil, and health problems, which affect both farmers and consumers as well.

There is a trans-boundary issue, illegal import of pesticides and banned pesticides over Nepal's boarder and such pesticides are found into local markets (Palikhe, 1998). Most farmers' do not understand the nature of pesticides as insecticides and fungicides as poisons (Palikhe, 2001). Many studies showed that the chemical pollution of the environment has long-term effects on human life. It is therefore essential that manufacture, use, storage, transport and disposal of chemical pesticides be strictly regulated (Palikhe 2001).

Various studies in Nepal (Dahal, 1995; Pujara and Khanal, 2002; Atreya, 2007) reported the massive use of chemical pesticides in vegetable growing areas that raised issue of possible health risks. Pesticide pollution not only affects human health, but also other ecological assets, such as soil surface and ground water, micro and macro flora and fauna, etc. (Pimental, 2005). Studies conducted in the past, shows that the chemical pesticides are intensively being used in agricultural production in Nepal. Pesticide consumption in the country has changed a significantly during past one-decade. The largest quantity of pesticides is used in rice (40–50 percent) followed by grain legumes (14–20 percent), fiber crops (13–15 percent), and vegetables and fruits (10–20 percent), and the use of various pesticides has been found in the following order: insecticides, fungicides, herbicides, rodenticides, others. Pesticide use pattern on crops is as follows: use after pest outbreak (59 percent) followed by preventive control (39 percent) and post-harvest control (2 percent) (Manandhar and Palikhe, 1999).

Misuse of pesticides, especially the broad-spectrum ones in Nepal has caused pests to adapt and become resistant to the pesticides (Yadav and Lian, 2009). Most pesticides are then required at higher doses to achieve the same level of control. Farmers generally do not follow the pre-harvest waiting period. They apply pesticides near harvesting time, and some farmers even dip vegetables in pesticides before selling (Dahal, 1995; Sharma, 2011). The proportion of vegetable growers using pesticides increased from 7.1 percent in 1991/92 to 16.1 percent in 2001/2002 (CBS, 2006). In the case of cereal crop growers the rate of increase is small. In the last three census of 1981/82, 1991/92 and 2001/02, the percent of pesticide users among maize growers were 0.9, 2.8 and 4.2percent, respectively (CBS, 2006). The study on productivity of Vegetable farming in Nepal estimates the optimal amount of pesticide per

hectare on Cole crop to be 680 grams of active ingredients, the average farmer in Bhaktapur uses 3.9 times as much pesticide as this optimal amount. Over 70 percent of the farmers use pesticides above the optimal level despite very small increases in yield attributable to pesticide applications (Jha, R.K and Regmi AP, 2009). Commodity wise detection of pesticides showed the highest level of residues in root vegetables (11.9 percent) followed by leaf vegetables (10.9 percent) (Koirala et al, 2009). The trend of pesticide use is increasing in Nepal by about 10-20 percent per year and expenses on pesticide in market-oriented vegetables and fruit production has been a major cost factor (Jasmine et al., 2008). Studies have shown that more than 90 percent of the total pesticides are used in vegetable farming (Atreya and Sitaula, 2010). In the 1980s, one percent of the wheat growers applied pesticides in their farming operations (CBS, 2006) while less than one percent of the rice, maize, potato and sugarcane growers used pesticides during the same period. Among the development regions the use of chemical pesticides was higher (31.9 percent of the total use) in the CDR and the lowest (6.4 percent in the FWDR in 2001/02. On an ecological basis, the highest average percentage of land using pesticides is the Terai (12 percent), followed by the hills (4.9 percent) and finally the mountains (0.7 percent), mostly on crops like rice, maize, wheat, potato and vegetables (Kansakar, 2002).Most of the households depend on agriculture for their livelihood and use pesticides for protecting their crops from various pest attacks. Rice, maize, wheat and mustard are treated 1-3 times per crop cycle whereas potato, tomato, cabbage, bitter gourd and cucumber are treated 2–15 times. Farmers have low knowledge on pesticides and their uses, as a result, general precautionary measures are also lacking (Shrestha & Neupane; 2002).

Pesticides are sold freely as consumer goods, farmers easily get it. A survey study on Pesticide Use on Paddy and Vegetables showed that use of pesticide per ha of crop land on cauliflower in Bhaktapur, Kavre, Sindhupalchowk, Dhading and Sarlahi districts was 2.5 kg a.i., 5 kg a.i., 9.4 kg a.i. 5.6 kg a.i. and 8.7 kg a.i. respectively (based on surveyed area treated). Pesticide consumption is the highest at 9.4 kg a.i. per ha of land of Sindhupalchowk district as against Bhaktapur, Kavre, Dhading and Sarlahi. An average consumption of pesticides per ha is 4.9 kg a.i. in cauliflower. It is also reported that an average pesticide use per ha of tomato land in above mentioned districts is 14.5 kg a.i. The report revealed that an average application of pesticide in seven districts (Jumla, Banke, Morang, Kailali, Syanja, Dhanusa) is 0.38 kg a.i per ha of surveyed irrigated paddy land (BPRC, 2005).

The study on use of pesticides in vegetable crops focused on the pesticide use of two districts (Gorkha and Tanahun) and average consumption of pesticide is 5.6 kg per ha (Baral, 2007). The application of pesticides in commercial vegetables is reported to be around 1450 gm/ha which is exceptionally high in Nepalese context (Sharma, 1994). Pesticide consumption data of District Agriculture Development Offices (DADOs) from few of the districts, show excessive use of pesticides is common in commercial production area i.e. mainly vegetables.

The data reveal that Districts like Kavre, Morang, Chitwan, Siraha, Sindhuli, Dhading, Makawanpur, Parsa, Bara, Rautahat, Kaski, Dang, Banke, Kailali, and Kanchanpur, having the commercial vegetable production area use more pesticides as compared to other districts. However, some districts (which data is not available) like Jhapa, Ilam, Sarlahi, Kathmandu valley, Nawalparasi, Rupandehi, Kapilvastu etc. seems to use high pesticides, whose data are however, unavailable at present (GC, 2012).

Health risks might still be through pesticide accumulation in the food chain and unsafe application practices. Lacking precautions also comprise too short waiting periods between pesticide application and crop consumption (Hermann A, Schumann S. 2002). The current trends of increase in volume of pesticides use seems very high so national average value of pesticide consumption of 142 gm/ha needs to be revised. On an ecological basis, the highest average percentage of land using pesticides is the Terai (12 percent), followed by the hills (4.9 percent) and finally the mountains (0.7 percent), mostly on crops like rice, maize, wheat, potato and vegetables (Kansakar *et al*., 2002).A study showed that chemical pesticides are used by 25 percent of Terai households, 9 percent of mid hill households and 7 percent of mountain households (CBS, 2003). In certain mid- hill pockets close to urban markets, the pesticide use is considerably high.

Pesticide safety and protection of consumers' health is the absolute priority of all countries. In recent years, relevant progress has been made in food policy and regulation for pesticide control. Department of Food Technology and Quality Control monitors regularly pesticide residues in food products (Koirala *et al*., 2008). GoN has accorded high priority to integrated pest management (IPM) to minimize pesticide risk (PPD, 2008).

A study in India showed that 31 percent of farmers complained of headache, 27 percent eye irritation, 24 percent skin burning, 10 percent nausea and 9 percent dizziness associated with plant protection sprayers (Rao *et al*., 2009). Many farmers do not care about the safe handling of pesticides. Studies have reported that more than 50 percent farmers used their bare hands while mixing pesticides (Shrestha *et al*., 2010). Many farmers do not care about the safe handling of pesticides. Studies have reported that more than 50 percent farmers used their bare hands while mixing pesticides (Shrestha *et al.,* 2010).

The developing nations utilize only 20 percent of world total pesticides applied. Despite increasing application of tons of pesticides worldwide, more than 40 percent of all potential food production and another 20 percent of the harvested crop is lost to pests (Paoletti and Pimentel, 2000). For example, a 33-fold increase in pesticide use in the United States since the 1940s, crop lost due to pest have not changed significantly (Raven *et al*., 2008). Only a small amount of the applied pesticide actually reaches the intended target organism and the vast majority ends up elsewhere in the environment (Pimentel, 2005; Pimentel and Burgess, 2012). Less than one percent of pesticides applied to the agriculture reach their target pests,

and more than 99 percent of it adversely affects unintended targets including the public and environmental health (Pimentel, 2005) and pesticides pollute environment and ecosystems and marginalize human populace thus its use and sale is under strict control in many developed countries (Atreya *et al*., 2012)

3.3 Registered Pesticides in Nepal

In total 108 different pesticides (by common name) have been registered under different trade names (1098) (Table 3). Some pesticides under different trade names have created confusion among the farmers as they think the products are different in their use. Most pesticides used in Nepal are imported from India, some from China and Japan and other countries on the basis of registration. Distribution of pesticides in Nepal is conducted only in the form of finished products.

In Nepal, 1098 types of pesticides by trade name (Insecticides-613, Fungicides-304, Herbicides-120, Rodenticides-18, Acaricides-12, Bacteriacides-7, Molluscicide-1 and Bio-pesticides-23) and 108 common names (Insecticides-44, Fungicides-31, Herbicides-18, Rodenticides-2, Acaricides-4, Bacteriacides-2, Molluscicide-1 and Bio-pesticides-6) have been registered up to 2069/11/30 for use under Pesticides Act and Rules. At present, there are about 67 pesticide importers and 5 company/firms involved in pesticide formulation. Some 8222 resellers are trained on safe use of pesticides and storage management, of which 6660 are licensed.

Table 3: Summary of registered pesticides up to 2069/11/30

S.N.	Pesticides	Trade name	Common name
1	Insecticide	613	44
2	Fungicide	304	31
3	Herbicide	120	18
4	Bio pesticide	23	6
5	Rodenticide	18	2
6	Acaricide	12	4
7	Bactericide	7	2
8	Molluscicide	1	1
	Total	1098	108

3.4 Importation of Pesticides

Based on the latest data from Pesticide Registration and Management Division under Plant Protection Directorate of the MoAD/GoN, the annual import of pesticides including local formulation during 2007/08 was almost 347.48 mt of a.i., 356.34 a.i. in 2008/09, 211.0 a.i. in 2009/10, 335.65 a.i. in 2010/11 and 345.0 in 2011/12 (Table 4). Pesticide imported and formulated in 2009/10 increased by 136.48, 145.34, 124.65 and 134 metric tons as compared with 2007/08, 2008/09, 2010/11 and 2011/12 respectively. It is somewhat difficult to document the amount of illegal trading and thus the size of such trading has not been

reflected in the public report. Due to open boarder, it is very difficult to control the illegal entry of pesticides into Nepal. As a result the total quantity of imported pesticides is unknown. Despite all, in comparison to other countries in the Asia-Pacific region, the use of chemical pesticides in Nepal is comparatively small.

The gross sales and values account NRs. 272681.3, 351672.48, 207688.05, 397782.15 and 374908.20 (in '000) in FY 2007/08, 2008/09, 2009/10, 2010/11 and 2011/12 respectively (PRMS, 2069). Of the 108 different pesticides, based on WHO risk classification system, 2 (1.87 percent) are highly hazardous (WHO class Ib), 39 (36.44 percent) moderately hazardous (class II), 19 (17.75 percent) slightly hazardous (class III), 45 (42.06 percent) low risk (class NH) and 2 (1.87 percent) not calculated. None of them is extremely hazardous (IA).

Table 4: Import and formulation (a.i. MT)

S.N	Pesticides	Year				
		2007/08	2008/09	2009/10	2010/11	2011/12
1	Insecticides	60.28	105.81	61.61	96.11	114.71
2	Fungicides	237.37	203.39	129.56	183.89	166.81
3	Herbicides	6.57	11.12	15.68	46.69	53.47
4	Others	40.56	33.20	2.61	6.69	9.84
5	Public Health Insecticides	2.70	2.81	1.60	2.27	0.17
	Total	347.48	356.34	211.0	335.65	345.0

3.5 Trend of Bio-pesticides Import

Bio-pesticides are a set of tools and applications that will help our farmer's transition away from highly toxic conventional chemical pesticides. In Nepalese case, bio-pesticides play only a small part of a larger solution but it is coming up.

Botanical insecticides also play only a minor role in insect pest management and crop protection. Recent studies suggest that extracts of locally available plants can be effective as crop protectants in vegetables. This study suggests that indigenous knowledge and traditional practice can make valuable contributions to domestic food production in Nepal. The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt. The field study revealed that farmers used Botanical Pesticides; *Azadirachtin* (Neem), *Justica adhatoda* (Ashuro), *Eupatorium adenophoram* (Banmara), *Acorus calamus* (Bhojo), *Artemisia sp* (Tite pati), *Xanthoxylum armatum* (Timur) and *Melia azedarach* (Bakaino) and Biological Control using NPV, Bt.

The field of bio-pesticides is deep; consequently, they are a source of both optimism and concern. There is a tremendous amount of work and research occurring in this field in the world, but like other green chemistry solutions, developing safe, effective bio-pesticide products requires holistic thinking and multi-disciplinary approaches establishing safety,

which is a challenge for the bio-pesticide users. Bio-pesticide solutions often require the grower to learn new application techniques and new ways of thinking about pest management.

Share of bio-pesticides is only 0.035 percent of total quantity of active ingredient of pesticides imported and used in Nepal in 2011/12. Earlier, it was very small that is 0.023 percent in 2010/11. However, import and use of bio-pesticides in Nepal exhibit sharp increasing trend (Table 5). This data do not include the local botanical pesticides, pheromones and natural enemies at all. There are 23 commercial products of bio- pesticides registered in Nepal (PRMD, 2069). The negative impacts of synthetic pyrithroids and increasing pesticide resistance have increased the interest in alternative control methods, with emphasis being placed on botanical pesticides and biological control. Field results indicated that 88 percent were familiar with botanical pesticides and 92 percent farmers were not familiar with biological control. Manufacturing of bio-pesticides has been started in three districts; Kavre, Banke and Kailali and the government plans to establish in Chitwan and Kapilvastu from 2013 year (PPD, 2013) also.

Table 5: Trend of Bio-pesticide Import (a.i. Kg)

S.N.	Bio-pesticides	Year				
		2007/08	2008/09	2009/10	2010/11	2011/12
1	Botanical Pesticides	-	-	-	-	6.1
2	Microbial Pesticides	-	-	-	-	115.6
3	Combined (Botanical and Microbial Pesticides)	57.115	30.08	82.08	78.26	-
	Total	57.115	30.08	82.08	78.26	121.7

3.6 Banned and Restricted Pesticides

Since 2001, Nepal has banned all the POP pesticides such as DDT, Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, Toxaphene and Mirex, endosulfan and other pesticides (BHC, Lindane, Methyl parathion, Monocrotophos, Phosphamidon, organo-mercury compounds) (Table 6). However, due to trans-boundary movement and illegal importation, some of the banned pesticides are still found in local markets. There is only little or no information on such illegal movements regarding the name and quantities of chemical pesticides sold. Misuse of insecticides is common in Nepal. Unregistered and illegal products, open-air sales, sales of banned products, cases of decanting and reweighing, fake pest control products using counterfeit labels, sales of expired products with modified expiry dates are among the misuse cases that have been reported in Nepal (Palikhe 1998)

Endosulfan is an off-patentorgan chlorine insecticide and acaricidethat is being phased out globally. Endosulfan was developed in early 1950s. It is used to control a wide range of sucking and chewing insects, including aphids, thrips, beetles, foliar feeding caterpillars, mites, borers, cutworms, bollworms, bugs, whiteflies, leaf hoppers and tsetse flies. It is

widely considered to be a POP. It is volatile and has the potential for long-range atmospheric transport and therefore contaminates environments far from where it is used. It is stored in the fatty tissues of animals and humans, accumulating up the food chain, including in mothers' milk.

The Stockholm Convention entered into force on 17 May 2004, thus becoming an international law. The Conference of Parties (COPs) has identified 22 POP-chemicals (initial dirty dozen, nasty nine and endosulfan) for global control actions. Three additional POP-candidates have been proposed for sixth COP's consideration at Geneva, 2013. International steps were taken to restrict the use and trade of endosulfan. It is recommended for inclusion in the Rotterdam Convention on Prior Informed Consent and the European Union proposed inclusion in the list of chemicals banned under the Stockholm Convention on Persistent Organic Pollutants. Such inclusion would ban all use and manufacture of endosulfan globally.

Over the last ten years, endosulfan is increasingly viewed globally as a priority for phase-out (Watts, 2008).The European Union withdrew its approval in 2006 and notified it to the United Nations Prior Informed Consent (PIC) Rotterdam Convention as banned for agricultural use in Europe for health and environmental reasons. Apart from human health incidents, regional monitoring studies on water and aquatic fauna indicated endosulfan is a common water pollutant, contaminating surface, groundwater and wells for drinking water.

In March 2007, the Chemical Review Committee of the Rotterdam Convention on the Prior Informed Consent Procedure (PIC Convention) recommended the inclusion of endosulfan in its Annex III. Table 3 is the list of chemicals that have been banned or severely restricted for health or environmental reasons by Parties to the Convention. In July 2007 the Council of the European Union (EU) made the decision to propose endosulfan for listing in the Stockholm Convention on POPs Convention for global elimination.

The Stockholm Convention's Persistent Organic Pollutants Review Committee (POPRC) agreed that endosulfan is a persistent organic pollutant and that "global action is warranted", setting the stage of a global ban in 2009. The POPRC nominated endosulfan to be added to the Stockholm Convention at the COP in April 2011, which would result in a global ban. The EPA announced that the registration of endosulfan in the USA will be cancelled. Australia banned the use of the chemical. The Supreme Court of India banned manufacture, sale, and use of toxic pesticide endosulfan in India in 2011. A complete list of countries where endosulfan is currently in use does not exist.

In September 2004 the Conference of the Parties added a further set of chemicals based on work completed during the interim PIC procedure. In October 2008 an additional chemical was added in the list of Annex III chemicals. There are a total of 43 chemicals listed in Annex III, 32 are pesticides (including 4 severely hazardous pesticide formulations) and 11 industrial chemicals.

Being signatory country to Stockholm Convention, Endosulfan was banned for importation in Nepal by the Government of Nepal effective 2069/07/20 with a two-year phase-out for stock of endosulfan-containing products (i.e. deregistered in 2069/7/20) and livestock endosulfan may be used and distributed till 2071/07/19 (i.e. grace period for sale and use till 2071/7/19). Thus, the use of endosulfan, which has not expired, may be allowed for sale and distribution in Nepal so as to exhaust the existing stock of raw materials and finished products. No parties provided information on volumes of endosulfan in Nepal.

Highly hazardous pesticides are banned and restricted to use in most of the countries. India has banned 28 pesticides and those do not include highly hazardous pesticides like monocrotophos, phosphamidon, phorate, lindane, methyl parathion and endosulfan, whereas Nepal has banned only 15 pesticides till date.

Table 6: Banned pesticides in Nepal

S.N.	Name of pesticide	Remarks
1	Chlordane	POP
2	DDT	POP
3	Dieldrin	POP
4	Endrin	POP
5	Aldrin	POP
6	Heptachlor	POP
7	Toxafen	POP
8	Endosulfan*	POP
9	Mirex	POP
10	Lindane	POP
11	BHC	
12	Phosphamidon	
13	Organo mercury fungicides	
14	Methyl parathion	
15	Monocrotophos	

*POP: Deregistered in 2069/7/20, grace period for sell and use till 2071/7/19.

3.7 Pesticide Consumption in Nepal and other Countries

Globally, there is little hard data available on consumption of pesticides per unit area and crop in terms of frequency and quantity, method of pesticide use at farmer level. Similarly, crop wise pesticide use, technical information and its source, the appropriate pesticide use, management information of surplus/unused pesticides and data on adverse health, environmental effects of pesticide misuse and pesticide pollution is also not available.

In developed countries like USA, Europe, Japan, China, etc. pesticide use is many times more than in Nepal. Per hectare consumption of pesticide in Nepal is 142 gm which is lower than the world average of 500 gm ai/ha **(**Kodandaram, M.H., Saha, Sujoy, Rai, A.B., Naik, Prakash S. 2013). Although Nepalese average consumption of pesticide is far lower than many other developed economies (Table 7), the problem of pesticide residue in specific crops

and location is assumed to be high in Nepal. The pesticide consumption status in Nepal is presented in Table 7.

Table 7: Pesticide consumption status in Nepal

Date	Crop/Commodity	Results	Remarks
Sharma, 1994	Commercial vegetable	1.45 a.i. kg/ha	
Dahal L., 1995	National Average	142 gm/ha	IUCN report
Sharma D.R.2013	National Average	142gm/ha	PPD report
Thapa, 1997	Cotton	2.56 ai kg/ha	Thapa, 1997
Thapa, 1997	Tea	2.1 ai kg/ha	Thapa, 1997
BPRC, 2005	Cauliflower	Ave: 4.9 ai kg/ha	Bhaktapur, Kavre, Sindhupalchowk, Dhading, Sarlahi
BPRC, 2005	Tomato	Ave: 4.5 ai kg/ha	Bhaktapur, Kavre, Sindhupalchowk, Dhading, Sarlahi
BPRC, 2005	Paddy	Ave: 0.38 ai kg/ha	Jumla, Banke, Morang, Kailali, Syangja, Dhanusa

Global pesticide consumption scenario

The Global Consumption pattern of pesticides is presented in Table 8. The highest pesticide consumption pattern has been observed in Taiwan (17 a.i.kg /ha) followed by Hungary (12.57 a.i kg/ha) Japan (11a.i. kg/ha) and R.O. Korea (6.60 a.i. kg/ha).

Table 8: Pesticide consumption (a.i. kg/ha) in different countries

S.N.	Country	Pesticide use (a.i. kg/ha)
1	Japan	11.00
2	Europe	2.50
3	USA	2.25
4	France	3.07
5	India	0.38
6	Latin America	0.22
7	Oceania	0.20
8	Africa	0.13
9	Argentina	0.295
10	Indonesia	0.575
11	Thailand	1.367
12	Mexico	1.367
13	Rep. of Korea	6.60
14	Hungary	12.573
15	Italy	4.17
16	China	2.0-2.5
17	Pakistan	1.3
18	Bangladesh	0.400
19	Taiwan	17.00
17	World average	0.50
18	Nepal	0.142*

Sources: Arora *et al*., 2011, Compendium on Pesticide Use in Vegetable, Indian Institute of Vegetable Research (Indian Council for Agriculture Research), March 2013 and Dahal, L.1995*.

3.8 Misuse of Pesticides

Misuses of pesticides are common in Nepal. Misuse of pesticides, especially the broad-spectrum ones in Nepal has caused pests to adapt and become resistant to the pesticides (Yadav and Lian, 2009). Most pesticides are then required at higher doses to achieve the same level of control. Farmers generally do not follow the pre-harvest waiting period. They apply pesticides near harvesting time, and some farmers even dip vegetables in pesticides before selling (Dahal, 1995; Sharma, 2011). Misuse of pesticides has been reported from farmers, distributors and importers who do not realize the extent to which pesticides are poisonous and hazardous to human beings and environment. Unregistered and illegal products, open-air sales, sales of banned products, cases of decanting and reweighing, fake pest control products using counterfeit labels, sales of expired products with modified expiry dates are among the misuse cases that have been reported in Nepal.

Pesticide overuse can cause pollution of soil, water, and air making unstable ecosystem, pest build of resistance to pesticides, all of which result in unsustainable agriculture. They do play an immunosuppressive role for aquatic fishes and amphibians causing decline of species and number in total (Saied *et al*., 2010). They also cause death of wildlife and bees disturbing the ecosystem chain. Organic farming and following practice of IPM, which ensure the sustainability in agriculture with judicious use of all pest management options, will be better alternatives. IPM generally refers to the pest management system that utilizes all suitable technique and methods as compatible as possible keeping the pest below economic injury level.

3.9 Carcinogenic Pesticides

The following is a list of 24 pesticides, classified as Potential Carcinogens by the US EPA:

Acephate (C), Alachlor (B2), Atrazine(C), Benomyl (C), Bifenthrin (C), Captan (B2), Chlorothalonil (B2), Cypermethrin(C), Dichlorvos (C), Diclofop-Methyl (C), Dicofol (C), Mancozeb (B2), Methomyl (C), Metolachlor (C), Oxadiazon (C), Oxyflourfen (C), Permethrin (C), Phosphamidon (C), Propiconazole (C), Propoxur (B2), Thiodicarb (C), Thiophanate Methyl (C), Triadimefon (C), Trifluralin (C).

Group B2 is used for Agents for which there is sufficient: evidence from animal studies and for which there is "inadequate evidence" or "no data" from epidemiologic studies.

Group C–possible human carcinogen

3.10 Maximum Residue Limits

Pesticide residues are a major concern in fresh vegetables and their products for domestic consumption and export. Technically, pesticide residue in food is regulated using a set of quantitative standards called Maximum Residue Limits (MRL). The MRL specifies the

amount of pesticide residue that is allowed in food products. In Nepal, The Department of Food Technology and Quality Control (DFTQC) regulate MRLs of pesticides. In the absence of an established MRL, the DFTQC generally refer to FAO/WHO's CAC MRLs. The Codex MRLs serve as the reference standards in international trade, but many industrialized countries use their own set of MRLs for import and domestic food products. The EU MRLs are generally lower than USA MRLs, and often lower than Codex MRLs.

3.11 Rapid Bioassay of Pesticide Residue

The Rapid Bioassay for Pesticide Residue (RBPR) developed in Taiwan in 1985 and since then it has been successfully adopted as a supplement to sophisticated chemical analysis. It is a low- cost alternative to chemical analysis to achieve quick test results for pesticide residues in order to protect local consumers from contaminated vegetables. It is practical for use in screening large samples so that contaminated produce can be withdrawn from the farm gate or local market before they reach the consumers. PPD of DoA with DFTQC and Kalimati fruits and vegetable Market (KFVM) have established a laboratory that will assess chemical residue in vegetables on the premises KFVM.

The Directorate, under the Department of Agriculture test possible residue of chemicals that fall under organophosphate and carbamate group in vegetables by using the RBPR analysis technique. Reportedly, the technique is highly efficient in analyzing chemicals that fall under the group. Official data reveal that more than 60 per cent of pesticides imported in Nepal are from this chemical group.

Regular consumption of such chemically treated vegetables is to cause adverse effects on the human nervous system. It destroys or restricts secretion of AChE, which is essential for normal functioning of nervous system. Cholinesterase is one of many important enzymes needed for the proper functioning of the nervous systems of humans, other vertebrates, and insects. Certain chemical classes of pesticides, such as organophosphates (OPs) and carbamates (CMs) work against undesirable bugs by interfering with, or 'inhibiting' cholinesterase.

Using AChE, the RBPR analysis technique finds the inhibition per cent which determines whether the produce is consumable or not As per the working procedure for Rapid Bioassay for Pesticide Residue (RBPR) analysis technique laboratory issued by MoAD, only vegetables with AChE inhibition below 35 percent pesticide residue will be categorized as acceptable and safe´ for consumption purpose, while those with inhibition between 35 to 45 percent need quarantine for 4-5 days and then the produce especially vegetables are rechecked in the lab for pesticide residue after quarantine. If the samples are found below the 35 percent, the vegetables are permitted for sale in the market. However, vegetables with pesticide residue of 35-45 percent will be acceptable only if they are consumed after 4-5 days.

MoAD has categorized vegetables having more than 45 percent pesticide residue as harmful to human health. Vegetables with more than 45 percent pesticide residue are harmful not only to human being but also animals. Such vegetables with more than 45 percent pesticide residue should not be consumed and need to immediately dump such vegetables regardless of their quantity.

Adopting this technique will help generate awareness among farmers, while consumers too will have access to safe food. This technique will help acquire information regarding the use of pesticides in different districts of the country. In the future, Government should develop good infrastructure with enough fund for rapid detection of pesticide residue that will be useful for the assurance of safety.

Overexposure to organophosphate and carbamate insecticides can result in cholinesterase inhibition. These pesticides combine with acetylcholine esterase at nerve endings in the brain and nervous system, and with other types of cholinesterase found in the blood. This allows acetylcholine to build up, while protective levels of the cholinesterase enzyme decrease. The more cholinesterase levels decrease, the more likely symptoms of poisoning from cholinesterase inhibiting pesticides are to show. Anyone exposed to cholinesterase-affected pesticides can develop lowered cholinesterase levels. However, the interpretation of cholinesterase test results should be done by a physician. A 15-25% depression in cholinesterase means that slight poisoning has taken place. A 25-35% drop signals moderate poisoning, and a 35-50% decline in the cholinesterase readings indicates severe poisoning.

The MoAD has also underlined the need to make local farmers and traders at collection centers aware of the negative aspects of excessive use of pesticide residue in fruits and vegetables. It has also said that legal action could be taken against farmers and traders who repeatedly supply fruits and vegetables with high pesticide residue.

4. Government Policies and Programs on Pesticide

There is a regulatory infrastructure established for the management of pesticides in Nepal. It covers all handling and use aspects of pesticides. The importers wishing to market and sell pesticides must submit an application dealing with the use of pesticides, toxicity and the correct use of pesticides in agriculture and health sector from the health point of view. No pesticide may be imported into the country without the appropriate certificate of importation issued by Registration Authority.

Large persistent chemical pesticides have been banned for agriculture and public health from 9th April, 2001 and also hazardous pesticides have been phased out from the use since 9th April, 2001. At present, prohibition on the use of Quinalphos, Ethion, Monocrotophos and Phorate in the tea field is being campaigned and implemented from 9thMay, 2005 because these pesticides are highly toxic. The pesticides to be imported, distributed, traded and used should be friendlier and less hazardous to health and environment. More emphasis has been given to use organic pesticides as an alternative of chemical pesticides to control crop pests. Development and use of some microbial and botanical pesticides which are eco-friendly has opened a new field of bio-pesticides. The best know form of bio-pesticide is the *Bacillus thuringensis* (Bt). Eco-friendly neem formulations are also being used currently. IPM has been widely accepted as the alternative to pesticide application. The significant being phasing out of an environmental unfriendly pesticides are rigorous approval of the newer and more safer and specific molecules. Government has already conducted or is regularly lunching training programs to educate the concerned personnel. In Nepal, as in most of the other developing countries in the region, the capabilities, expertise and resources to fully implement the regulation are limited. Further, there is a need to strengthen the scientific and technical base for health and environmental risk assessment.

5. Problems Associated with Pesticides

Both the misuse and excessive use of pesticides disturbs the natural ecosystems and creates environment pollution (air pollution, water pollution and soil pollution). In addition to these they create adverse effect on public health, effect on wildlife and fishes, pesticide residues in food grain, vegetables, and milk etc., detrimental effect on natural enemies, insect resistance to pesticide, pest resurgence, secondary pest outbreaks and incidental loss of life due to pesticide contamination or deliberately intake etc. Pesticides related problems in Nepal are difficult to detect except poisoning cases, which however, may have posed long-term effects to the non-target organisms, environments and human-beings.

5.1 Issues and Challenges

Pesticide use is very technical and it is very difficult for the individual farmer or extension agent to adopt safe and responsible practices without detailed step-by-step instructions. The level of pesticide use depends on commodity types and agronomical practices followed, socioeconomic factors, and level of awareness of the farmers while making the decision. Some issues and challenges associated with the chemical pesticides which need to be addressed adequately are as follows.

Pesticide Use:

- Improper selection of pesticides
- Use of highly toxic and broad spectrum of insecticides
- Use of pesticides even when it is unnecessary
- Indiscriminate use of chemical pesticides
- Overdose and frequent application of pesticides
- Wrong advice and supply of pesticides to the farmers by pesticide dealers
- Non-observance of prescribed waiting periods

Quality:

- Adulterated or substandard products making farmers use it repeatedly with high dosage.
- Use of date expired pesticides

Marketing:

- Aggressive marketing strategy by pesticide dealers and retailers
- Illegal trans-boundary movement or trade of pesticides
- Alternatives to chemical pesticides not readily available

Disposal:

- Wrong disposal of left over pesticides and cleaning of plant protection equipment's.

- Throwing of empty pesticide containers in public areas etc.
- Disposal of obsolete pesticides.

Regulatory:

- In general, Lengthy registration process.
- Difficulty in registration of bio pesticides and marketing.
- Low quantity of import of sex pheromones, botanical and bio pesticides.
- Weak regulatory and poor monitoring system.
- Poor coordination and cooperation among the research, extension and teaching institutions in plant protection.

Public awareness:

- Low public awareness.
- Lack of awareness and availability of bio-pesticides and bio-rational compounds.
- Treatment of pesticide like medicine.
- Pesticide residue in food grains and vegetable.

6. Results and Discussion

6.1 Background to the Household and Farm

6.1.1 Socio-Demographic Characteristics

Age of respondents

The age of study participants is in Figure 1. The age of the household head has a positive effect on pesticide use. The age of participants below 25, 25-34, 35-44, 45-54 and above 55 are 112 (7 percent), 359 (23 percent), 458 (29 percent), 356 (23 percent) and 290 (18 percent) respectively. The field study showed that older farmers use more pesticides than younger farmers, all things being equal. Because they often lack education and information, older farmers might have less accurate prediction skills to determine the economic threshold level of pests.

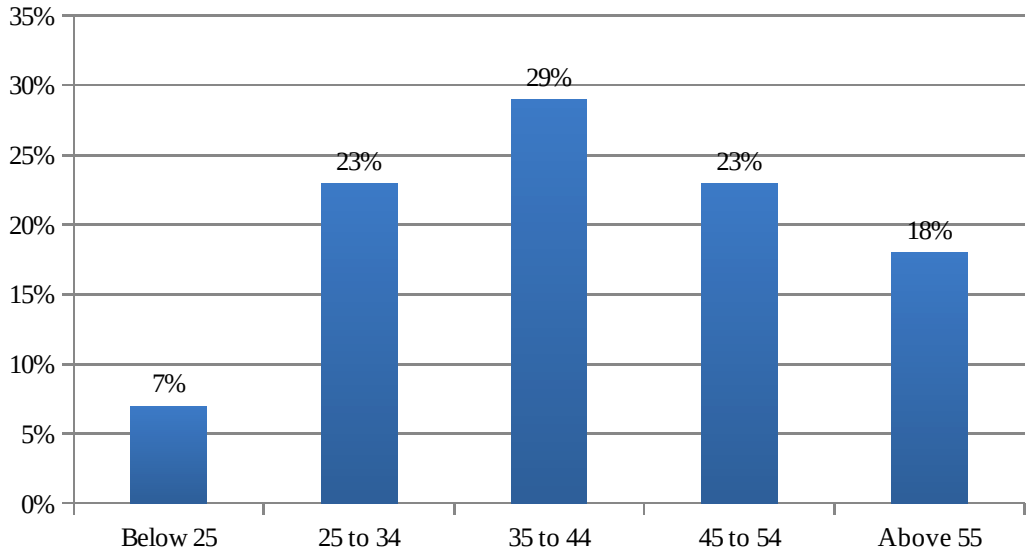


Figure 1: Categorization of respondent age

Educational level of the respondents

In terms of the respondents' level of education, educational subgroup comparisons presented in this report are generally based on five categories: Only numerical count, literate, secondary, 10+2 and above undergraduate. Among all respondents, 348 (22 percent) can only numerical count, 680 (43 percent) are literate, and 377 (24 percent) have attended secondary level. The figure 2 show that 124 (8 percent) of people educated to level 10+2 with 46 (3 percent) having received above graduate from a college or university.

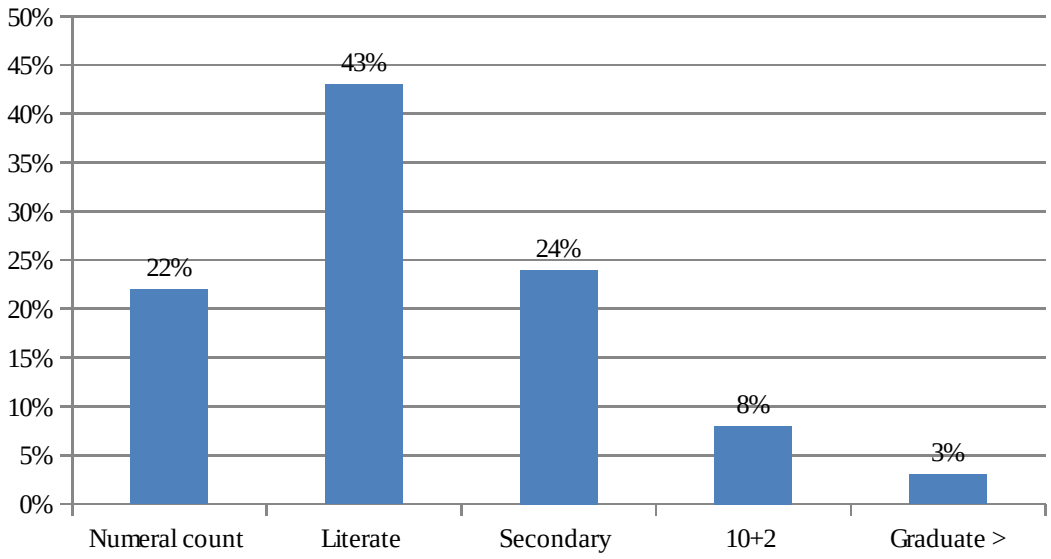


Figure 2: Educational level

Occupation of farmers

Most farmers 1317 (85 percent) depended only on agriculture for living whereas 115 (7 percent) of them work as servants besides their farming, 72 (5 percent) were traders besides their farming and 46 (3 percent) had another occupation besides farming (Figure 3).

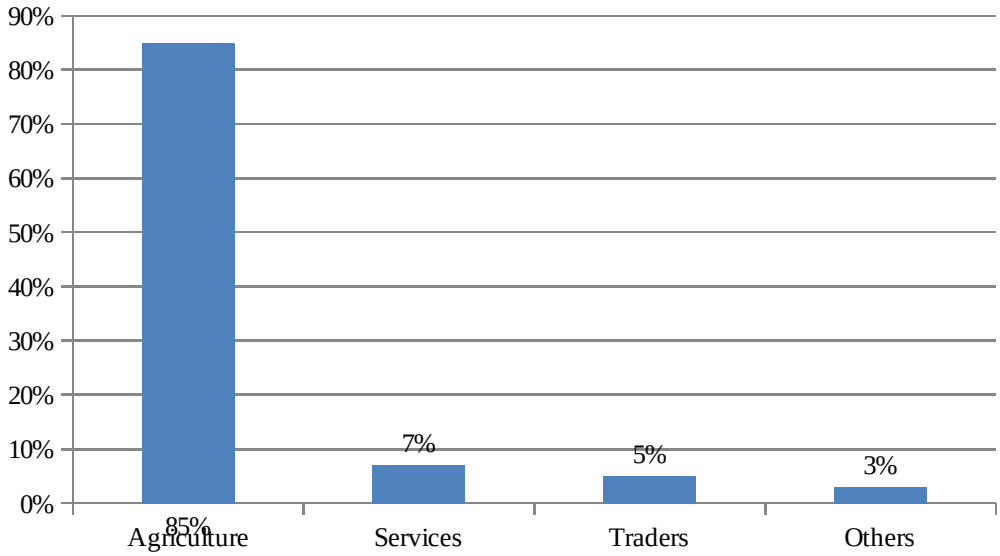


Figure 3: Farmer's occupation

Nature of Farming

The numbers of commercial, non-commercial and subsistence farmers in the survey districts were 252 (16 percent), 409 (26 percent) and 914 (58 percent) respectively (Figure 4). Intensive farming is characterized by a low fallow ratio and the high use of inputs such as capital, labor, or heavy use of pesticides and chemical fertilizers relative to land area.

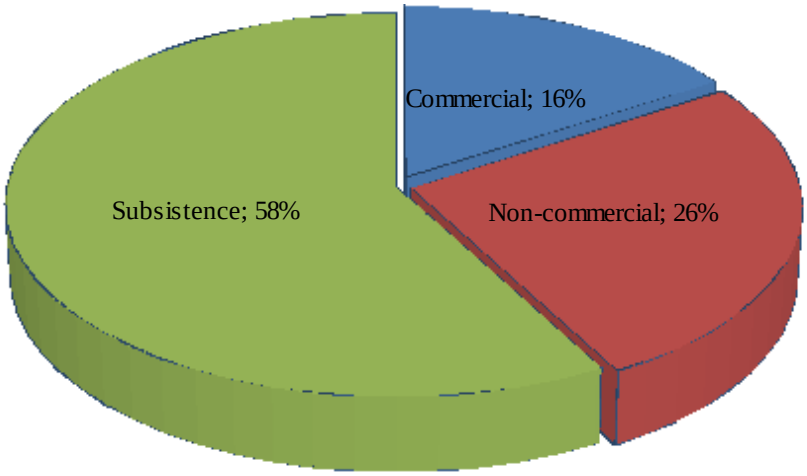


Figure 4: Nature of Farming

Feeding the family with produce from the land

514 (33 percent), 641 (41 percent) and 420 (26 percent)respondents said that they have land to feed a family more than 12, more than 6 months but less than 12 months and less than 6 months respectively (Figure 5).

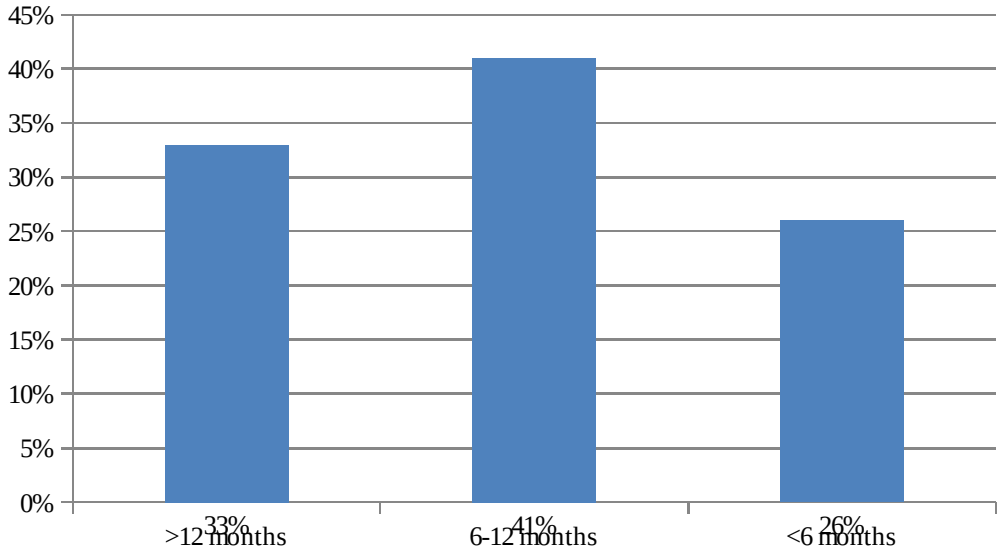


Figure 5: Feeding the family with produce from land

General Information on pesticides use

Regarding chemical pesticide utilization, the majority, and 1197 (76 percent) of the study participants said that they use chemical pesticides at different levels (regularly or occasionally) and 378 (24 percent) said that they do not use chemical pesticides for crop production. In total nearly 24 percent of Nepal's faming system is still not using the pesticides and chemical fertilizers which are by default organic in nature (Figure 6).

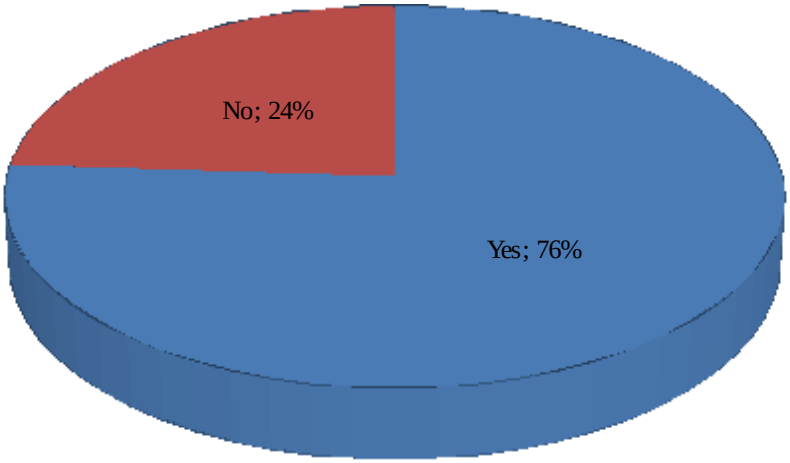


Figure 6: Use of pesticide

Participation in pesticide training

394 (25 percent) of respondents had pesticide related training in the past or are doing so currently. 1181 (75percent) respondents said that they have never taken this kind of education and training (Figure 7). Majority of respondents think that vocational education and training has a positive image. Many said that people in vocational education and training acquire skills that are needed by farmers. Trained farmers will make better predictions on expected yield loss associated with pests and diseases while making pesticide use decisions.

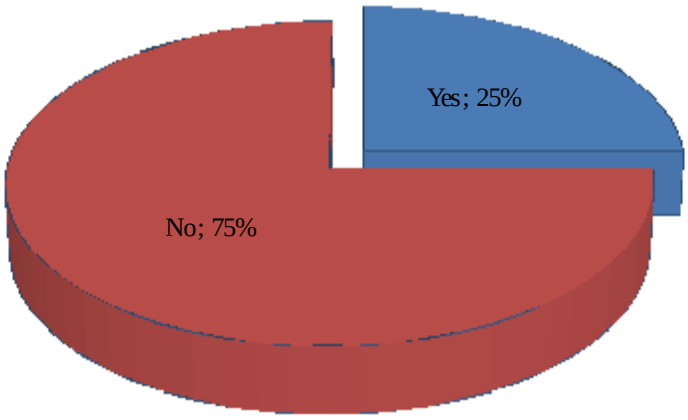


Figure 7: Participation in pesticide training

Members in any professional organization

Regarding members of professional organization, the majority, 1442 (92 percent) of the study participants said that they are not members in any professional organization and only 133 (8 percent) of the study participants indicated that they were members in professional organization (Figure 8).

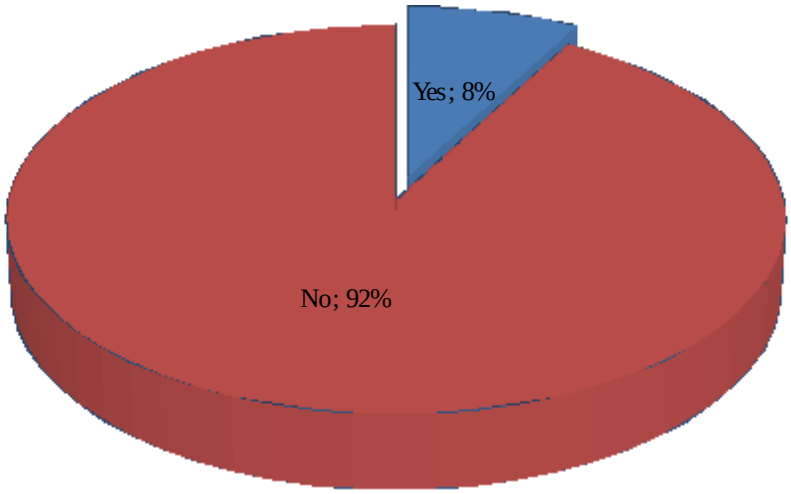


Figure 8: Members in any professional organization

6.2 Source of Information

Source of information for pest control decisions

Growers often take advice from various sources that help them make pest management decisions. Potential sources of advice were grouped into the five categories: local farmers/neighbor, Self, DADO/NARC, pesticide retailers/Agro-vet and Radio/Media. The data mentioned in figure 9 indicates that majority of the respondents 404 (34 percent) obtained about the appropriate pesticide use and other technical advice from local farmers/neighbor. Of the remaining farmers surveyed, 362 (30percent) obtained information from DADO/NARC, 297 (25 percent) from pesticide retailers/ Agro vet, 118 (10 percent) use their own discretion and 6 (1 percent) from radio/pamphlets.

The flow of information to farmers concerning pesticides and other aspects of farming is severely limited. One of the main sources of information to farmers is from dealers. A dealer is motivated by profit and sales and yet they also have some role in assisting the farmer to select the correct solution to his/her problem. Support and information from other farmers also threw up mixed attitudes towards the relative reliability and credibility of the information they got from others. Farmers sometimes tried the suggestions of others but we only found instances where they relied on others for assistance with farming information. Farmers were more prepared to trust others when they had an unknown pest or had been unsuccessful with several applications of pesticides.

When the reason for this gap between the knowledge about the pests and its application for diagnosis of pests affecting the crops was asked, respondents replied that they were not sure about their self-diagnosis and they thought that extension worker and agriculture experts might have this job with more accuracy. Given the dependence in farming communities to rely on dealers for information, greater attention needs to be given to the nature of the

information they provide and how greater transparency can be made so that farmers can develop trust in the credibility of the information. The lack of reliable and credible information available within farming communities suggests a number of improvements could be made.

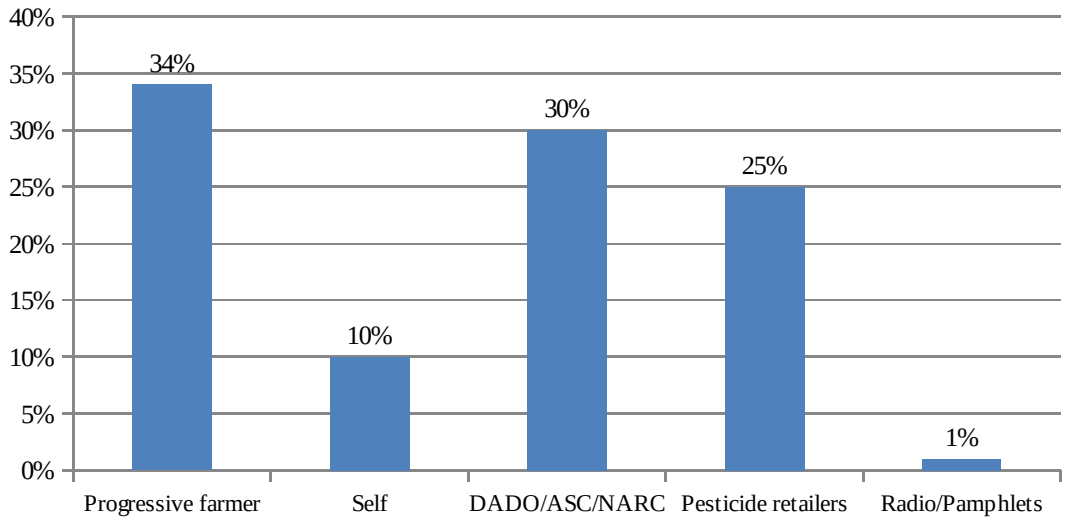


Figure 9: Sources of information on pesticide use

Source of purchasing pesticides

Results of the study showed that almost 1417 (90 percent) of respondents purchased pesticides from dealers while almost 110 (3 percent) of respondents purchased pesticides from wholesalers and rest 48 (7 percent) from service providers (Figure 10). Farmers should only buy recommended pesticides must examine the pack carefully to make sure that tamper-evident seals and original labels have not been broken. They must ask the dealer to show the expiration dates and do not buy or accept any pesticides that have passed their expiry dates. Farmers not buy pesticides in repackaged bottles, which cannot be identified.

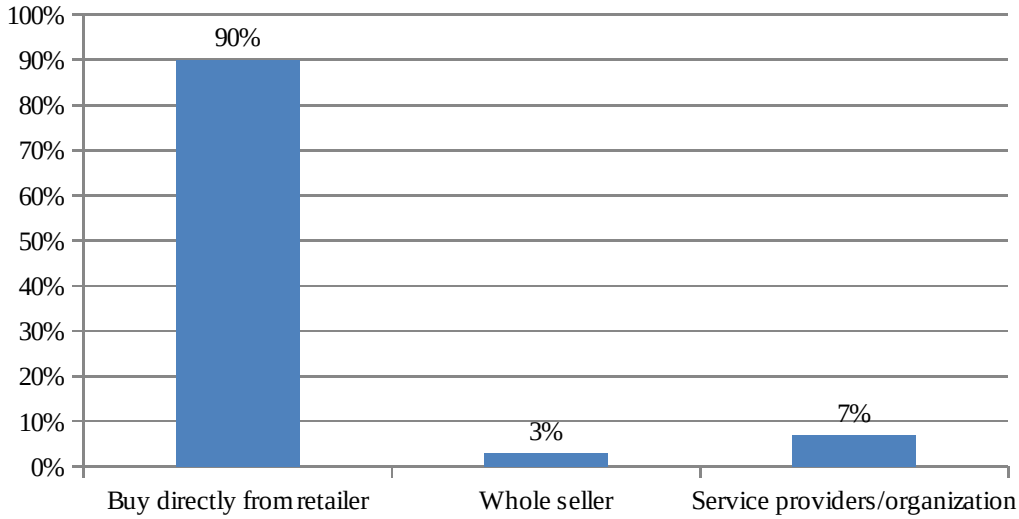


Figure 10: Pesticides purchasing

6.3 Pesticide Knowledge and Perception of Farmers

In this cross-sectional questionnaire study, farmers in study districts were interviewed on their knowledge and practices of pesticide use. Pesticide use is also affected by the kind of knowledge acquired by farmers, and farmers' access to extension agents and other agricultural experts. In fact, farmers' knowledge on pest management has direct and indirect impacts on pesticide use. Direct impacts arise due to the fact that better knowledge leads to lower levels of pesticide use as the farmers' substitute pesticide with other alternative methods. Indirect impacts arise as farmers can better predict levels of pest-related damage and yield loss, and subsequently use the pesticides judiciously after such training and contacts with extension.

Reading and understanding pesticides instructions/ labels

Pesticides label hold different information related to safety measures to be taken while using. 615 (55 percent) of the respondents indicated that they could read labels on pesticide containers and the farmers applied pesticides according to instruction on the labels. 392 (35 percent) could not read and 112 (10 percent) did understand to read and did not follow the instructions (Figure 11). Results emphasized that half of respondents were not equipped with knowledge to diagnose their crop problems i.e. they were not in a position to observe the sign and symptoms of disease affecting their crop. Therefore, if they were in a position of making early diagnosis, pests might be managed easily by proper usage and handling of pesticides, saving the crop and maintaining or improving the yield, otherwise late or without diagnosis, results might be lethal for their crop.

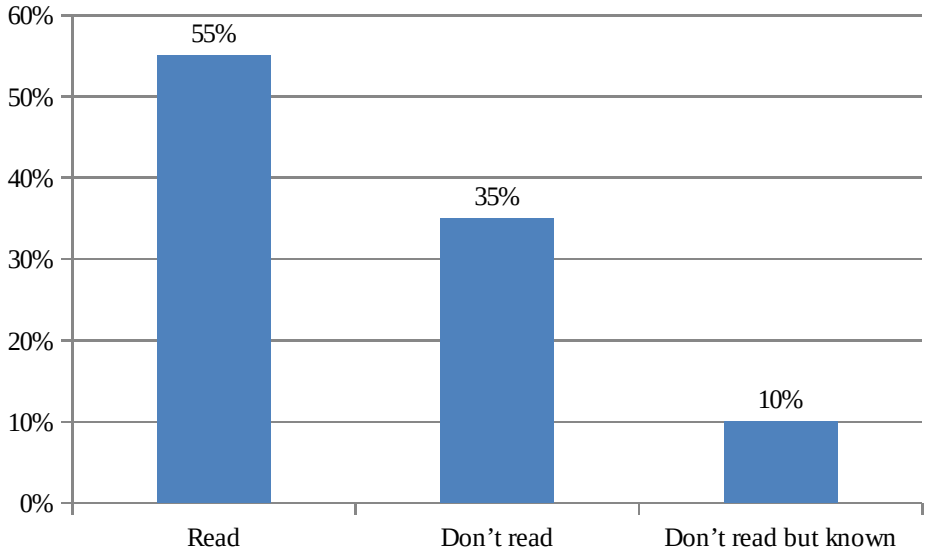


Figure 11: Read the instruction before using pesticides

Types of application equipment while spraying pesticides

The respondents who used sprayer for application were 1024 (95 percent), those who used power sprayer were 23 (2 percent) whereas 18 (2 percent) used jhari and 11 (1 percent) used brooms. The majority of farmers (95 percent) used sprayers for pesticide application (Figure 12).

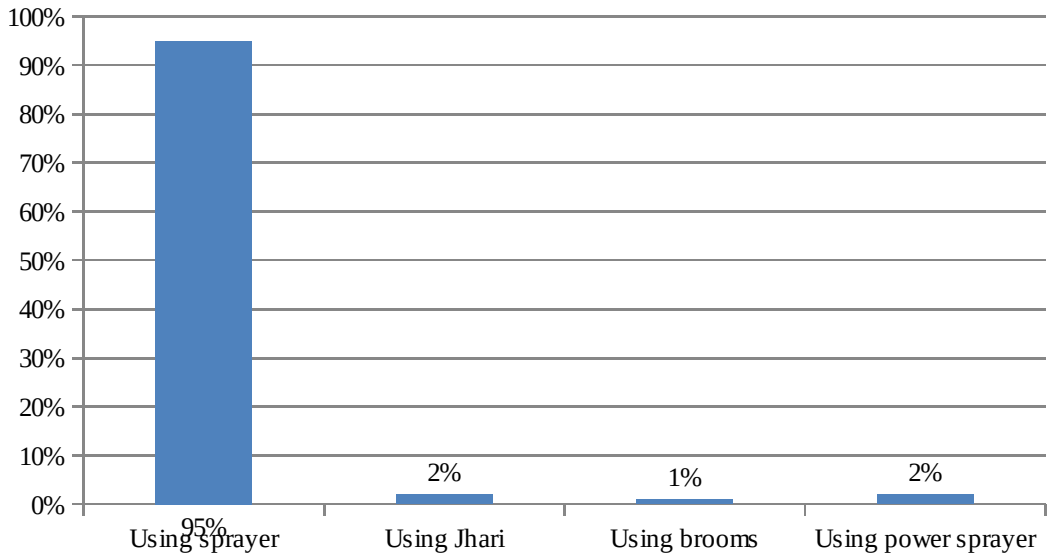


Figure 12: Types of application equipment

Types of method when using dust and granules

As the application method for granule formulation, 334 (39 percent) used hands, 41 (5 percent) used duster, 183 (21 percent) used mixed with manures, 245(29 percent) mixed with ash and 47 (6 percent) mixed with seed (Figure 13).

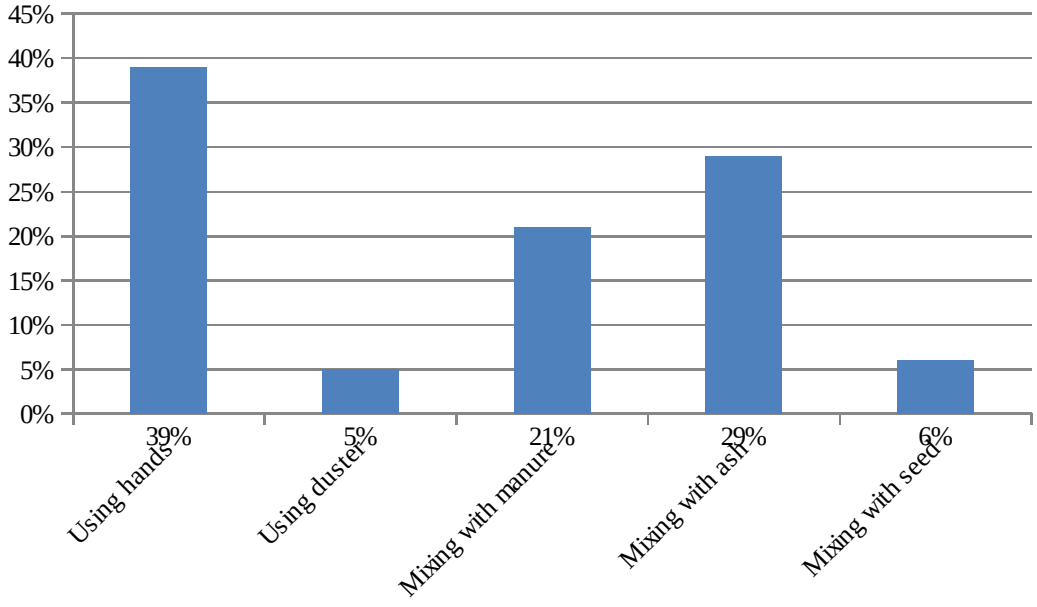


Figure 13: Types of method

Pesticide mixtures

Farmers applied pesticides by both single and mixed method ("cocktail"). The results revealed that 635 (60 percent) of respondents applied single spray solution but mixing of pesticides was common practiced by most growers. Based on survey, an average of 433 (40 percent) of the sampled farmers use pesticide combination (cocktails) for pest management at the same time frequently, where a combination of two pesticides was most common (Figure 14). In general, farmers in many developing countries follow a weekly calendar of spraying with "cocktails" of insecticides specially formulated for high value vegetable crops. Farmers believe that a "cocktail" application is always more effective and reduce labor cost even though the Plant Protection Directorate of Department of Agriculture strongly objects such practice. The quantity of pesticides applied by the mixed method was four times higher than that by the single method.

The results also suggest that farmers using the cocktail method apply more pesticides than those using the single method. In reality, when farmers observe higher numbers of insect pests and diseases, they are also likely to use a cocktail of various insecticides and fungicides so that the range of pests and diseases would be controlled by single spray. This is also to save labor costs for spraying. As seen in practice, farmers who apply a single pesticide are also more likely to target for one to two pests and would use the appropriate pesticide and dose.

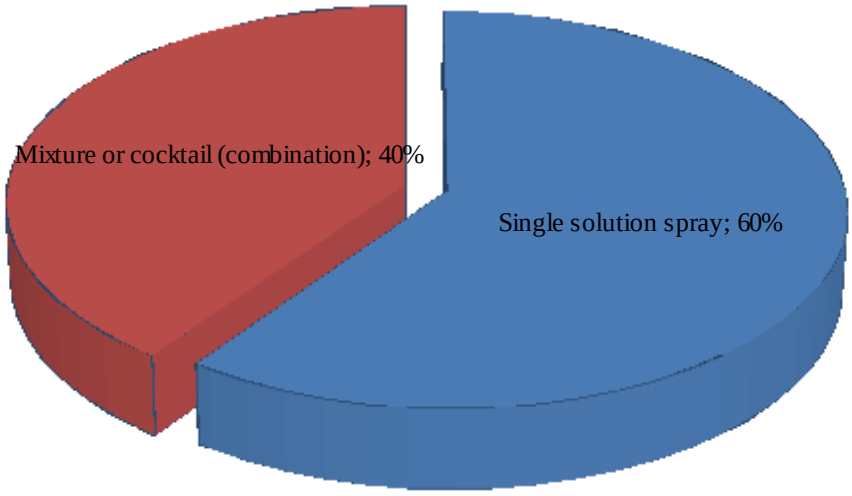


Figure 14: Pesticide mixtures

Direction of spraying

Many pesticides users are highly exposed to dermal exposure due to unsafe mixing and spraying practices resulting acute and chronic health hazards. Similarly, there is a need of determination of wind before the application of pesticides. The investigations showed that,

farmers' opinions on the direction of spraying varied. Many farmers considered the wind direction during spraying and therefore sprayed with the wind direction 721 (76 percent) and others did not 307 (24 percent) (Figure 15).

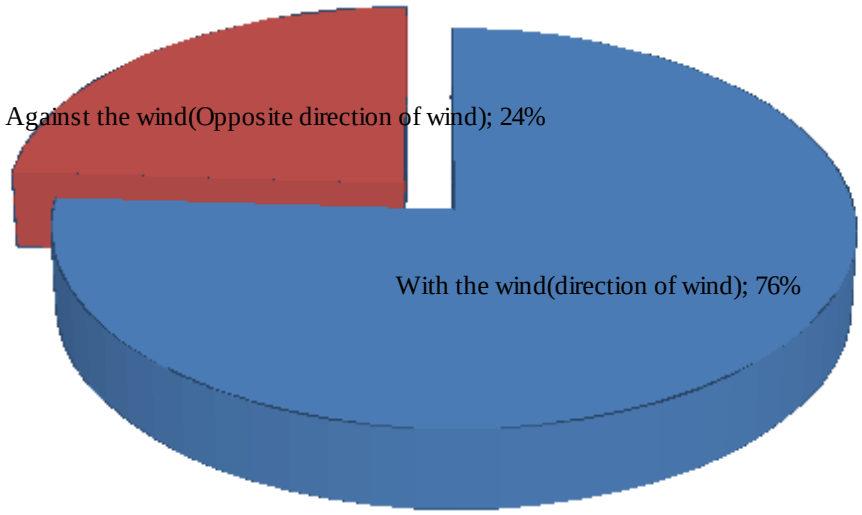


Figure 15: Direction of spraying

Duration for pesticide application

Health problems depend on how long farmers use pesticide in the farm. The general principle is that it is not good to spray pesticides for long periods of time. The field results showed that are 426 (40 percent), 398 (37 percent), 176 (17 percent) and 66 (6 percent) of the farmers spray the pesticide for 1hour, 1-2 hours, 2-3hours and above 3hours respectively (Figure 16).

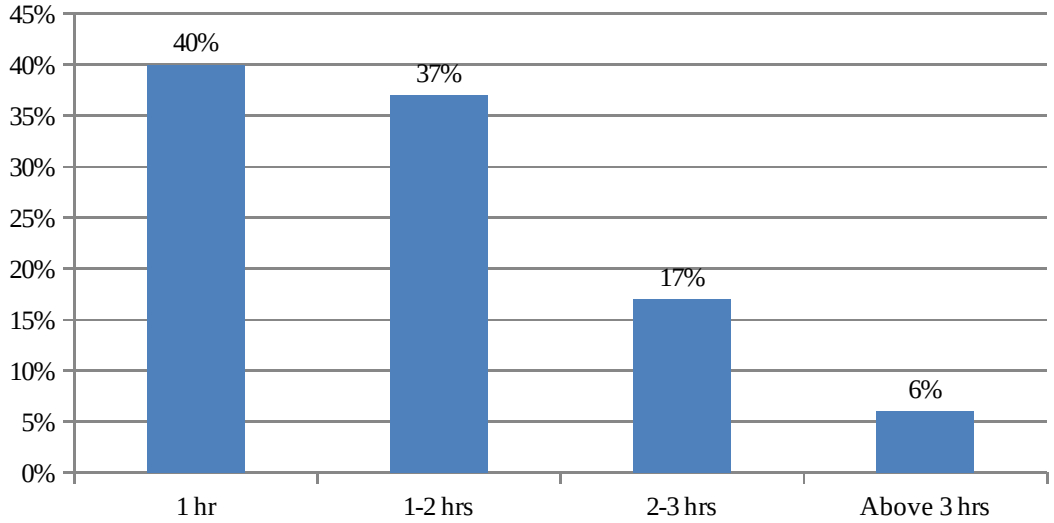


Figure 16: Duration for pesticide application

Use of tobacco products while applying pesticides

It is advisable not to use such products during pesticide application. About 166 (15 percent) respondents said that they use such products during pesticide application. But majority of respondents 904 (85 percent) did not use tobacco products while applying pesticides in the field (Figure 17).

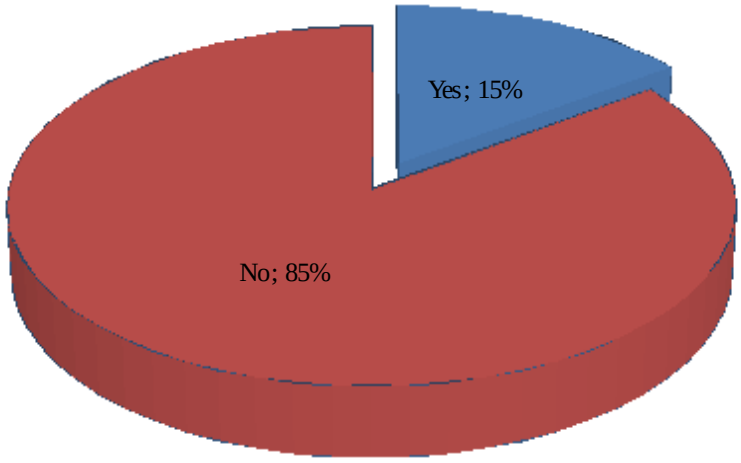


Figure 17: Use of tobacco products while applying pesticides

Timing of pesticide application

In line with the timing of pesticide application, 533(51 percent) farmers stated that they used pesticides after the presence of pests. 231(22 percent) indicated that they use before pest attack and 290 (27 percent) indicated that they use pesticides after pest start destroying crops (Figure 18). The farmers decide the type of pesticide application method they want to adopt. They either spray whenever there is symptom of pest attack or spray according to schedule.

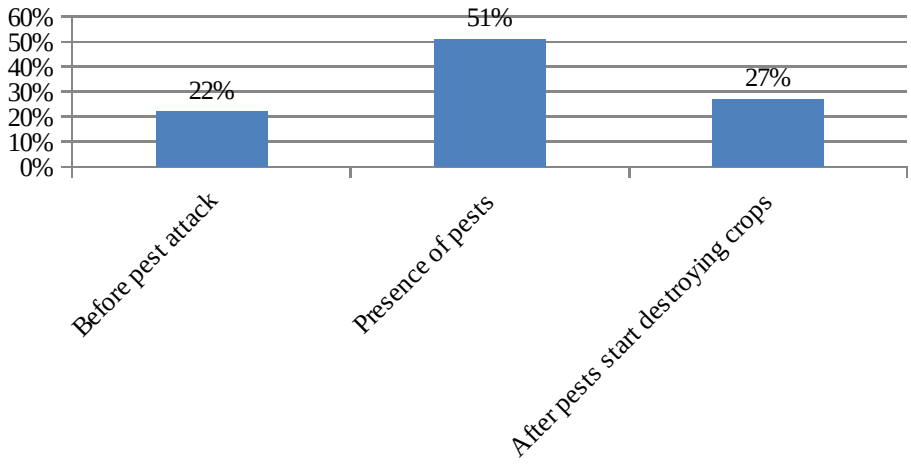


Figure 18: Timing of pesticide application

Changes in pest infestation levels after using pesticides

In line with the changes in pest infestation levels after using pesticides, the farmers were asked if it would be possible to protect the damage from pests and only 277 (26 percent)

indicated that it was increasing occurrence trend of pests, 424 (39 percent) said it was decreasing and 159 (15 percent) said it was as before and 214 (20 percent) said there was new occurrence of pests (Figure 19).

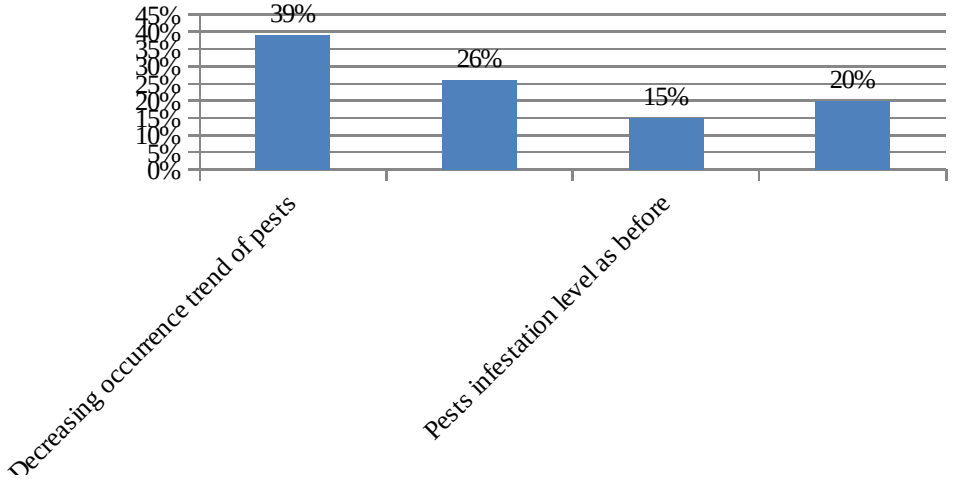


Figure 19: Changes in pest infestation levels

Pesticide use situation

When respondents were asked about the increasing and decreasing trend of pesticide use, 532 (45 percent) of these respondents stated that the amount of pesticide use every year increased whereas 380 (32 percent) indicated that the amount of pesticide use every year decreased and 276 (23 percent) indicated that they did not notice any change (Figure 20). Increasing use of pesticides on vegetables is a growing environmental problem and food safety threat in Nepal where vegetable farming is becoming more intensive and a widespread.

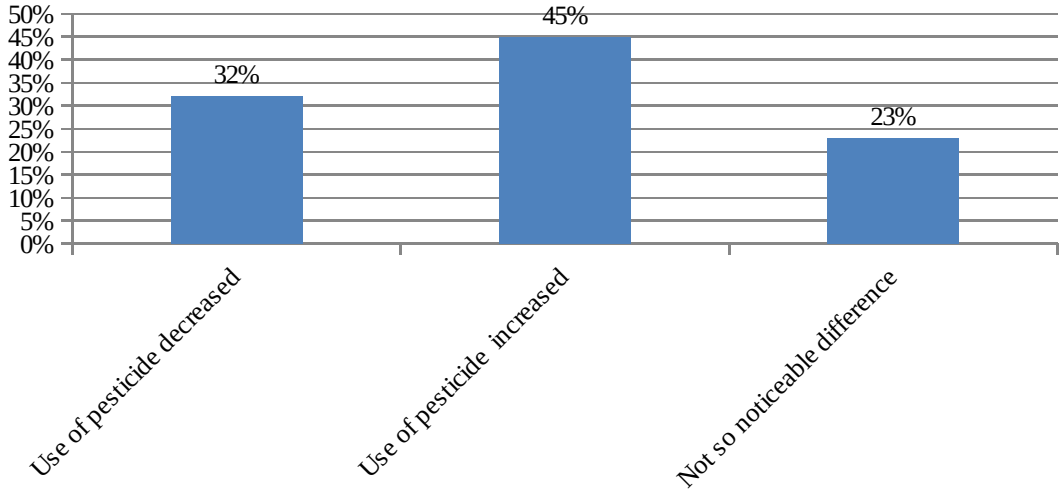


Figure 20: A graph showing pesticide use situation

Crop saves percentage by insects and diseases after using pesticides

The study area's experience with regard to crop damage by insects and diseases after using pesticides indicated that 482 (45 percent) said it saved above 75 percent, 572 (53 percent) said it saved up to 25 percent and 22 (2 percent) said there was no change (Figure 21).

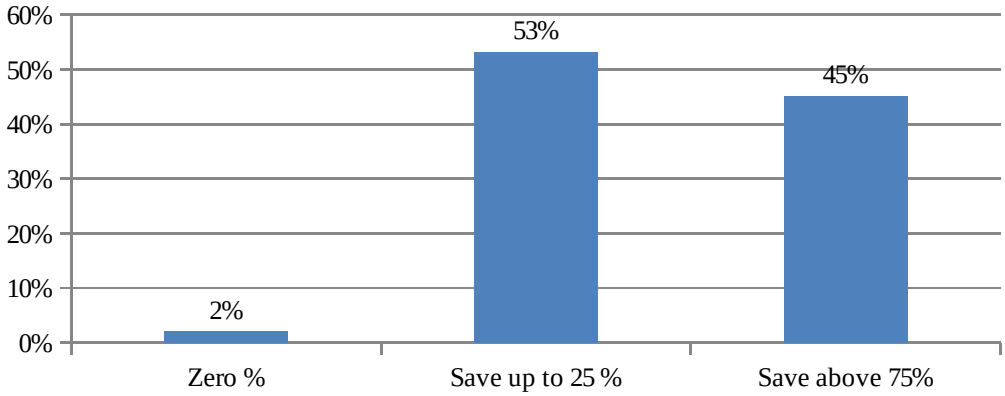


Figure 21: Crop saves percentage by pests after using pesticides

Knowledge on natural enemies of pests

Evaluating farmer's knowledge and perception of pests and natural enemies is especially useful to set research agenda for planning campaign strategies and developing messages for communication. Only 495 (43 percent) of the participating farmers knew about natural enemies and 666 (57 percent) indicated that they do not know (Figure 22).

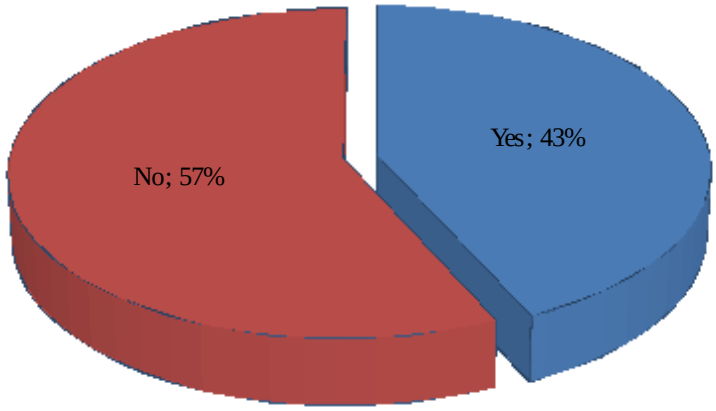


Figure 22: A chart showing knowledge on natural enemies of pests

Impact of pesticides to the human and animal health and environment

Regarding Impact of pesticides to the human and animal health and environment 1040 (91 percent) indicated that they know the impacts and 104 (9 percent) indicated that they do not know the impacts. 29 percent and 18 percent respondents could understand negative impact to the human and animal health and negative impact to the person who spray pesticide respectively. 8 percent, 4 percent, 8 percent, and 6 percent respondents knew that they destroy

the natural enemies, pollute water, pollute air and harmful to crops respectively. 27 percent respondents said that they knew the Impact of pesticides to the human and animal health and environment. Such case suggests that majority want to diminish the use of pesticide and use alternative method that are not dangerous to human and environment (Table 9)

Table 9: Impact of pesticides to the human and animal health and environment

Variables	Frequency	Responses in percent
Know the impacts of Pesticides	1040	91
Do not Know the impacts	104	9
Total	1144	100
Impacts:		
Destroy the natural enemies	86	8
Water pollution	42	4
Air pollution	94	8
Negative impact to the person who spray pesticide	195	18
Negative impact to the human and animal health	321	29
Harmful to crops	67	6
Above all	296	27
Total	1101	100

Adoption of IPM

It was noted that one fourth of the respondents 257 (22 percent) knew the IPM for agriculture farming purposes and adopted IPM. In response to the query about the IPM, the rest number of respondents stated that they know the IPM 506 (43 percent) and do not adopt IPM but farmers were enough aware about the program. 410 (35 percent) of respondents did not know the IPM Figure 23). Government of Nepal is promoting IPM to reduce users' dependency on pesticides in agriculture farming. One of the objectives of IPM is to promote food safety. This study also suggests that the government should promote IPM program for healthier agriculture practices because one-fourth growers now already using IPM technique. Bio-pesticides can reduce the use of conventional pesticides when used as part of an Integrated Pest Management program. Bio-pesticides, however, require knowledgeable users for maximum effectiveness.

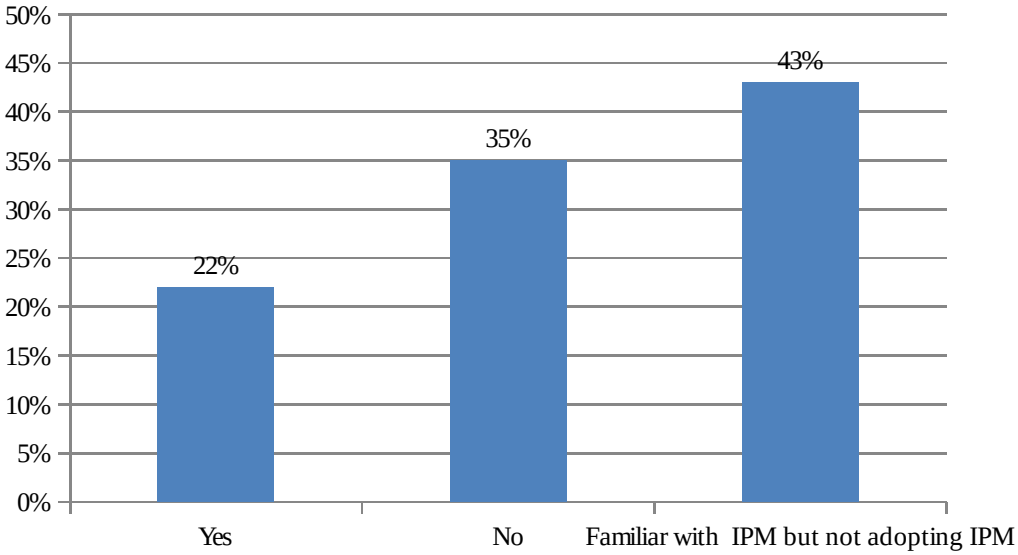


Figure 23: Adoption of IPM

Waiting time between pesticide applications and harvesting

Waiting period is the duration after which the crops treated with pesticides can be used. The result indicated 76 percent respondents know about waiting time between pesticide applications and harvesting and 24 percent did not know about it (Figure 24). Less waiting period indicates that there is a higher risk of presence of pesticides residue in crops, which poses higher health risk to crop growers as well as consumers.

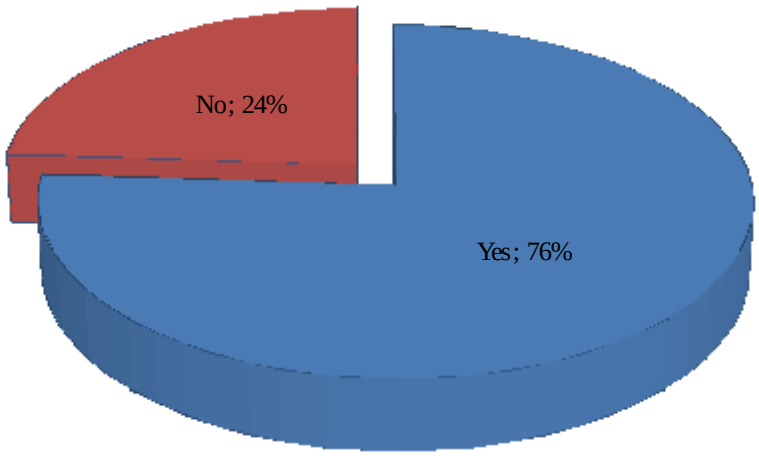


Figure 24: Waiting time between pesticide applications and harvesting

Sources for knowing harvesting time after application of pesticides

Regarding sources for knowing harvesting time after application of pesticides, 37 percent, 35 percent and 28percent respondents indicated that they obtained the information from JT/JTAs, fellow friends and training respectively (Figure 25).

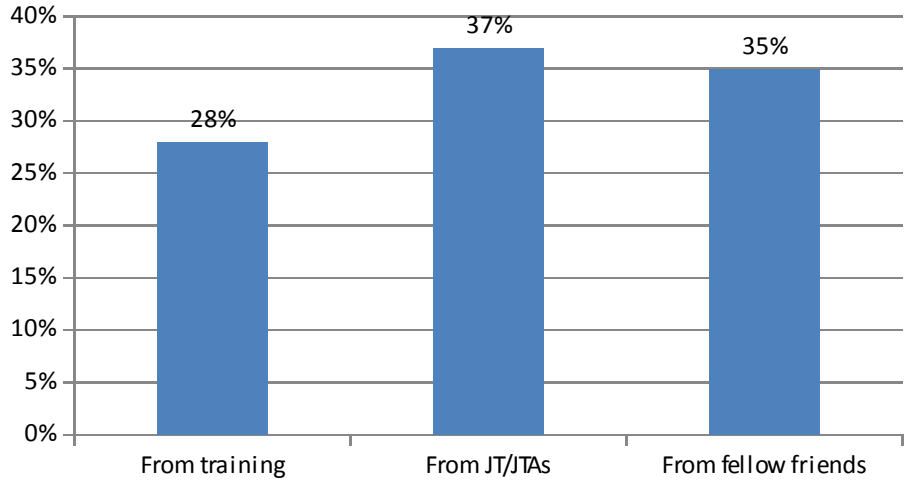


Figure 25: Sources for knowing harvesting time after application of pesticides

6.4 Pre-cautionary Measures/Safety and Awareness about Health

Familiarity with safety measures during pesticide spraying

The study area's experience with regard to safety measures during pesticide spraying indicated that 97 percent know about the safety measures and only 3 percent did not care about the safety measures during pesticide spraying (Table 10).

Regarding protective equipment use whiles praying pesticides, 29 percent of them said that they use normal clothes, 19 percent covered face and body, 3 percent used gloves, and 1 percent used boots while 48 percent said they follow all the practices mentioned above. Like many previous reports on the use of safety measures in farming communities our study showed that there is little concern or interest in safety. Personal protective equipment includes clothes and devices that protect the body from the contact with pesticide during pesticide application. Most of the pesticide users did not use PPE. The reason for not using PPE was lack of knowledge. They do not have affordability and the habit of wearing. Due to unsafe practices, vegetable growers are more vulnerable to expose with toxic pesticides and are in higher health risks as there has been too much use of pesticides with too little or no protection.

It is interesting to note that no one used recommended personal protection equipment. The towels were used as face/nose mask and head dress. But everybody expressed desire to use the recommended PPE but the availability was a big problem even on payment of cost and the PPEs' made available to few farmers by pesticide firms were said to be not fit to this climate as results in heavy sweating. Hence, earlier attempts to adopt the protective dresses were failed. If the pesticide industry provides suitable PPEs at affordable price farmers expressed their desire to use them.

Table 10: Familiarity with safety measures during pesticide spraying

Variables	Frequency	Responses in percent
Knowledge on safety measures on pesticides	1121	97
No knowledge on safety measures on pesticides	33	3
Total	1154	100
Types of safety measures		
Normal clothes covering face	326	29
Covering face and body	209	19
Use of gloves	32	3
Use of boots	7	1
All above mentioned measures	534	48
Total	1108	100

Washing of hands and body after application of pesticides

Majority, 99 percent of the respondents said that they wash hands body after application of pesticides (Table 11). Study shows that 98 percent of respondent use soap, 1percent only water and 1 percent use soil or ash for hand washing.

Table 11: Washing of hands and body after application of pesticides

Variables	Frequency	Responses in percent
Yes	1060	99
No	9	1
Total	1069	100
Use of materials in hand/body washing		
Washing with water only	6	1
Washing with soap	1047	98
Washing with soil/ash	17	1
Total	1070	100

Health effects of pesticide misuse

Regarding the health effects of pesticide misuse, majority of respondents 1016 (95 percent) said that they are aware about pesticide use and 54 (5 percent) indicated that they didn't notice (Figure 26).

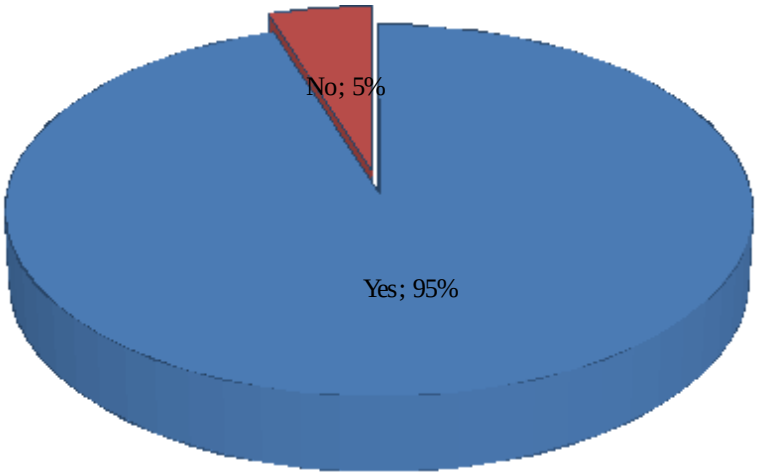


Figure 26: Health effects of pesticide misuse

6.5 Agro-vets/Pesticide Retailers

Sale of substances other than pesticides

Majority 32 (76 percent) of the 42 sample retailer-respondents reported that they sell only pesticides in their shops. The remaining retailers 10 (24 percent) reported that they sell items other than pesticides such as seed, vet medicines, micronutrients/vitamins, agri-tools and bio-fertilizer (Table 12). Pesticides are usually sold to consumers by private retailers and/or wholesalers in Nepal. Pesticide retailers are an important link in pesticide distribution chain in Nepal. The most common pesticides used and sold from shop on the priority basis of agro-vets/retailers.

Table 12: Sale of substances other than pesticides

Variables	Frequency	Responses in percent
Yes	10	24
No	32	76
Total	42	100

Pesticides buying

It was found that 8 (18 percent) of the farmer-respondents asked the pesticide retailers for particular types of pesticide for the specific crop. It was also noted that 21 (50 percent) of the farmer fully trust the dealer for suggestions when purchasing pesticides. All the farmer groups considered the pesticides salesmen's recommendations as the second most important factor which influenced their decision on the timing of pesticide application. Dealers take up intensive and aggressive marketing strategies to sell their products with the perception that there are no other alternatives for farmers except the use of chemical pesticides. The rest 13 (32 percent) is based on Technical SMS recommendations (Figure 27).

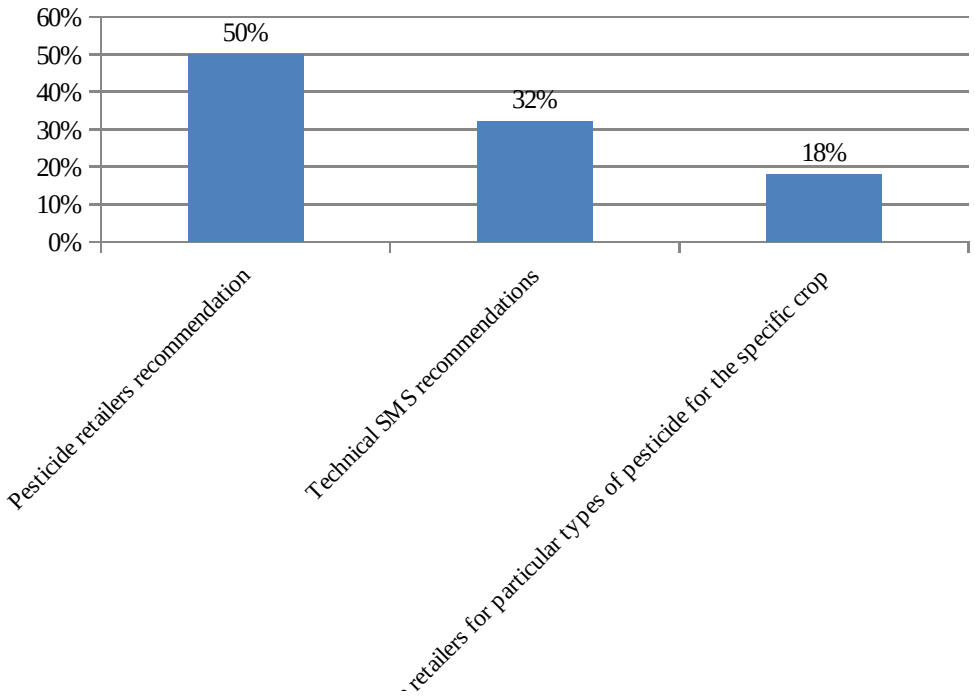


Figure 27: Asking for pesticides

Stock of Banned and Date Expired Pesticides in the shop

About 40 (95 percent) retailers said they do not stock banned and DEPs in the shop. The field results showed that most of the pesticide retailers are well familiar with the banned and DEPs pesticides. The results have shown that some retailers 2 (5 percent) store and sell endosulfan which will be phased out after 2071/7/19 (Pesticide Statistics Pustika, 2069) (Figure 28).

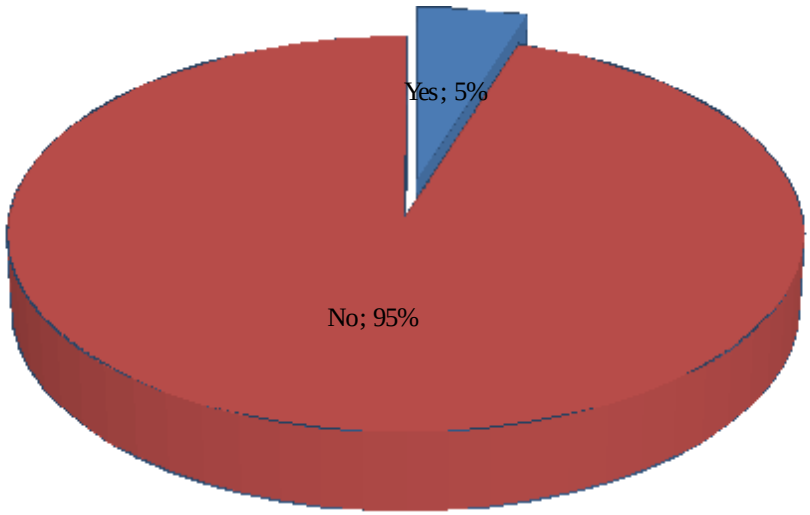


Figure 28: Stock of banned and DEPs in the shop

6.6 Pesticide Usage Pattern

6.6.1 Types of Pesticide Used

The sample farmers used different types of pesticides (54 Technical Products): Insecticides (26), Fungicides (17), Herbicides (3), Rodenticides (2), Acaricide (1) and Bio- and Botanical pesticides (4) under a different brand (trade) names (Annex-1). All pesticides were stated by their trade names without any awareness of the common names. During HHs survey the quantity of pesticides recorded was in Commercial Formulation (CF).

6.2 WHO Classification of Pesticide

The farmers used a number of pesticides belonging to organophosphate, synthetic pyrethroids, and organo chlorine group. Most of the pesticides used on the sample farms belonged to the moderate risk/ moderately hazardous (category II-23), followed by low risk/ slightly hazardous (category III-10), non-hazardous (NH-16), hazardous (IB-3) and not calculated (NC-1) groups as classified based on acute dermal LD50 for Rabbits/Rat (Table13).The application of organophosphates ranked high in farmers' preferences. Among the pesticides sprayed, 43% of it was of category II, 19% was of category III, 6% was of category IB, 2% was of category NC and 30 % was of category NH. Use of extremely hazardous pesticides (category I) are banned in the country. The application of organophosphates ranked high in farmers' preferences.

Table 13: WHO Classification of Pesticide

S.N.	Pesticides	Number					
		Common Name (No.)	WHO Class				
			II	III	IB	NC	NH
1	Insecticides	26	21	3	1	1	-
2	Fungicides	17	1	6	-	-	10
3	Herbicides	3	-	1	-	-	2
4	Rodenticides	2	-	-	2	-	-
5	Bio-pesticides and Botanicals	4	-	-	-	-	4
6	Acaricides	1	1	-	-	-	-
	Total	53	23	10	3	1	16

Note: Hazardous (IB), Moderately Hazardous (II), Slightly Hazardous (III), Non Hazardous (NH) and Not Calculated (NC)

6.6.3 Pesticide Use by Chemical Type

Fungicides (60.4 percent) and insecticides (37.13 percent) were the most widely used plant protection product types; Herbicides accounting for 1.66 percent of the weight applied, bio-pesticide for 0.73 percent of the weight applied followed by Rodenticides (0.09 percent) and Acaricide (0.01 percent). The increase in overall pesticide use was mainly driven by greater application of fungicides. Manual weeding is common in most of rural Nepal, in some crops like rice, herbicides have a significant application, and however, the overall use is

comparatively low. There is very little quantity on the bio-pesticide consumption situation in the study districts and the results show that there is lack of awareness and availability of bio-pesticides and bio-rational compounds (Table 14).

Table 14: Estimation of usage for individual active ingredients according to pesticide type

S.N.	Pesticides	Quantity (a.i. kg)	Percent
1	Insecticide	213.48	37.13
2	Fungicide	347.27	60.40
3	Herbicide	9.52	1.66
4	Rodenticide	0.49	0.09
5	Bio pesticide	4.17	0.73
6	Acaricide	0.037	0.01
	Total (a.i. kg)	574.993	100.00

6.6.4 Use of Locally Prepared Plant Protection Products/Others

Bio and Botanical insecticides presently play only a minor role in insect pest management and crop protection. Recent studies in Nepal suggest that extracts of locally available plants can be effective as crop protectants in vegetables. This study suggests that indigenous knowledge and traditional practice can make valuable contributions to domestic food production in Nepal. Some sample farmers used different types of locally prepared botanical pesticides (Table15).

It is quite interesting to know that farmers of Taplejung, Kaski and Darchula applied cow urine sprays for plant protection in tomato crop. The research findings published in Scientific Books by Gaby Stroll, 1986 revealed that undiluted urine killed 95% of the aphids, 67% of the caterpillars and 87% of the mites. The research suggests a mixture of 1:1 because undiluted urine causes slight damage to the plants. Too strong a solution can produce a burning of the leaves. Bio-pesticides are gaining increasing acceptance from growers, few bio-pesticides reach market. Whatever may be the challenges and issues, further R&D on bio-pesticides must be given high priority.

Table 15. Locally Prepared Botanical Pesticides

S.N.	Particulars	Remarks
	Jholmol	Locally Prepared bio and Botanical Pesticides are not included in national estimates as a.i of each pesticide not known.
1	Justica adhatoda(Ashuro)	
2	Artemisia spp. (Titepati)	
3	Agave Americana (Hattibar/Ketuke)	
4	Acorus calamus (Bhojo)	
5	Xanthoxylum armatum(Timur)	
6	Melia azedarach (Bakaino)	
	Others	
7	Tobacco liquid	
8	Mustard Cake (Pina)	
9	Cow urine	

6.6.5 Use of Pesticides in Different Districts

Of the total pesticides consumption, Jhapa is the highest pesticides consuming district (25.7 percent) followed by Rautahat (17.7 percent), Kavre (15.52 percent), Chitwan (10.44 percent), Banke (6.98 percent) and Kaski (5.59 percent). But with regard to consumption a.i. kg/ha, Kavre is the highest pesticide consuming district (1.854 a.i. kg/ha), followed by Rautahat (1.731 a.i. kg/ha), Jhapa (1.656 a.i. kg/ha), Banke (1.25 a.i. kg/ha) and Chitwan (0.712 a.i. kg/ha) (Annex-2 and 3).

6.6.6 Pesticide Consumption by Category

Pesticide Consumption by Category (a.i. kg) is presented in Table 16 of the total pesticides consumption, fungicide is the highest (347.274 a.i. kg) category followed by insecticide (213.489 a.i. kg), herbicide (9.523 a.i. kg) and bio/botanical pesticide (4.175 a.i. kg).

Table 16: Pesticide Consumption by Category (a.i. kg)

Crops	Insecticide	Fungicide	Herbicide	Rodenticide	Bio pesticide	Acaricide	Total Pesticide	Total Area (ha)	Quantity (a.i.kg/ha)
Cereals	30.809	3.542	9.523	0.100	0.001	0.000	43.975	953.379	0.046
Vegetables	168.083	341.592	0.000	0.080	4.175	0.037	513.967	320.290	1.605
Cash Crops	11.681	1.240	0.000	0.000	0.000	0.000	12.921	69.266	0.187
Pulses	1.278	0.900	0.000	0.000	0.000	0.000	2.178	42.916	0.051
Fruits	1.637	0.000	0.000	0.314	0.000	0.000	1.952	66.880	0.029
Total	**213.489**	**347.274**	**9.523**	**0.494**	**4.175**	**0.037**	**574.993**	**1452.730**	**0.396**

6.6.7 Proportion of Each Crop Group Treated with Pesticides

The consumption (a.i. kg) and percent of different pesticides by crops have been presented in Table17.Cereal was the major crops grown in the sample farms, occupying 953.38 ha, Vegetable (320.29 ha) and cash (69.27 ha) were the next most important crops. The largest quantity of pesticides is used in vegetables (513.967 a.i.kg) followed by cereals (43.975 a.i. kg), cash crop 12.921 a.i.kg, and pulses 2.178 a.i. kg) and fruits (1.952 a.i. kg) and the use of various pesticides have been found in the following order: Fungicides, Insecticides, Herbicides, Bio-pesticides, Rodenticides and Acaricides. Average pesticide usage has been estimated at 1.605, 0.187, 0.051, 0.046 and 0.029 kg active ingredient per hectare on vegetables, cash crops, pulses and fruits crops respectively.

Table 17: Chemical Pesticide Consumption by Crop

Crops	Total Pesticide a.i. kg	Total Area (ha)	Quantity (a.i. kg/ha)
Cereals	43.975	953.379	0.046125
Vegetables	513.967	320.290	1.604693
Cash Crops	12.921	69.266	0.186542
Pulses	2.178	42.916	0.05075
Fruits	1.952	66.880	0.029187
Total	**574.993**	**1452.730**	

6.6.8 Share of the Pesticide by Crop

Crops receiving the most intensive application of various pesticides were vegetables for fungicides (89 percent) followed by insecticides (7.5 percent), cash crop (2.5 percent), pulses (0.5 percent) and fruits (0.5 percent) (Table18). Hence, the issue of pesticide residues assumes much greater importance for these food items. Examination of use trends of pesticides indicates that the volume in kg of bio-pesticides used on crops is increasing, whereas the quantities of insecticides and fungicides remain stable. The increased usage of chemical pesticides, together with knowledge of some of their adverse effects, has alerted the public to the need for regulation. To assist in the regulatory decision-making process, emphasis is being placed on benefit-cost analyses. Additional and improved biological inputs and methodologies are needed to provide accurate analyses. There is no safe dose for a carcinogen. These chemicals, possibly in small, possibly eating in large quantities, and certainly they are being stored in our livers and our fat.

Table 18: Share of the Pesticide by crop

Crops	Share of Pesticide (percent)
Cereals	7.5
Vegetables	89.0
Cash Crops	2.5
Pulses	0.5
Fruits	0.5
Total	**100**

6.6.9 Pesticides Applied per hectare of Individual Crop Grown

The average weight of pesticide active substances applied per hectare of crop grown for each crop is provided in Table 19. The highest level of use was on brinjal (3.34 a.i. kg/ha), which was much higher than on any of the other arable crops. The tomato crops were next highest in level of use ((1.95 a.i. kg/ha) with cotton (1.5 a.i. kg/ha, potato (1.03 a.i. kg/ha) and Cole crop (0.70 percent a.i. kg/ha). The relatively high number of pesticide treatments, in particular fungicide treatments, applied to tomato and potato crops explains this. Pesticides used in different major crops are presented in Annex-4.

Table 19. Pesticide consumption in major individual crop

Crop	Pesticides				Total a.i kg	Area (ha)	Consumption a.i. kg/ha
	Insecticide	Fungicide	Bio-pesticide	Rodenticide			
Brinjal	17.31	32.55	0.015		49.88	14.91	3.34
Tomato	17.26	118.51	2.89		138.67	70.79	1.95
Potato	4.95	103.52	0.002	0.08	108.35	104.5	1.03
Cole crop	34.47	35.75	0.144		70.37	100	0.70
Cotton	7.5	-	-	-	7.5	5	1.5

6.6.10 Amounts of Each Active Substance Applied to Each Crop Category

Amounts of each active substance applied to each crop category are presented all together in Table 20-25.

Table 20 Amounts of insecticides applied to each crop category

Crop	Area (ha)	a.i. kg	%age	Consumption (a.i. kg/ha)
Cereals	953.38	30.80	14.43	0.032
Vegetables	320.29	168.08	78.73	0.525
Cash Crops	69.27	11.68	5.47	0.169
Pulses	42.92	1.27	0.60	0.030
Fruits	66.88	1.63	0.77	0.024
Total	**1452.73**	**213.48**	**100.00**	**0.147**

Table 21: Amounts of fungicide applied to each crop category

Crop	Area (ha)	a.i. kg	%age	Consumption (a.i. kg/ha)
Cereals	953.38	3.542	1.02	0.004
Vegetables	320.29	341.592	98.36	1.067
Cash Crops	69.27	1.240	0.36	0.018
Pulses	42.92	0.900	0.26	0.021
Fruits	66.88	0.000	0.00	0.000
Total	**1452.73**	**347.274**	**100.00**	**0.239**

Table 22: Amounts of herbicide applied to each crop category

Crop	Area (ha)	a.i. kg	Percentage	Consumption (a.i. kg/ha)
Cereals	953.38	9.523	100.00	0.010
Vegetables	320.29	0.000	0.00	0.000
Cash Crops	69.27	0.000	0.00	0.000
Pulses	42.92	0.000	0.00	0.000
Fruits	66.88	0.000	0.00	0.000
Total	**1452.73**	**9.523**	**100.00**	**0.007**

Table 23: Amounts of rodenticide applied to each crop category

Crop	Area (ha)	a.i. kg	Percentage	Consumption (a.i. kg/ha)
Cereals	953.38	0.100	20.23	0.000
Vegetables	320.29	0.080	16.18	0.000
Cash Crops	69.27	0.000	0.00	0.000
Pulses	42.92	0.000	0.00	0.000
Fruits	66.88	0.314	63.59	0.005
Total	**1452.73**	**0.494**	**100.00**	**0.000**

Table 24: Amounts of bio pesticide applied to each crop category

Crop	Area (ha)	a.i. kg	Percentage	Consumption (a.i. kg/ha)
Cereals	953.38	0.001	0.01	0.000
Vegetables	320.29	4.175	99.99	0.013
Cash Crops	69.27	0.000	0.00	0.000
Pulses	42.92	0.000	0.00	0.000
Fruits	66.88	0.000	0.00	0.000
Total	1452.73	4.175	100.00	0.003

Table 25: Amounts of acaricide applied to each crop category

Crop	Area (ha)	a.i. kg	Percentage	Consumption (a.i. kg/ha)
Cereals	953.38	0.000	0.00	0.000
Vegetables	320.29	0.037	99.94	0.000
Cash Crops	69.27	0.000	0.06	0.000
Pulses	42.92	0.000	0.00	0.000
Fruits	66.88	0.000	0.00	0.000
Total	**1452.73**	**0.037**	**100.00**	**0.000**

6.6.11 Chemical pesticide use Scenario in Development Region

On development region basis, study showed that the amount of pesticide used in FWDR is 31.27 a.i. kg (5.43 percent). The MWDR accounted for 45.66 a.i. kg (7.94 percent) followed by WDR 66.35 a.i. kg (11.53 percent), CDR 261.50 a.i. kg (45.48 percent) and EDR 170.19 a.i. kg (29.62 percent). The average per hectare consumption of pesticides in Far West, Mid-West, Western, Central and Eastern development region was 0.146 a.i. kg/ha, 0.225 a.i. kg/ha, 0.276 a.i. kg/ha, 1.015a.i. kg/ha, 0.616 a.i. kg/ha respectively. Details are provided all together from Table 26-31.

Table 26: Regional Scenario

Region	Total pesticides applied(kg)	Percentage	Quantity(a.i. kg/ha)
FWDR	31.27	5.43	0.146
MWDR	45.66	7.94	0.225
WDR	66.35	11.53	0.276
CDR	261.50	45.48	1.015
EDR	170.19	29.62	0.616
Total	574.97	100	

Table 27: Amount of Pesticides Applied and the Area Treated in FWDR

Districts	Insecticide	Fungicide	Herbicide	Rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Darchula	2.052	0.413	0.000	0.000	0.000	0.037	2.501	42.15	0.059
Dadeldhura	2.558	0.653	0.215	0.080	0.000	0.000	3.506	123.10	0.028
Kailali	13.124	11.342	0.000	0.000	0.798	0.000	25.265	48.88	0.517
Total	**17.73**	**12.41**	**0.21**	**0.08**	**0.79**	**0.037**	**31.27**	**214.1**	**0.146**

Table28: Amount of Pesticides Applied and the Area Treated in MWDR

Districts	Insecticide	Fungicide	Herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Jumla	0.000	0.000	0.000	0.000	0.000	0.000	0.000	39.45	0.000
Kalikot	2.014	0.975	0.000	0.000	0.000	0.000	2.989	18.78	0.159
Salyan	0.209	0.233	0.000	0.000	0.000	0.000	0.442	44.71	0.010
Banke	9.826	30.314	0.000	0.000	0.000	0.000	40.14	32.00	1.254
Dang	1.186	0.905	0.000	0.000	0.000	0.000	2.091	68.21	0.031
Total	**13.23**	**32.43**	**0.000**	**0.000**	**0.000**	**0.000**	**45.66**	**203.1**	**0.225**

Table 29: Amount of Pesticides Applied and the Area Treated in WDR

District	Insecticide	Fungicide	Herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Mustang	3.90	0.53	0.0	0.0	0.0	0.0	4.43	34.16	0.130
Gulmi	0.78	1.72	0.0	0.0	0.0	0.0	2.50	42.45	0.059
Kapilvastu	22.19	2.49	2.58	0.0	0.03	0.0	27.29	115.2	0.237
Kaski	5.977	26.155	0.000	0.000	0.000	0.000	32.132	48.23	0.666
Total	32.851	30.896	2.578	0.000	0.030	0.000	66.356	240.04	0.276

Table 30: Amount of Pesticides Applied and the Area Treated in CDR

District	Insecticide	Fungicide	Herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Dolakha	2.661	7.190	0.000	0.000	0.453	0.000	10.304	66.33	0.155
Kavre	19.624	69.321	0.296	0.000	0.001	0.000	89.241	48.12	1.854
Rautahat	31.239	66.293	4.426	0.004	0.000	0.000	101.962	58.92	1.731
Chitwan	23.572	35.476	0.945	0.008	0.000	0.000	60.001	84.23	0.712
Total	**77.096**	**178.279**	**5.667**	**0.012**	**0.454**	**0.000**	**261.508**	**257.6**	**1.015**

Table 31: Amount of Pesticides Applied and the Area Treated in EDR

District	Insecticide	Fungicide	Herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Taplejung	3.150	2.747	0.298	0.402	0.000	0.000	6.597	99.48	0.066
Dhankuta	5.094	10.709	0.000	0.000	0.000	0.000	15.803	87.68	0.180
Jhapa	64.329	79.810	0.765	0.000	2.892	0.000	147.796	89.23	1.656
Total	**72.572**	**93.265**	**1.063**	**0.402**	**2.892**	**0.000**	**170.195**	**276.38**	**0.616**

6.6.12 Chemical pesticide use Scenario in Ecological Zones

On ecological basis, highest average pesticides use was in Terai (0.995 a.i. kg/ha) followed by valley (0.470 a.i. kg/ha) hill (0.314 a.i. kg/ha) and high hill (0.085 a.i. kg/ha) (Table 32-36)

Table 32: Ecological Scenario

Ecological Belt	Total Pesticide applied (a.i. kg)	Percentage	Quantity (a.i. kg/ha)
High hill	23.83	4	0.085
Hill	114.4	20	0.314
Terai	342.4	59	0.995
Valley	94.22	17	0.470
Total	574.9	100	-

Table 33: Quantity of Pesticides Applied and the Area Treated Mountains districts

Districts	Insecticide	Fungicide	herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Darchula	2.052	0.413	0.000	0.000	0.000	0.037	2.501	42.15	0.059
Jumla	0.000	0.000	0.000	0.000	0.000	0.000	0.000	39.45	0.000
Mustang	3.904	0.526	0.000	0.000	0.000	0.000	4.431	34.16	0.130
Dolakha	2.661	7.190	0.000	0.000	0.453	0.000	10.30	66.33	0.155
Taplejung	3.150	2.747	0.298	0.402	0.000	0.000	6.597	99.48	0.066
Total	**11.767**	**10.87**	**0.298**	**0.402**	**0.453**	**0.037**	**23.83**	**281.5**	**0.085**

Table 34: Quantity of Pesticides Applied and the Area Treated in Hill districts

Districts	Insecticide	Fungicide	herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Dadeldhura	2.558	0.653	0.215	0.080	0.000	0.000	3.506	123.1	0.028
Kalikot	2.014	0.975	0.000	0.000	0.000	0.000	2.989	18.78	0.159
Gulmi	0.780	1.724	0.000	0.000	0.000	0.000	2.504	42.45	0.059
Kavre	19.624	69.321	0.296	0.000	0.001	0.000	89.241	48.12	1.854
Dhankuta	5.094	10.709	0.000	0.000	0.000	0.000	15.803	87.68	0.180
Salyan	0.209	0.233	0.000	0.000	0.000	0.000	0.442	44.71	0.010
Total	**30.279**	**83.61**	**0.511**	**0.080**	**0.001**	**0.000**	**114.4**	**364.8**	**0.314**

Table 35: Quantity of Pesticides Applied and the Area Treated in Terai districts

District	Insecticide	Fungicide	herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Kailali	13.124	11.342	0.000	0.000	0.798	0.000	25.265	48.88	0.517
Banke	9.826	30.314	0.000	0.000	0.000	0.000	40.140	32.00	1.254
Kapilvast	22.190	2.491	2.578	0.000	0.030	0.000	27.28	115.2	0.237

u							9	0	
Rautahat	31.239	66.293	4.426	0.004	0.000	0.000	101.96	58.92	1.731
Jhapa	64.329	79.810	0.765	0.000	2.892	0.000	147.79	89.23	1.656
Total	**140.70**	**190.24**	**7.769**	**0.004**	**3.721**	**0.000**	**342.4**	**344.2**	**0.995**

Table 36 Quantity of Pesticides Applied and the Area Treated in Valley districts

Districts	Insecticide	Fungicide	herbicide	rodenticide	Bio pesticide	Acaricide	Total (kg)	Area (ha)	Quantity (a.i. kg/ha)
Dang	1.186	0.905	0.000	0.000	0.000	0.000	2.091	68.21	0.031
Kaski	5.977	26.155	0.000	0.000	0.000	0.000	32.132	48.23	0.666
Chitwan	23.572	35.476	0.945	0.008	0.000	0.000	60.001	84.23	0.712
Total	**30.735**	**62.536**	**0.945**	**0.008**	**0.000**	**0.000**	**94.22**	**200.6**	**0.470**

6.6.13 Pesticide consumption in survey districts

The estimated weight of pesticide active substances applied for each district is provided in Table 37**.** The amount applied annually to area treated (that is, intensity of application) and percentage of total use among the study units are also shown. Average weights were calculated as the total weight of active substances applied divided by the total area of crop grown (whether treated or untreated).

Table 37: Pesticide consumption in survey districts

District	Consumption (a.i. kg/ha)	Area (ha)	Consumption (a.i. Kg)
Banke	1.254	57252	71815
Chitwan	0.712	46894	33405
Dadeldhur	0.028	19532	556
Dang	0.031	69950	2144
Darchula	0.059	29544	1753
Dhankuta	0.180	40723	7340
Dolkha	0.155	56683	8805
Gulmi	0.059	34102	2012
Jhapa	1.656	98716	163508
Jumla	0.000	39486	0
Kailali	0.517	90550	46802
Kalikot	0.159	17994	2864
Kapilvastu	0.237	83000	19662
Kaski	0.666	48678	32430
Kavre	1.854	61595	114227
Mustang	0.130	3661	475
Rautahat	1.731	65999	114212
Salyan	0.010	45567	450
Taplejung	0.066	27551	1827

7. National Estimates

There are many ways of presenting usage data, if not interpreted properly may often result in confusion and even mislead the reader. Essentially, usage has several components, the easiest to understand being the weight of active substance applied. There can be no confusion over this as it cannot be adjusted or presented in any way but as a straightforward tonnage of active substance per annum to a particular crop or crops surveyed. The area treated with this weight of pesticide, however, may be presented only in area treated or often termed the treated basic area. This is the area of crop receiving a particular pesticide (or all pesticides) and is most easily understood (and calculated) by considering the area of farmer's crop farm land. Treated area (ha) is the area of a crop treated with a given active ingredient multiplied by the number of applications that area received. In case of the cropping intensity the areas are obviously larger than the actual area of the farmer. The survey period in this study covered 12 months and considers all pesticide applications made to the land on which the crop is grown over a 12 months period. Essentially, a statistically valid random sample will give an average use per hectare for each pesticide on each crop (within each region). Multiplying this by the total area grown (within each region) gives the total use. The baseline for calculating the consumption of pesticides per hectare was total agricultural land area (even though pesticides are not applied on all farmland). National estimates of pesticide use are based on the distribution of farmer's treated crop land and agricultural cultivated land or agriculture area (AA) within the county. The county representative's pesticide-use data were used to calculate national use by pesticide compound, to rank pesticide use by individual crop, to "calculate total "pesticide use for national estimation and assessment of pesticide use in agriculture sector. The method for estimating average national pesticide use per hectare for county areas is based on farmer's crop treated area and that used to produce county totals and national estimates of pesticide use in this study.

7.1 Average National Consumption

The average weight of pesticide active ingredient applied per hectare is presented in Table 38**.** While analyzing the data, the crops area coverage and treated areas with pesticide and the quantity of pesticide used calculated and then based on the data on as per the mentioned parameters the national average was obtained. The study revealed that an average national consumption of pesticides in terms of kg of active ingredient (a.i.) is **0.396** per ha in Nepal which is higher than the corresponding old value 142 gm/ha reported in 1995 but is lower than world average **0.500** a.i. kg per ha.

Table 38: Average national consumption of pesticides

Particulars	Quantity
Pesticide Consumption (a.i. kg)	574.9
Crop Treated Area (ha)	1452.73
National Consumption in Nepal (a.i. kg/ha)	**0.396**

8. Conclusion and Recommendations

Eventually, injudicious and indiscriminate use of pesticides and presence of pesticide residues in food and environment is a matter of grave-concerns of all the concern parties. The study shows that exposure of farm families to pesticides and intake of pesticides by consumers are a major health concerns. Further, the findings show that the pesticide use in Nepal has increased, but it is within the range in most SAARC member countries. However, in Nepalese case it is the misuse, which is serious and need educational program to update the knowledge and skill and understanding of the farmers in general. Efforts to support the pesticide retailer to increase the sale of bio pesticides also need to go side by side. Similarly, waiting period rules after pesticide application and the precautionary measures the farmers and the applicators need take while applying the pesticide need to be followed by all. The most importantly the issues of farmers not following the code of conduct on waiting period must strictly regulated. If all farmers follow this practice many experts belief that half the problem of pesticide residue will be tackled and consumer will get safe and healthy products. Over all national agriculture policy and related strategies now have emphasized the IPM approach to be adopted. This also will reduce the pesticide hazards in fresh products.

8.1 Conclusion

Recent advances in the science of ecology and environment have paved the way for restricting the use of harmful practices in agriculture and going for alternative farming methods which are more sustainable. Farmers generally opt for quick results and apply most toxic chemicals, even while the safer ones are technically suitable. Many a time farmers buy the chemicals from the dealers based on the advice by fellow farmers or dealers. By and large, it has been observed that farmers with higher education level and more experience in farming used less pesticide than their counterpart farmers.

Findings of this study indicates a rising level of consumption of undesirable chemical pesticide while the safer ones (bio-pesticides and botanicals) are used in smaller quantities. Increased use of IPM and Integrated Crop Management (ICM) practices would allow the low current level of usual pesticides to be reduced substantially without adverse consequences for agriculture. Recently invented ‘Bio-pesticides’ could also be used instead of chemical pesticides to protect crops and useful insects. However, a positive aspect is that the consumption of some of the highly harmful ones is in decreasing trend. In majority of cases of pesticide use, the quantity of chemical used is found to be much higher than the recommended levels and the higher pesticide consumption is found in vegetables. The results of this study indicate that most farm workers in surveyed district need more educational programs regarding the safety and use of pesticides. Legislation promoting the use of safer pesticides is also needed. This study also shows that an information campaign regarding pesticide use and food safety for farmers and consumers is essential.

Based on results from the elasticity measures, we can conclude that the most effective ways to minimize the level of pesticide use in farming in Nepal are to focus efforts on enhancing farmers' capacity to observe and accurately diagnose pest- and disease-related symptoms, the nature of damage to crops in the field, and enhance farmers knowledgebase on complex agro-ecological factors affecting the level of pest infestation at any moment of time. This can be done through farmer training and more crop-specific extension efforts. Intensive awareness training of farmers on safety measures regarding application of pesticides and its rational use is necessary to avoid potential health and environmental hazards.

Based on the information from the field the following conclusions are made:

- Participants in the survey reported that they have difficulty identifying pesticide products
- Most farmers were unable to read the label and correctly identify information
- Fungicides accounted for the greatest percentage of active ingredient kg at 60.40 percent
- Insecticides accounted for 37.13 percent of the reports
- Vegetables accounted for 89 percent of total pesticides
- Most control products contain higher percentages of active ingredients and typically have II WHO Class, than do other types of products. Farmers are using more hazardous pesticides to fight pests due largely to heavy adoption of hybrid variety. Farmers get caught on the treadmill as they are forced to use more and more and increasingly toxic chemicals to control insect pests that develop resistance to pesticides.
- Average national consumption of pesticides in terms of kg of active ingredient is less than global average.

8.2 Recommendations

Based on findings work the following recommendations have been made.

8.2.1 Pesticide policies

Many international and national policies are trying to regulate pesticide use as consumers are becoming more aware of pesticide externalities and demand pesticide free agricultural products and cleaner and safer natural habitat. National policies should be developed to encourage farmers to change their pest management methods from chemical based to methods that are healthier and more environmentally friendly.

8.2.2 Strengthening pesticide legislation and regulation

The pesticide act and regulations are to be amended as per the present needs and context. Government of Nepal has expressed its consent for organic agriculture and banning of obsolete pesticides during various treaties and conventions. However, much need to be done in terms of enforcement of the legislations and regulations. Registration procedure should be amended for provisional & full certificate system as in other SAARC countries.

As part of the registration process PPD/PRMD of DoA should include and implement Good Agricultural Practice (GAP) for each pesticide that is registered. The government should improve regulations in relation to collecting and recording data on import, formulation, quality and quantity of pesticides.

8.2.3 Institutional development

- National organization need to prioritize promoting pesticide alternatives
- Advancing alternatives to pesticides should be made easily available at farm level
- PPD should start" **Pesticide free Week Celebration Day"** and create mass awareness program for pesticide alternatives

8.2.4 Strengthening of import controls

In order to promote the entry of safe pesticides in Nepal, control mechanisms should be enhanced in the border areas with Nepal. The illegal entry may be harassed through effective quarantine measure and imposition of the government rules and regulations. Dealers should be trained in the proper handling, storage, display for sale, record keeping. Obliviously it is the farmer's group and farmer's members who only can reduce the informal entry of pesticide in the country. So, launch educational program including short training, exposure visit, and awareness campaign in mass scale.

8.2.5 Pesticide use reduction strategies

- Increase public understanding of pests and pesticide risk
- Prioritize Bio Control Demonstration
- Eliminating use of the most hazardous pesticides
- Encourage alternatives to pesticides and promote alternative approaches
- Strengthen the post-registration control of pesticide
- Develop mechanism to regularly review the pesticides marketed in country,
- Carry out health surveillance program of those who are occupationally exposed to pesticides especially the farmers of commercial production areas
- Improve regulations in relation to collecting and recording data on import, formulation, quality and quantity of pesticides;

- Encouraged to observe the provisions laid down in any relevant international instruments concerning chemical management, environmental and health protection, sustainable development and international trade

8.2.6 Coordination and monitoring activity

There should be coordination and monitoring activity and integrated effort from governmental and non-governmental organizations that focus on the awareness raising of farmers on proper pesticide management and related issues.

8.2.7 Intensive advocacy

- An intensive advocacy is recommended on the enforcement of Stockholm and Rotterdam Conventions especially in relation to the use of POP and PIC pesticides for Agriculture.
- Laboratory data based advocacy. A laboratory based study (residual analysis in crops, food applicators blood, soil and water) is recommended so that the extent of pesticide damage on public health and the environment could be confirmed based on analytical data.

8.2.8 Safe use of chemical pesticides

Selection of appropriate pesticides and their handling and use as per the label are the most important steps for safe use of chemical pesticides. For this, the government needs to develop mechanisms for enforcing the regulations for the overall management and use of pesticides, adopting, code of conduct and guidelines developed from FAO with adequate educational and training interventions as per Nepalese farmers need.

8.2.9 Intensive IPM program

Strong science-based and research-supported intensive IPM program is required. Government should encourage the adoption of Integrated Pest Management practices through government strong support and other technology transfer initiatives. There is need to Institutionalize IPM components, in relevant educational, research, extension services and farmers group as IPM has been considered as alternative solution to reduce the overuse and misuse of pesticide.

8.2.10 Research& Development on the use of bio-pesticides and eco-friendly measures

Research and development on the use of bio-pesticides and eco-friendly measures are highly recommended to minimize the use of hazardous pesticides. For this, research laboratories must be strengthened in terms of both human resources and physical infrastructure.

8.2.11 Information, education and communication

Dissemination of information about insights, experience, and lessons learnt from project research and interventions should be formulated as recommendations to guide global policy and local action for prevention and management of pesticide poisoning. Therefore, information, education and communication should be strengthening to raise awareness about proper use of pesticides and its safety measures

9. Team Composition

S.N.	Name
1	Dr. Bhimsen KC, Team Leader-Pesticide Expert
2	Mr. Ganesh Kumar KC, Team Member- Pesticide Expert
3	Mr. Bhakta Raj Palikhe, Team Member- Pesticide Expert
4	Mr. Keshav Prasad Shrestha, Team Member-Agri-economist

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ANNEXTURE

Annex-1: Types of Pesticide Used

Insecticides

S.N.	Common Name	a.i.	Formulation	WHO Class
1	Acephate	75%	SP	II
2	Acetamiprid	20%	SP	II
3	Alphacypermethrin	10%	EC	II
4	Alphamethrin 1%+ Chlorpyriphos 16%	17%	EC	II
5	Aluminium Phosphide	56%	TAB	NC
6	Carbofuran	3%	GR	II
7	Cartap Hydrochloride	50%	SP	II
8	Chlorpyriphos	20%	EC	II
9	Chlorpyriphos50%+Cypermethrin 5%	55%	EC	II
10	Chlorpyriphos 8 %+Triazophos 17%	25%	EC	II
11	Cyfluthrin	5%	EW	II
12	Cypermethrin	25%	EC	II
13	Cyromazine	10%	SC	III
14	Deltamethrin	2.5%	EC	II
15	Cyromazine	10%	SC	III
16	Dichlorvos	76%	EC	IB
17	Dimethoate	30%	EC	II
18	Emamectin benzoate	5%	SG	II
19	Endosulfan	35%	EC	II
20	Fenvalerate	20%	EC	II
21	Imidacloprid	17.8%	EC	II
22	Malathion	50%	EC	III
23	Phorate	10G	G	II
24	Quinalphos 20%+Cypermethrin 3%	23%	EC	II
25	Quinalphos	25%	EC	II
26	Trizophos	40%	EC	II

Fungicides

SN	Common Name	a.i. (%)	Formulation	WHO Class
1	Benomyl	50	WP	NH
2	Captan-50%	50	WP	NH
3	Carbendazim	50	WP	NH
4	Carbendazim 12%+Mancozeb 63%	75	WP	NH
5	Carboxin	75	WP	III
6	Carboxin 22.5%+Thiram 22.5%+Imidacloprid 18%	63	WP	III
7	Carboxin 37.5%+Captan 37.5%	75	WP	NH
8	Copper oxychloride	50	WP	III
9	Cymoxani l8%+Mancozeb 64%	72	WP	NH
10	Hexaconazole	5	EC	III
11	Iprobenfos	48	SL	III
12	Mancozeb	75	WP	NH
13	Metalaxyl 8%+Mancozeb 64%	72	WP	NH
14	Thiophanate Methyl	70	WP	NH
15	Thiram	75	WP	III
16	Metalaxyl	35	WP	II
17	Propineb	70	WP	NH

Herbicides

S.N.	Common Name	a.i. (%)	Formulation	WHO Class
1	Glyphosate	41	SL	NH
2	Butachlor	50	EC	III
3	Oxadiargyl	80	WP	NH

Rodenticides

1	Zinc-phosphide	80	WW	IB
2	Bromadiolone	0.005	RB	IB

Acaricide

1	Colonel	18.5%	EC	II

Bio-pesticides and Botanicals

1	Tricoderma viride	1%	WP	NH
2	Azadiractin	10%	EC	NH
3	Pseudomonas flurescens	1.75%	EC	NH
4	Beauveria bassiana	1.15%	WP	NH

Annex-2: Consumption of pesticide in different district

District	Consumption a.i. kg	Percent	Consumption a.i. kg/ha
Jhapa	147.796	25.70	1.656
Rautahat	101.962	17.73	1.731
Kavre	89.241	15.52	1.854
Chitwan	60.001	10.44	0.712
Banke	40.140	6.98	1.254
Kaski	32.132	5.59	0.666
Kapilvastu	27.289	4.75	0.237
Kailali	25.265	4.39	0.517
Dhankuta	15.803	2.75	0.180
Dolkha	10.304	1.79	0.155
Taplejung	6.597	1.15	0.066
Mustang	4.431	0.77	0.130
Dadeldhura	3.506	0.61	0.028
Kalikot	2.989	0.52	0.159
Gulmi	2.504	0.44	0.059
Darchula	2.501	0.44	0.059
Dang	2.091	0.36	0.031
Salyan	0.442	0.08	0.010
Jumla	0.000	0.00	0
Total	574.993	100.00	

Annex-3 District wise consumption by pesticide type

Insecticide consumption

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Banke	9.826	4.60	0.307
Chitwan	23.572	11.04	0.280
Dadeldhura	2.558	1.20	0.021
Dang	1.186	0.56	0.017
Darchula	2.052	0.96	0.049
Dhankuta	5.094	2.39	0.058
Dolkha	2.661	1.25	0.040
Gulmi	0.780	0.37	0.018
Jhapa	64.329	30.13	0.721
Jumla	0.000	0.00	0.000
Kailali	13.124	6.15	0.269
Kalikot	2.014	0.94	0.107
Kapilvastu	22.190	10.39	0.193
Kaski	5.977	2.80	0.124
Kavre	19.624	9.19	0.408
Mustang	3.904	1.83	0.114
Rautahat	31.239	14.63	0.530
Salyan	0.209	0.10	0.005
Taplejung	3.150	1.48	0.032
Total	213.489	100.00	0.179

Fungicide consumption

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Banke	30.314	8.73	0.947
Chitwan	35.476	10.22	0.421
Dadeldhura	0.653	0.19	0.005
Dang	0.905	0.26	0.013
Darchula	0.413	0.12	0.010
Dhankuta	10.709	3.08	0.122
Dolkha	7.190	2.07	0.108
Gulmi	1.724	0.50	0.041
Jhapa	79.810	22.98	0.894
Jumla	0.000	0.00	0.000
Kailali	11.342	3.27	0.232
Kalikot	0.975	0.28	0.052
Kapilvastu	2.491	0.72	0.022
Kaski	26.155	7.53	0.542
Kavre	69.321	19.96	1.441
Mustang	0.526	0.15	0.015
Rautahat	66.293	19.09	1.125
Salyan	0.233	0.07	0.005
Taplejung	2.747	0.79	0.028
Total	347.274	100.00	0.292

Herbicide consumption

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Banke	0.000	0.00	0.000
Chitwan	0.945	9.92	0.011
Dadeldhura	0.215	2.26	0.002
Dang	0.000	0.00	0.000
Darchula	0.000	0.00	0.000
Dhankuta	0.000	0.00	0.000
Dolkha	0.000	0.00	0.000
Gulmi	0.000	0.00	0.000
Jhapa	0.765	8.03	0.009
Jumla	0.000	0.00	0.000
Kailali	0.000	0.00	0.000
Kalikot	0.000	0.00	0.000
Kapilvastu	2.578	27.07	0.022
Kaski	0.000	0.00	0.000
Kavre	0.296	3.11	0.006
Mustang	0.000	0.00	0.000
Rautahat	4.426	46.48	0.075
Salyan	0.000	0.00	0.000
Taplejung	0.298	3.13	0.003
Total	9.523	100.00	0.008

Rodenticide consumption

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Banke	0.000	0.00	0.000
Chitwan	0.008	1.62	0.000
Dadeldhura	0.080	16.18	0.001
Dang	0.000	0.00	0.000
Darchula	0.000	0.00	0.000
Dhankuta	0.000	0.00	0.000
Dolkha	0.000	0.00	0.000
Gulmi	0.000	0.00	0.000
Jhapa	0.000	0.00	0.000
Jumla	0.000	0.00	0.000
Kailali	0.000	0.00	0.000
Kalikot	0.000	0.00	0.000
Kapilvastu	0.000	0.00	0.000
Kaski	0.000	0.00	0.000
Kavre	0.000	0.00	0.000
Mustang	0.000	0.00	0.000
Rautahat	0.004	0.81	0.000
Salyan	0.000	0.00	0.000
Taplejung	0.402	81.39	0.004
Total	0.494	100.00	0.000

Bio-pesticide consumption

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Banke	0.000	0.00	0.000
Chitwan	0.000	0.01	0.000
Dadeldhura	0.000	0.00	0.000
Dang	0.000	0.00	0.000
Darchula	0.000	0.00	0.000

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Dhankuta	0.000	0.00	0.000
Dolkha	0.453	10.85	0.007
Gulmi	0.000	0.00	0.000
Jhapa	2.892	69.27	0.032
Jumla	0.000	0.00	0.000
Kailali	0.798	19.12	0.016
Kalikot	0.000	0.00	0.000
Kapilvastu	0.030	0.73	0.000
Kaski	0.000	0.00	0.000
Kavre	0.001	0.02	0.000
Mustang	0.000	0.00	0.000
Rautahat	0.000	0.00	0.000
Salyan	0.000	0.00	0.000
Taplejung	0.000	0.00	0.000
Total	4.175	100.00	0.004

Acaricide Consumption

District	Consumption (a.i. kg)	Percent	Consumption (a.i. kg/ha)
Banke	0.000	0.00	0.000
Chitwan	0.000	0.00	0.000
Dadeldhura	0.000	0.00	0.000
Dang	0.000	0.00	0.000
Darchula	0.037	99.94	0.001
Dhankuta	0.000	0.00	0.000
Dolkha	0.000	0.00	0.000
Gulmi	0.000	0.00	0.000
Jhapa	0.000	0.06	0.000
Jumla	0.000	0.00	0.000
Kailali	0.000	0.00	0.000
Kalikot	0.000	0.00	0.000
Kapilvastu	0.000	0.00	0.000
Kaski	0.000	0.00	0.000
Kavre	0.000	0.00	0.000
Mustang	0.000	0.00	0.000
Rautahat	0.000	0.00	0.000
Salyan	0.000	0.00	0.000
Taplejung	0.000	0.00	0.000
Total	0.037	100.00	0.000

Annex-4: Chemical Pesticides used in different crops

Rice	Brinjal	Tomato
Insecticides	**Insecticides**	**Insecticides**
Acetamiprid	Acephate	Acetamiprid
Aluminium Phosphide	Acetamiprid	Alphamethrin
Malathion	Alphamethrin	Cartap Hydrochloride
Carbofuran	Carbofuran	Chlorpyriphos
Cartap Hydrochloride	Chlorpyriphos	Chlorpyriphos 50 percent + Cypermethrin 5 percent
Chlorpyriphos	Chlorpyriphos 50 percent + Cypermethrin 5 percent	Cypermethrin
Chlorpyriphos 50%+ Cypermethrin 5%	Cypermethrin	Deltamethrin

Rice	Brinjal	Tomato
Deltamethrin	Dichlorovos	Dichlorvos
Dichlorovos	Dimethoate	Dimethoate
Dimethoate	Emamectin benzoate	Emamectin benzoate
Endosulfan	Endosulfan	Endosulfan
Phorate	Malathion	Malathion
Triazophos	Triazophos	Imidacloprid
Emamectin benzoate	Fungicides	Triazophos
	Carbendazim	
Fungicides	Carbendazim 12% + Mancozeb 63 percent	**Fungicides**
Carbendazim	Propinew	Carbendazim
Carbendazim 12% + Mancozeb 63 %	Mancozeb	Carbendazim 12%+ Mancozeb 63%
Iprobenfos	Metalaxyl 8% + Mancozeb 64%	Mancozeb
Copper oxychloride		Metalaxyl
Mancozeb		Metalaxyl 8%+Mancozeb 64%
Metalaxyl 8% + Mancozeb 64%		Copper oxychloride
Cymoxanil 8%+Mancozeb 64%		Cymoxanil 8% + Mancozeb 64%
Thiram		Thiram
Hexaconazole		Propinew
Herbicides		Hexaconazole
Butachlor		**Bio/Botanical pesticides**
Rodenticide		Tricoderma viridae
Bromadioline		Azadiractin
Botanical pesticides		
Azadiractin		

Potato	**Cole crop**
Insecticides	**Insecticides**
Acetamiprid	Acephate
Alphamethrin	Acetamiprid
Carbofuran	Carbofuran
Chlorpyriphos	Chlorpyriphos
Endosulfan	Chlorpyriphos 50% + Cypermethrin 5%
Chlorpyriphos 50% + Cypermethrin 5%	Cypermethrin
Cypermethrin	Deltamethrin
Deltamethrin	Dichlorvos
Emamectin benzoate	Dimethoate
Dichlorvos	Emamectin benzoate
Dimethoate	Endosulfan
Imidacloprid	Imidacloprid
Iprobenfos	Malathion
Malathion	Phorate
Phorate	Quinalphos 20% + Cypermethrin 3%
Triazophos	Triazophos
Fungicides	**Fungicides**
Carbendazim	Metalaxyl 8% + Mancozeb 64%
Carbendazim 12%+ Mancozeb 63%	Fenvelerate
Copper oxychloride	Carbendazim
Cymoxanil 8%+Mancozeb 64%	Carbendazim 12% + Mancozeb 63%
Hexaconazole	Copper oxychloride
Mancozeb	Hexaconazole
Metalaxyl	Mancozeb
Metalaxyl 8% + Mancozeb 64%	Metalaxyl
Thiram	**Botanical pesticides**
Rodenticide	Azadiractin
Zinc phosphide	
Bio/Botanical pesticides	
Trrichoderma viridae	
Azadiractin	

Annex 5: Questionnaire used in survey

जीवनाशक विषादी प्रयोग/खपतको अध्ययन सर्भेक्षण

कृषक घरधुरी अध्ययन सर्भेक्षण प्रश्नावली

बिषादी सूचना/तथ्यांक संकलन गर्ने अवधि १ आर्थिक बर्ष (२०६९ साल श्रावण देखि २०७० साल आषाढ सम्म

परिच्छेद १, भाग १: घरधुरीको समान्य जानकारी

सि.न.	प्रश्न	उत्तर
१	जिल्ला	
२	नगरपालिका/गा.वि.स.	
३	वडा.न.	
४	गाउँ/टोल	
५	क्षेत्र	शहरी ..... १ ग्रीमण २
६	उत्तरदाताको नाम	
७	उत्तरदाताको सम्पर्क नम्बर	
८	उत्तरदाताको खेतीको प्रकार	ब्यबसायिक ..... १ ब्यबसाय उन्मुख ..... २ निर्बाहमुखी ३
९	जातियता	मधेसी ..... १ ब्राम्हण/क्षेत्रि ..... २ जनजाति .....३ दलित ४
१०	उत्तरदाताको उमेर (बर्ष)	२५ बर्ष भन्दा कम.....१ २५-३४ बर्ष सम्म.....२ ३५-४४ बर्ष सम्म.....३ ४५-५४ बर्ष सम्म..... ४ ५५ बर्ष भन्दा माथि..... ५
११	शिक्षा (उत्तरदाताको मात्र)	गन्न मात्र सक्ने .....१ पढ्न/लेख्ने जान्ने .....२ माध्यमिक शिक्षा .....३ दश जोड दुई .....४ स्नातक वा सो भन्दा माथि.....५
१२	घरधुरीको मुख्य पेशा/आम्दानी (कुनै एक उत्तर मात्र)	जागिर .....१ कृषि खेती पाती ..... २ ज्यालादारी ..... ३ व्यापार ..... ४ बैदेशिक रोजगार ..... ५ अन्य भए खुलाउनुहोस् ६
१३	घरधुरीको दोश्रो मुख्य	जगिर १

	पेशा/आम्दानी (कुनै एक उत्तर मात्र)	कृषि खेती पाती ..... २ ज्यालादारी ..... ३ व्यापार ..... ४ बैदेशिक रोजगार ..... ५ अन्य भए खुलाउनुहोस् ६
१४	घरधुरीको तेश्रो मुख्य पेशा/आम्दानी (कुनै एक उत्तर मात्र)	जगिर .....१ कृषि खेती पाती ..... २ ज्यालादारी ..... ३ व्यापार ..... ४ बैदेशिक रोजगार ५
१५	घरधुरीको चौथो मुख्य पेशा/आम्दानी (कुनै एक उत्तर मात्र)	जगिर .....१ कृषि खेती पाती ..... २ ज्यालादारी ..... ३ व्यापार ..... ४ बैदेशिक रोजगार ५
१६	तपाइको परिवारलाई आफ्नै जमिनको उत्पादनबाट कति महिना खान पुग्छ ?	१२ महिना भन्दा बढी .....१ ६ महिना भन्दा बढी १२ महिना भन्दा कम .२ ६ महिना भन्दा कम ३

१७. जग्गाको उपलब्धता (रोपनी/कठ्ठामा)

सि.न.	बिवरण	सिंचित	असिंचित	जम्मा
क	आफनै खेती योग्य जग्गा			
ख	आफनो जग्गा अरुलाई दिएको			
ग	अरुको जग्गा आफूले कमाएको			

सि.न.	प्रश्न	उत्तर
१८	बालीमा विषादि प्रयोग गर्नुभएको छ ?	छ ..... १ छैन २
१९	विषादि प्रयोग गर्नुभएको कति वर्ष भयो ?	१-५ बर्ष सम्म ..... १ ६-१० बर्ष ..... २ १० भन्दा बढी ३
२०	तपाईले विषादी प्रयोग व्यवस्थापन सम्बन्धी कुनै तालिम लिनु भएको छ ?	छ ..... १ छैन २
२१	तपाई विषादी व्यबस्थापन सम्बन्धी संघ/संस्था वा समुहमा सदस्य बन्नु भएको छ ?	छ ..... १ छैन २

सि.न.	प्रश्न	उत्तर
	भाग-२ :- विषादीको स्रोत	
२२	बालीमा रोग कीरा लाग्दा रोकथामको लागि आवश्यक सरसल्लाह कोसँग लिने गर्नु हुन्छ ?	स्थानिय अगुवा कृषक/ छिमेकी ..... १ आफ्नै खुशी ..... २ जि.कृ.वि.का/अनुसन्धान केन्द्र ..... ३ विषादी विक्रेता ..... ४ रेडियो/पम्प्लेट ५
२३	विषादी कहाँबाट प्राप्त/किन्नु हुन्छ ?	विषादी खुद्रा विक्रेता ..... १ थोक विक्रेता ..... २ ग) सेवा प्रदायक संघ संस्था ३
	भाग-३: विषादी प्रयोग प्रति कृषकको ज्ञान एवम् सोच	
२४	विषादी प्रयोग गर्नु अघि विषादीसाथ रहेको पर्चा पढ्नु हुन्छ ?	पढ्छु ..... १ पढ्दिन ..... २ पढ्दिन तर थाहा छ ३
२५	तपाईले विषादी छर्कनको लागि कुन उपकरणको प्रयोग गर्नु हुन्छ ?	स्प्रेयर ..... १ झारी ..... २ कुचो ..... ३ पावर स्प्रेयर ४
२६	धुलो वा गेडा विषादीको कसरी प्रयोग गर्नु हुन्छ ?	हातैले ..... १ डस्टर ..... २ मलमा मिसाएर ..... ३ खरानीमा मिसाएर ..... ४ बिउमा मिसाएर ५
२७	विषादी छर्दा एकल वा एक भन्दा बढी विषादीहरु मिसाई छर्कनु हुन्छ ?	एक पटकमा एकथरी मात्र छर्कन्छु ... १ एक भन्दा बढी मिसाएर छर्कन्छु २
२८	तपाईले विषादी छर्नुहुंदा कुन बेला छर्कर्नु हुन्छ ?	फुर्सदको समय ..... १ बिहान ..... २ दिउँसो ..... ३ बेलुकी ४
२९	तपाईले विषादी छर्नुहुंदा कुन दिशा पट्टि फर्केर छर्कर्नु हुन्छ ?	हावा बगेको दिशा पट्टि फर्केर ..... १ हावा बगेको विपरित दिशा पट्टि फर्केर..२
३०	तपाईले विषादीको प्रयोग कति समय सम्म गर्नु हुन्छ ?	१ घन्टा सम्म ..... १ १–२ घन्टा सम्म ..... २ २–३ घन्टा सम्म ..... ३ ३ घन्टा भन्दा माथी ४
३१	तपाईले विषादी	गर्छु १

सि.न.	प्रश्न	उत्तर
	प्रयोगको समयमा केही अम्मल लिने गर्नु हुन्छ ?	गर्दिन २
३२	तपाईले खेतवारीमा विषादीको प्रयोग कहिले गर्नु हुन्छ ?	रोगकीरा लाग्नु अगाडि ..... १ रोगकीराको उपस्थितिमा ..... २ रोगकीराको क्षति देखा परेपछि ३
३३	तपाईले विषादीको प्रयोग गरेपछि विगतमा भन्दा हाल आएर रोगकीराको प्रकोपमा के फरक देख्नु भएको छ ?	रोग कीराको प्रकोपमा कमी हुँदै आएका.१ रोग कीराको प्रकोपमा बढी हुँदै आएको .२ रोग कीराको प्रकोप पहिला जस्तै नै छ .३ नया रोग कीराको प्रकोप देखिएको ४
३४	तपाईको विचारमा विषादीको प्रयोगको स्थिति विगतमा भन्दा कस्तो छ ?	विषादीको प्रयोग घट्दै गएको ..... १ विषादीको प्रयोग बढ्दै गएका ..... २ खासै फरक छैन ३
३५	विषादीको प्रयोग पछि वालीको क्षति कति प्रतिशतले जोगाउनु भो ?	० प्रतिशत सम्म ..... १ २५ प्रतिशत सम्म..... २ ७५ प्रतिशत भन्दा माथी ३
३६	रोगकीराको प्राकृतिक शत्रुबारे तपाईलाई थाहा छ ?	छ ..... १ छैन २
३७	विषादीले मानिस, पशु-पन्छी र वातावरणलाई नराम्रो असर गर्छ भन्ने कुराको जानकारी तपाईलाई छ ?	छ ..... १ छैन २
३८	यदि थाहा छ भने के जानकारी राख्नु हुन्छ ?	प्राकृतिक शत्रुको नाश ..... १ पानी प्रदुषण ..... २ हावा प्रदुषण ..... ३ छर्ने व्यक्ति वा मजदुरलाई हानि गर्ने...४ मानिस र जनावरको स्वास्थ्यमा असर..५ बालीको लागि हानिकारक ६
३९	तपाईले खेती गर्नु भएको बालीमा रोग/कीरा व्यवस्थापनको	छ ..... १ छैन ..... २ आई.पी.एम. नै थाहा छैन ३

सि.न.	प्रश्न	उत्तर
	एकिकृत रोगकीरा व्यवस्थापन (आई.पी.एम.) पद्धति अपनाउनु भएको छ ?	
४०	यदि थाहा छ भने बाली विरुवामा विषादी प्रयोग गरेपछि तपाइले उक्त बाली काट्न पर्खनु पर्ने समय थाहा छ?	छ ..... १ छैन २
४१	तपाइले उक्त बाली टिप्न पर्खनु पर्ने समय कसरी थाहा पाउनु हुन्छ ?	आफुले लिएको तालिमबाट..... १ जेटी, जेटीए बाट ..... २ सहयोगी साथीहरुबाट ३

भाग ४: सुरक्षात्मक उपायहरु र स्वास्थ्य सम्बन्धी सचेतना

४२	विषादी छर्कदा आफूलाई सुरक्षित राख्नु पर्छ भन्ने कुरा तपाईलाई थाहा छ	छ ..... १ छैन २
४३	यदि छ भने कसरी सुरक्षित राख्नुहुन्छ ?	अनुहार कपडाले छोपेर ..... १ शरीर र अनुहार कपडाले छोपेर .. २ लामो पञ्जा लगाएर ..... ३ बुट लगाएर ..... ४ माथि भनिएका सबै थोक गरेर ५
४४	विषादी छर्किसकेपछि हातखुट्टा धुने गर्नुहुन्छ ?	गर्छु ..... १ गर्दिन २
४५	यदि धुनुहुन्छ भने के ले धुने गर्नुहुन्छ ?	पानीले मात्र ..... १ साबुन पानीले ..... २ माटो/खरानीले ३
४६	विषादीको दुरुपयोगबाट जनस्वास्थ्यमा पर्न सक्ने प्रतिकुल असर सम्बन्धमा जानकारी छ ?	छ ..... १ छैन २

एग्रो भेट/विषादी खुद्रा विक्रेतासंग सोधिने प्रश्नावली

१. विक्रेता फर्मको नाम:.....
२. विक्रेताको नाम: .....
३. जिल्ला:..... ४. नगरपालिका/गा.वि.स.:..... ५. वडा.न.: .....
६. सम्पर्क नम्बर: ..... ७. रजिष्ट्रेशन नं.: .....
७. विषादी बाहेक अन्य सामाग्री पनि विक्रि गर्नु हुन्छ ?
क) गर्छु ख) गर्दिन
८. यदि गर्नुहुन्छ भने के के विक्रिमा राख्नु भएको छ ?
क) रसायनिक मल ख) बिउ ग) कृषि उपकरण घ) खाधान्न
ङ) अन्य खुलाउने .....
९. विक्रिकोलागि कति किसिमका विषादीहरु राख्नु भएको छ ? नाम भन्नुस् ।
क) कीटनाशक ख) रोग नाशक ग) मूसा नाशक घ) झारपात नाशक
ङ) अन्य खुलाउने .....
१०) तपाईबाट विशेष गरी विषादीहरु कुन बालीका लागि जाने गर्छ ?
क) ख) ग)
११. तपाईसँग विषादी खरिद गर्न आउनेहरुले
क) नाम तोकेर विषादी माग्छन्
ख) प्राबिधिकको सिफारिस लिएर आउछन्
ग) बालीमा यस्तो रोग/कीरा लाग्यो भनेर सुनाउंदा त्यस अनुसार तपाईले दिएको विषादी लिएर जान्छन्
१२. तपाईको पसलमा म्याद नाघेका/प्रयोग गर्न नहुने विषादी स्टक छ ?
क) छ ख) छैन
१३. तपाईको पसलबाट सबै भन्दा बढी बिक्री हुने बिषादी कुन कुन हो प्राथमिकताको आधारमा भन्नुस ?
क) ..... ख) ..... ग) .....

घ) ..... ङ) .....

प्रश्नकर्ता

नाम थर : ..... दस्तखत: ..... मिति : .....

प्रति एकाई क्षेत्रफल विषादी प्रयोग/खपत तथ्याङ्क पत्ता लगाउने उद्देश्यले संचालन गरिएको कार्यक्रममा सहभागिताको लागि धन्यवाद छ । यो अध्ययन सर्भेक्षण अनुसन्धान कार्यमा उपयोगी एवम् सहयोगी हुने अपेक्षा राखिएको छ । यहाँबाट प्राप्त उत्तर गोप्य राखिने छ र अन्य अनुसन्धान समूहलाई पूर्व स्वीकृतिबिना उपलब्ध गराइने छैन ।

सहयोगको लागि स-धन्यवाद !

Annex 6: Pesticide Use Statistics in Farmer's Field

बाली अवधिभर बिषादीप्रयोग/खपततथ्याङ्क विवरणः

(खाद्यान्नबाली)

सि.नं.	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपातनाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशकभाइरस बिरुद्ध		वनस्पति/जैबिकबिषादी		अन्यबिषादी	
			नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)
१	**धानः**																	
१.१	धान(बसन्ते)																	
१.२	धान(मुख्यमौसममा)																	
२.	**मकैः**																	
२.१	मकै (हिउदे)																	
२.२	मकै (बसन्ते)																	
२.३	मकै (वर्षे)																	
३.	**गहुँ**																	
३.१	**गहुँ**(हिउदे)																	
३.२	**गहुँ**(बसन्ते)																	
४	कादो																	
५. तरकारी बालीहरु																		
५.१	**काउलीवर्ग (काउली, बन्दा, ब्रोकाउली, अन्य)**																	
५.२	**काँक्रो फर्सि वर्ग (** काँक्रो, फर्सि, अन्य)																	
५.३	भाण्टा																	

सि.नं.	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपातनाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशकभाइरस बिरुद्ध		वनस्पति/जैबिकबिषादी		अन्यबिषादी	
			नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)
५.४	गोलभेडा																	
५.५	आलु																	
५.६	**कोसे तरकारी** (केराउ, सिमि, बोडी अन्य)																	
५.७	**हरियो तरकारी** (रायो, तोरी, पालुङ्गो, चम्सुर, मेथी, सलाद, धनिया, अन्य)																	
५.८	**जरे तरकारीहरु (मुला,** गाँजर, सलगम, अन्य)																	
६. फलफुल-बालीहरु																		
६.१	आँप																	
६.२	केरा																	
६.३	स्याऊ																	
६.४	सुन्तलाजात (सुन्तला, कागती, जुनार, मौसम, अन्य)																	
७. नगदे र मसलाबाली																		
७.१	उखु																	
७.२	कपास																	
७.३	सुर्ति																	
७.४	ाचया																	
७.५	कफि																	
७.६	अलैंची																	
८. दालबालीहरु																		

सि.नं.	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपातनाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशकभाइरस बिरुद्ध		वनस्पति/जैबिकबिषादी		अन्यबिषादी	
			नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)	नाम	परिमाण (मि.ली/ ग्राम/ के.जी.)
८.१	रहर																	
८.२	च्ना																	
८.३	मुसुरो																	
८.४	मास																	
८.५	ग्हत																	
९. तेलबालीहरु																		
९.१	कालो तोरी (रायो)																	
९.२	तोरी																	
९.३	सरस्युँ																	
९.४	सूर्यमुखी																	
१०. अन्नबाली भण्डारण																		
१	गहुँ																	
२	मकै																	
३	धान(चामल)																	
४	आलुबाली																	
५	अन्यबाली																	

Annex 7: Guidelines for Pesticide Survey

जीवनाशक विषादी प्रयोग/खपतको अध्ययन सर्भेक्षण

मार्गदर्शन

१) विषादी प्रयोग/खपत मात्रा (परीमाण) को सूचना/तथ्यांक संकलन गर्ने अवधि गत आ.व. २०६९ साल श्रावण देखि २०७० साल आषाढ सम्म (१ बर्ष) को हुनेछ । माथि उल्लेखित समयसम्मको कृषकले प्रयोग गरेको विषादीको नाम र त्यसको परीमाण संकलन गर्नु पर्नेछ ।

२) प्रश्नकर्ता सर्वेक्षकले कृषकले बताएको बिषादीको नाम सहित बिषादीको प्रतिशत अनिवार्यरुपमा लेख्नुपर्ने छ । उदाहरणकोलागी ***मालाथायन ५० प्रतिशत*** प्रतिशत उल्लेख नभएको बिषादीको हकमा सक्रिय तत्व (active ingredients) मा रुपान्तरण गर्न नसकिने भएकोले प्रतिशत उल्लेखहुनु जरुरी भएको हो ।

३) यो अध्ययन सर्भेक्षण दुई परिच्छेदमा विभाजन गरिएको छ ।

४) पहिलो परिच्छेदमा जम्मा ४ भाग (भाग १:घरधुरीको सामान्य जानकारी, भाग २: विषादीको श्रोत, भाग ३:विषादी प्रयोग प्रति कृषिको ज्ञान एवम् सोच, भाग ४: सुरक्षात्मक उपायहरु र स्वास्थ्य सम्वन्धी सचेतना) समावेश गरिएका छन् ।

५) **पहिलो परिच्छेदः बाली अवधिभर बिषादी प्रयोग/खपत तथ्याङ्क विवरण लाई यो अध्ययन सर्भेक्षणको मेरुदण्ड/केन्द्र विन्दु/मुटु नै मानिएको छ । तसर्थ अनुसूची १ राम्रोसँग बुझ्नु अति आवश्यक छ । सूचना/तथ्यांक भर्ने बेलामा कृषकले खेती गरेका बालीगत नाम र तिनका बालीगत क्षेत्रफल (रोपनी/कट्ठा) लेख्ने र प्रत्येक बालीमा कुन विषादी कति परीमाणमा प्रयोग/खपत भएको थियो सो समेत उल्लेख गर्नुहोला । विशेष ध्यान र समय दिएर भर्नुहोला । नमूना संलग्न छ ।**

६) विषादी प्रयोग/खपत परीमाण (मात्रा) को एकाइ **मि.लि. वा ग्राम, वा के.जी.** के हो स्पष्ट लेख्नुहोला ।

७) दोश्रो परिच्छेदमा (एग्रोभेट/विषादी खुद्रा विक्रेता) मात्र समावेश छ ।प्रत्येक जिल्लाबाट ५-१० जना खुद्रा विषादी विक्रेताबाट विषादी सम्वन्धी सूचना/तथ्यांक संकलन गर्नुपर्नेछ ।

८) प्रत्येक जिल्लाबाट **८४** घरधुरी छनौट गर्ने ।

९) घरधुरी छनौट गर्दा प्रत्येक जिल्लामा **व्यवसायिक** र **निर्वाहमुखी** खेती गर्ने कृषकहरु समावेश गर्नुपर्नेछ ।

१०) छनौट गरिएका कृषकहरुबाट लगाइएका मुख्य र सहायक बाली सबै समेटेर सूचना/तथ्यांक संकलन गर्नुपर्नेछ । (उदाहरण: झापामा चिया, ताप्लेजुंगमा अलैची, गुल्मीमा कफी, बाँकेमा कपास आदी)

११) फर्मेट भर्दा बिषादीको नामको कोलममा बिषादीको नामको सट्टामा संलग्न कोड नक्बर लेख्ने साथै Reference Sample copy समेत हेर्नु होला ।

Annex 8: Commodity wise Pesticide Use data collection format

बाली अवधिभर बिषादी प्रयोग/खपत तथ्याङ्क विवरण:

(खाद्यान्न बाली)

सिनं	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपात नाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशक भाइरस बिरुद्ध		वनस्पति/जैबिक बिषादी		अन्य बिषादी	
			नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी	नाम	परिणाम मि.ली/ ग्राम/ के.जी
१	**धानः**																	
१.१	धान (बसन्ते)	१० रोपनी	I २४ I २५	४००मि.ली ३५०मि.ली			H ६ H७	५००ग्राम ४०० ग्राम			R ५ R ६	१००ग्राम १५०ग्राम	BC १ BC२	१००ग्राम १५०ग्राम	B १ B २	३५०मि.ली ४०० मि.ली		
१.२	धन(मुख्य मौसममा)	१० रोपनी	I २४ I २५	४००मि.ली ३५०मि.ली			H ६ H७	५००ग्राम ४०० ग्राम			R ५ R ६	१००ग्राम १५०ग्राम	BC १ BC२	१००ग्राम १५०ग्राम	B १ B २	३५०मि.ली ४०० मि.ली		
२	**मकैः**																	
२.१	मकै (हिउदे)	५ रोपनी	I ४३ I ४४	२००मि.ली २००मि.ली			H १३ H १४	३००मि.ली २५० मि.ली			R ५ R ६	१००ग्राम १५०ग्राम			B १ B २	३५०मि.ली ४००मि.ली		
२.२	मकै (बसन्ते)	५ रोपनी	I ४३ I ४४	२००मि.ली २००मि.ली			H १३ H १४	३००मि.ली २५० मि.ली			R ५ R ६	१००ग्राम १५०ग्राम			B १ B २	३५०मि.ली ४०० मि.ली		
२.३	मकै (बर्षे)	५ रोपनी	I ४३	२००मि.ली			H १३	३००मि.ली			R ५ R ६	१००ग्राम १५०ग्राम			B १	३५०मि.ली		
३	**गहुँ**																	
३.१	**गहुँ** (हिउदे)	१० रोपनी	I २६ I २७	२००मि.ली २००मि.ली			H १३	३००मि.ली			R ५ R ६	१००ग्राम १५०ग्राम			B २	४०० मि.ली		
३.२	**गहुँ**(बसन्ते)	१० रोपनी	I २८	२००मि.ली			H १४	२५० मि.ली			R ५ R ६	१००ग्राम १५०ग्राम			B ६	३०० मि.ली		
४	कादो	१० रोपनी	I २४ I २५	४००मि.ली ३५०मि.ली			H ६ H७	५००ग्राम ४०० ग्राम			R५ R ६	१००ग्राम १५०ग्राम			B १ B २	३५०मि.ली ४०० मि.ली		
तरकारी बालीहरु																		
१	**काउली वर्गः**																	

सिनं	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपात नाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशक भाइरस बिरुद्ध		वनस्पति/जैबिक बिषादी		अन्य बिषादी	
			नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी	नाम	परिणाम मि.ली/ ग्राम/ के.जी
१.१	काउली	५ रोपनी	I ४३ I ४४	२००मि.ली २००मि.ली			H १३ H १४	३००मि.ली २५० मि.ली							B १ B २	३५०मि.ली ४०० मि.ली	I ५६	३००मि.ली
१.२	बन्दा	**५ रोपनी**	I ४३ I ४४	२००**मि.ली** **२००मि.ली**			H १३ H १४	३००**मि.ली** **२५० मि.ली**							**B** १ **B** २	३५०**मि.ली** ४०० **मि.ली**	I ५६	३००मि.ली
१.३	ब्रोकाउली	**५ रोपनी**	I ४३ I ४४	२००**मि.ली** **२००मि.ली**			H १३ H १४	३००**मि.ली** **२५० मि.ली**							**B** १ **B** २	३५०**मि.ली** ४०० **मि.ली**	I ५६	३००मि.ली
१.४	अन्य																	
२	**काँक्रो फर्सि वर्ग**																	
२.१	काँक्रो	**५ रोपनी**	I २९	२००**मि.ली**											**B** ५	१५०**मि.ली**	I ५६	३००मि.ली
२.२	फर्सि	**५ रोपनी**	I २९	२००**मि.ली**											**B** ५	१५०**मि.ली**	I ५६	३००मि.ली
२.३	अन्य																	
३	भण्टा	**१०रोपनी**	I ५१	४००**मि.ली**											**B** ८	२५०**मि.ली**		
४	गोलभेडा	**५ रोपनी**	I ४३ I ४४	१५०**मि.ली** २००**मि.ली**	F३० F३१	१५० **ग्राम** २००**ग्राम**							BC १ BC२	१००ग्राम १५०ग्राम	**B** १ **B** २	३५०**मि.ली** ४०० **मि.ली**		
५	आलु	**५ रोपनी**	I २६ I २७	१५०**मि.ली** १५०**मि.ली**	F३० F३१	१५० **ग्राम** २००**ग्राम**							BC १ BC२	१००ग्राम १५०ग्राम	**B** ८	२५०**मि.ली**		
६	**कोसे तरकारी**																	
६.१	केराउ	**१०रोपनी**	I २८	२००**मि.ली**											**B** ५	१५०**मि.ली**		
६.२	सिमि	**१०रोपनी**	I २८	२००**मि.ली**											**B** ५	१५०**मि.ली**		
६.३	बोडी	**१०रोपनी**	I २८	२००**मि.ली**											**B** ५	१५०**मि.ली**		
६.४	अन्य																	
७	**हरियो तरकारी**																	

सिनं	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपात नाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशक भाइरस बिरुद्ध		वनस्पति/जैबिक बिषादी		अन्य बिषादी	
			नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी	नाम	परिणाम मि.ली/ ग्राम/ के.जी
७.१	रायोको साग	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली					A१	३०० मि.ली					B ८	२५०मि.ली	I ५६	३००मि.ली
७.२	तोरीको साग	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली					A१	३०० मि.ली					B ८	२५०मि.ली		
७.३	पालुङ्गो	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली					A१	३०० मि.ली					B ८	२५०मि.ली	I ५६	३००मि.ली
७.४	चम्सुर	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली					A१	३०० मि.ली					B ८	२५०मि.ली	I ५६	३००मि.ली
७.५	मेथी	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली					A१	३०० मि.ली					B ८	२५०मि.ली		
७.६	सलादको साग	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली											B ८	२५०मि.ली		
७.७	धनियाँ	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली											B ८	२५०मि.ली		
७.८	अन्य																	
८	**जरे तरकारीहरु:**																	
८.१	मुला	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली											B ८	२५०मि.ली		
८.२	गाँजर	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली											B ८	२५०मि.ली		
८.३	सलगम	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली											B ८	२५०मि.ली		
८.४	अदुवा	५ रोपनी	I ५० I ५१	१५०मि.ली १५०मि.ली											B ८	२५०मि.ली		

सिनं	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपात नाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशक भाइरस बिरुद्ध		वनस्पति/जैबिक बिषादी		अन्य बिषादी	
			नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी	नाम	परिणाम मि.ली/ ग्राम/ के.जी
८.५	अन्य																	
९. फलफुल-बालीहरु																		
९.१	आँप	**५ रोपनी**	I ४३ I ४४	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**							**B** ८	२५०मि.ली		
९.२	केरा	**५ रोपनी**	I ४३ I ४४	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**							**B** ८	२५०मि.ली		
९.३	स्याऊ	**५ रोपनी**	I ४३ I ४४	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**					BC १ BC२	१००ग्राम १५०ग्राम	**B** ८	२५०मि.ली		
१०	**सुन्तलाजात**																	
१०.१	सुन्तला	**५ रोपनी**	I ४३ I ५५	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**					BC १ BC२	१००ग्राम १५०ग्राम	**B१**	२५०मि.ली		
१०.२	कागती	**५ रोपनी**	I ४३ I ५५	१५०मि.ली १५०मि.ली											**B१**	२५०मि.ली		
१०.३	जुना	**५ रोपनी**	I ४३ I ५५	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**							**B१**	२५०मि.ली		
१०.४	मौसम	**५ रोपनी**	I ४३ I ५५	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**							**B१**	२५०मि.ली		
१०.५	अन्य																	
११. नगदे र मसला बाली																		
११.१	उखु	**५ रोपनी**	I ३४ I ३५	१५०मि.ली १५०मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**							**B२**	२५०मि.ली		
११.२	कपास	**५ रोपनी**	I ५४ I ५१	१५०मि.ली १५०मि.ली २००मि.ली			H १३ H १४	३००मि.ली **२५० मि.ली**					BC १ BC२	१००ग्राम १५०ग्राम	**B१**	२५०मि.ली		

सिनं	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		दुसीनाशक		झारपात नाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशक भाइरस बिरुद्ध		वनस्पति/जैबिक बिषादी		अन्य बिषादी	
			नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी	नाम	परिणाम मि.ली/ ग्राम/ के.जी
			I ४६															
११.३	सुर्ति	**५ रोपनी**	I ५४ I ५१ I ४६	१५०**मि.ली** १५०**मि.ली** २००**मि.ली**			H १३ H १४	३००**मि.ली** **२५० मि.ली**							**B१**	२५०**मि.ली**		
११.४	चिया	**५ रोपनी**	I ३९ I ४०	१५०**मि.ली** १५०**मि.ली**			H १३ H १४	३००**मि.ली** **२५० मि.ली**	A१	३०० **मि.ली**					**B१**	२५०**मि.ली**		
११.५	कफी	**५ रोपनी**	I ३९	१५०**मि.ली**			H १३ H १४	३००**मि.ली** **२५० मि.ली**							**B१** B२	२५०**मि.ल** २५०**मि.ली**		
११.६	अलैंची	**५ रोपनी**	I ३९	१५०**मि.ली**											**B१** B२	२५०**मि.ल** २५०**मि.ली**		
१२. दाल बालीहरु																		
१२.१	रहर	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१२.२	चना	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१२.३	मुसुरा	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१२.४	मास	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१२.५	ग्हत	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१३. तेल बालीहरु																		
१३.१	कालो तोरी (रायो)	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		

सिनं	बाली	क्षेत्रफल (रोपनी/कट्ठा)	कीटनाशक		ढुसीनाशक		झारपात नाशक		शुलशुले नाशक		मुसानाशक		व्याक्टेरियानाशक भाइरस बिरुद्ध		वनस्पति/जैबिक बिषादी		अन्य बिषादी	
			नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी.	नाम	परिणाम मि.ली/ ग्राम/ के.जी	नाम	परिणाम मि.ली/ ग्राम/ के.जी
१३.२	तोरी	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१३.३	सरस्युँ	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१३.४	सूर्यमुखी	५ रोपनी	I ५१ I ५२	१५०मि.ली १५०मि.ली											B१	२५०मि.ली		
१४. अन्नबाली भण्डारण																		
१४.१	गहुँ	५ MT	I १८ I १९	५TAB ५ TAB											B१	२५०मि.ली		
१४.२	मकै	५ MT	I १८ I १९	५TAB ५ TAB											B१	२५०मि.ली		
१४.३	धान(चामल)	५ MT	I १८ I १९	५TAB ५ TAB											B१	२५०मि.ली		
१४.४	अन्य बाली																	