FACTORS INFLUENCING KNOWLEDGE, ATTITUDE AND PRACTICE ON SAFE PESTICIDE USE AMONG VEGETABLE FARMERS IN MANDANDEUPUR, KAVREPALANCHOK

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AN ABSTRACT

of the dissertation of *Prabina Makai* for the degree *Master in Sustainable Development* presented on *16 December 2025* entitled *Factors Influencing Knowledge, Attitude and Practice on Safe Pesticide Use Among Vegetable Farmers in Mandandeupur, Kavrepalanchok.*

APPROVED BY

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Kishor Atreya, PhD

Dissertation Supervisor

Pesticide use in agriculture is a critical issue for sustainable development. Despite the introduction of policies, regulations, and safer alternatives such as Integrated Pest Management by the Government of Nepal, haphazard use of pesticide persists because of poor implementation and low farmer awareness. The purpose of this study was to evaluate farmers' knowledge, attitudes, and practices regarding the use of pesticides in Mandandeupur, Kavrepalanchok.

This study applies a cross-sectional, explanatory design. Structured face-to-face interviews were conducted among 151 farmers. Quantitative data was collected from KoBoCollect and analyzed in SPSS, using descriptive statistics, chi-square tests, and Ordinary Least Squares regression.

Regression analysis showed that ethnicity, IPM training, and food sufficiency were significant predictors of farmers' knowledge, while age had a negative association. For attitude, only education and IPM training emerged as significant positive predictors. Food sufficiency, IPM training, and ethnicity were important positive predictors for practice. The greatest positive impact on knowledge, attitude, and practice was consistently shown by IPM training.

The results indicate that IPM training and socioeconomic factors are directly linked for improving farmers' knowledge, which in turn supports stronger IPM understanding. It also suggests that attitude and practice can be enhanced through

targeted training, particularly for ethnic groups and farmer with lack of food sufficiency, to ensure more safe practices.

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शोध सार

विकास शिक्षामा स्नातकोत्तर उपाधिका लागि प्रबिना मकैको शोध प्रबन्धको शीर्षक "काभ्रेपलाञ्चोक मण्डनदेउपुरका तरकारी किसानहरूमा सुरक्षित कीटनाशक प्रयोगसम्बन्धी ज्ञान, दृष्टिकोण र व्यवहारलाई प्रभाव पार्ने कारकहरू" ४ मंसिर २०८२ मा प्रस्तुत गरिएको थियो ।

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किशोर आत्रेय, पीएचडी

शोध निर्देशक

कृषिमा कीटनाशकको प्रयोग दिगो विकासका दृष्टिले अझै पनि एक गम्भीर चुनौती रहँदै आएको छ, जसले खाद्य सुरक्षा आवश्यकता र मानव स्वास्थ्य तथा वातावरणीय जोखिमबीच सन्तुलन कायम गर्नुपर्ने हुन्छ। नेपाल सरकारले नीतिहरू, नियमावलीहरू र एकीकृत कीट व्यवस्थापन (IPM) जस्ता सुरक्षित विकल्पहरू अपनाएको भए पनि किसानहरूमा कमजोर कार्यान्वयन र सीमित सचेतनाका कारण कीटनाशकको दुरुपयोग निरन्तर रहँदै आएको छ। यस अध्ययनले काभ्रेपलाञ्चोकको मण्डनदेउपुर क्षेत्रमा किसानहरूको कीटनाशक प्रयोगसम्बन्धी ज्ञान, दृष्टिकोण र व्यवहार मूल्याङ्कन गर्न खोजिएको हो।

यस अध्ययनमा क्रस–सेक्सनल, व्याख्यात्मक डिजाइन प्रयोग गरेको छ। अन्तरवार्ता १५१ जना किसानहरूसँग सञ्चालन गरियो। परिमाणात्मक तथ्याङ्क KoBoCollect मार्फत सङ्कलन गरी SPSS मा वर्णनात्मक तथ्याङ्क, chi-square परीक्षण (फ्रिक्वेन्सी ५ भन्दा कम भएपछि Fisher's Exact Test), र Ordinary Least Squares (OLS) regression प्रयोग गरी विश्लेषण गरियो।

Regression विश्लेषणले जातीयता, IPM तालिम, र खाद्य पर्याप्तता किसानहरूको ज्ञानका महत्वपूर्ण पूर्वान्कक भएको देखायो, भने उमेरको नकारात्मक सम्बन्ध पाइयो। दृष्टिकोणका लागि शिक्षा र IPM तालिम मात्र सकारात्मक पूर्वान्कक देखिए। व्यवहारका लागि जातीयता, IPM तालिम, र खाद्य पर्याप्तता सकारात्मक पूर्वान्कक देखिए। सबै मोडेलहरूमा IPM तालिमले ज्ञान, दृष्टिकोण, र व्यवहारमा सबैभन्दा शक्तिशाली सकारात्मक प्रभाव देखायो।

IPM तालिम र सामाजिक–आर्थिक कारकहरूले किसानहरूको ज्ञान सुधारमा महत्वपूर्ण भूमिका खेल्छन्, जसले IPM प्रति अझ बलियो समझ विकास गर्न मद्दत गर्दछ। यसले दृष्टिकोण र व्यवहारलाई पनि लक्षित तालिम र सहयोगमार्फत सुधार गर्न सकिने संकेत गर्छ, विशेष गरी जातीयता र खाद्य पर्याप्ततामा भिन्नता भएका समूहहरूमा, जसले सुरक्षित अभ्यास सुनिश्चित गर्न मद्दत गर्दछ।

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प्रबिना मकै

उपाधि उम्मेदवार

This dissertation entitled *Factors Influencing Knowledge, Attitude and Practice on Safe Pesticide Use Among Vegetable Farmers in Mandandeupur, Kavrepalanchok* presented by *Prabina Makai* on *16 December 2025*.

APPROVED BY

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I understand that my dissertation will become a part of the permanent collection of the library of Kathmandu University. My signature below authorizes the release of my dissertation to any reader upon request for scholarly purposes.

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DECLARATION

I hereby declare that this dissertation is my original work, and it has not been submitted for candidature for any other degree at any other university.

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TABLE OF CONTENTS

ABBREVIATIONS

BCT	Brahmin/Chhetri/Thakuri
GDP	Gross Domestic Product
IPM	Integrated Pest Management
KAP	Knowledge, Attitudes, and Practices
MoALD	Ministry of Agriculture and Livestock Development
PPE	Personal Protective Equipment
UGC	University Grant Commission
VIF	Variance Inflation Factors

LIST OF FIGURES

LIST OF TABLES

CHAPTER I
INTRODUCTION

Overview of the Chapter

This chapter provides comprehensive introduction to the study on safe pesticide use by farmers. The chapter starts with background of agricultural sector in context of global and Nepal relating to pesticide use. The contexts highlights the increasing use of pesticides, associated health and environment risks, and challenges in the developing countries such as Nepal. Further, the rationale for conducting this study is elaborated. The rationale provides need for sustainable pest management and knowledge gaps. The statement of problems explores the Nepalese context relating to the various studies. It explores the importance of assessing KAP in terms of safe pesticide use. The purpose, research questions and hypothesis are outlined. The limitation of this study is explained. Also, significance of the study is discussed highlighting the study's academics and practical importance.

Background

Agriculture is the backbone of human civilizations. It is essential for human survival and sustainable food system. The agriculture sector has evolved over the period. Similarly, agricultural tools and technique have also changed over the period. During the changes, farmers face challenges related to pests, plant diseases, and weeds that harm the plants and reduce crop production, which affect in food security. To tackle this problem, farmers began to rely on pesticides, especially after green revolution as they used modern agricultural ways (Carvalho, 2017). Pesticides are chemical or biological substances designed in a way to prevent, control or destroy pests and protect plants (Sharma et al., 2019). These are beneficials to some extents in terms of yielding more crops if used safely (Poudel et al., 2020). However, it has more human and environmental impacts if used haphazardly (Gyawali, 2018). Hence, it is important to understand pesticide use patterns to formulate strategy and policies to benefit from pesticides and reduce the risks.

Global Context

Globally, pesticide use is common in commercial agriculture for pest management. Agricultural development, particularly the intensification of agriculture, has led to increased crop production and farmers' income while simultaneously driving higher application of chemical pesticides, whose use has expanded in modern agriculture to minimize crop losses and meet the growing global food demand, with an estimated 2 million tons applied annually worldwide and increasing each year (Kumar et al., 2021), thereby posing significant health and environmental hazards when handled unsafely; hence, the increasing use of pesticides possesses various health and environmental hazards if handled unsafely (Kumar et al., 2021). The developing countries are more affected in terms of consequences of the mishandling of pesticide use (Khanal & Singh, 2016).

National Context

In Nepal, 55.8 metric tonnes of pesticides are used in a year (Society for Human Rights, Environment, Law and Governance Activities [SHELGA], 2006), and it is also increasing by 10-20% each year (Khanal & Singh, 2016). The use of pesticides is very intensive in commercial farming (Sharma, 2015; Sharma et al., 2019). The use of pesticides is not systematized and monitored. Thus, farmers have limited knowledge of the handling and use pesticides haphazardly (Kapeleka, 2024). For example, Gyawali (2018) explained that haphazard use of pesticide had exposed farmers to risks. The haphazard use of pesticides can cause harm to human health, environment and overall ecosystem services (Poudel et al., 2020).

Rationale use of pesticides is essential to protect human health, environment and overall ecosystem services for sustainability. However, prior studies informed us otherwise. Moreover, safety measures is an important aspect to consider in the context of pesticide use. A study conducted in Chitwan on the use of pesticides found that none of the farmers followed any precautionary measures (Khanal & Singh, 2016). The lack of protective measures during pesticide handling enables farmers to exposure to pesticides. It can lead to short and long-term health effects that incur an additional economic burden on the households (Atreya et al., 2012).

The study area, Mandandeupur, Kavrepalanchok is one of popular commercial farming field nearby Kathmandu valley. The vegetables grown in the study areas is brought to Kathmandu valley for selling purposes. As the farmers are more into commercial farming, the pesticide use has been integral part and largely used for farming purpose.

Rationale of the Study

Crop intensification, the practice of growing more crops in a unit of land during a growing season, is the norm for agriculture development. In Nepal, vegetable farming is becoming popular for diversifying income, instead of rice-wheat. Pesticide use in vegetables does not seem to decrease anytime sooner in Nepal. Approximately one fourth of the national Gross Domestic Product (GDP) is covered by agriculture sector. Moreover, according to Ministry of Agriculture and Livestock Development (MoALD) (2024), 60% of the labor force is engaged in agriculture sector. On contrary, agriculture sector faces many challenges including pest infestations that reduce the crop yields and loss of income. As a result, farmers are more interested in using pesticides for better yield and higher income without thinking about the damage chemical pesticides could cause (Suwal et al., 2025), which may affect sustainable development of agriculture sector. Thus, it is very important to plan interventions on the careful use of pesticides to reduce damage caused by pesticides to health and environment and consider sustainability as a core goal.

Many research studies found unsafe pesticide handling practices among Nepalese farmers. According to Suwal et al. (2025), almost all farmers had knowledge of the need for Personal Protective Equipment (PPE); however, only one third farmers use PPE on a regular basis. This shows that even though knowledge exists, practice is not done in the same way. Also, it does not ensure safe and sustainable practices. Several factors related to attitudes and contextual elements, such as beliefs, PPE accessibility, affordability, and cultural norms, can significantly influence outcomes (Suwal et al., 2025).

The haphazard use of pesticides has environmental impacts. There has been regular news about high pesticide residues being detected in vegetables sold in urban markets, exceeding permissible limits (Prasain, 2025). Moreover, continuous use of pesticides can lead to resistance in pest populations and the destruction of beneficial organisms in soils, which threatens the long-term sustainability of agricultural ecosystems (Zhou et al., 2025). Insufficient monitoring and the inability of the Nepali government to enforce pesticide regulations properly, along with relevant stakeholders' lack of providing IPM trainings, have been some of the contributing reasons for these problems (Adhikari et al., 2024). Moreover, human exposure to pesticide has been linked to acute health problems such as pesticide poisoning, skin, and eye irritation, headaches, respiratory distress and neurological symptoms among farmers (Atreya et al., 2012; Kafle et al., 2021; Yassin et al., 2002). Long term exposure pesticide adds risk of serious health conditions such as cancers, endocrine disruptions, reproductive dirsorders and non communicable diseases. According to the biomonitoring study conducted by Kumar et al. (2023), long-term exposure to pesticides may increase the risk of neurological disorders and non-communicable diseases. Moreover, it is associated with cancerous diseases, neurological disorders, and respiratory diseases (Ghimire et al., 2025). Several studies have been published regarding farmers' knowledge and practices relating to pesticides (Adhikari, 2018; Bhandari et al., 2023; Galli et al., 2022; Humagain, 2024). Those studies have examined knowledge, attitudes and practices separately. Moreover, those studies lack to include important factors such as socio-demographic (age, gender, education, ethnicity), socio economic (food sufficiency, income, family size), and programmatic factors (IPM training) in analysis relating to farmer's knowledge, attitudes, and practices. Furthermore, those studies did not include gender disaggregation even though it is prevalent that male and female farmers may differ in access to information, training opportunities and exposure risks. Interventions need to be designed including gender lens for ensuring inclusiveness.

There are limited studies linking farmers' training experiences and socioeconomic status with their pesticide-related attitudes and practices. In a study, it was found that IPM training enhance knowledge and promote safer pesticide use in other contexts (Bhandari et al., 2023); however, its coverage and impact remain unexplored in many municipalities in Nepal. Nepal government has prioritized promoting IPM and sustainable agriculture under National Pesticide Policy (MoALD, 2024). It is yet to be identified which factors most strongly predict safe pesticide use. This study assesses IPM training relating to KAP variables. .

There are major three knowledge gaps that this study focuses to fill in. The first knowledge gap is the weaknesses of current knowledge about farmers' attitudes and practices. Secondly, during literature review, analysis of variables such socio-demographic, programmatic and gender dimensions were missed. Thirdly, IPM program and its coverage are good in the policy but it is not applied in the practical scenario. Thus, this study is designed to fill these knowledge gap. The study systematically assesses KAP of pesticide use by male and female farmers and identifies the key predictors of these outcomes in the Nepalese context. The key predictors will be analyzed from quantitative perspective to assess the association from KAP perspective

Statement of the Problem

Agriculture is the backbone of Nepal's economy. Farmers depend on chemical pesticides for higher yields and minimize pest-related to losses even though they pose a major public health and environmental concern (Rijal et al., 2018). Pesticides might be temporarily effective in controlling pests; however, it can impact negatively on human health, food safety and ecological balance of agricultural systems. A study found that farmers lack knowledge regarding appropriate dosage, toxicity classification, and safe handling practices of pesticides (Atreya, 2007). Many cases related to acute and chronic form of pesticide poisoning have been reported because of direct exposure during pesticide mixing, spraying, storage and through contaminated food and water (Zhou et al., 2025). Due to the lack of awareness of such risks, negative attitude towards safety measures and inadequate adoption of right practices have resulted in severe health and environmental outcomes.

Integrated Pest Management (IPM) is an ecosystem-based strategy that combines biological, cultural, physical, and chemical tools to manage pests sustainably while minimizing economic, health, and environmental risks. It emphasizes prevention over eradication, using monitoring and action thresholds to apply controls only when necessary. IPM relies on six key components: accurate pest identification, regular monitoring of pest levels and damage, setting action thresholds, preventing pest buildup through cultural practices, integrating multiple control methods, and evaluating outcomes post-treatment. This approach prioritizes non-chemical methods like natural predators, crop rotation, and habitat manipulation before resorting to targeted pesticides (Food and Agriculture Organization [FAO], 2025). Integrated Pest Management is being promoted as an alternative to the haphazard use of pesticides. It protects soil and environment and considered sustainable approach. Thus, IPM training is one of the fundamental aspects in agriculture sector. There are many IPM related trainings and awareness campaigns being implemented by government and many non-governmental organizations in Nepal. However, their outreach, continuity and effectiveness remain limited (Adhikari et al., 2024; Atreya, 2007; Sapkota et al., 2025; Vaidya et al., 2017). As a result, farmers' understanding of pesticide hazards and safety handlings remain inadequate. Farmers' knowledge, attitudes, and practices (KAP) on pesticide use is largely influenced by gender, education level, and access to training (Wang et al., 2017).

However, there has been limited study in the context of the study area to identify these influencing factors and quantity their effects.

Findings from previous studies conducted in Chitwan, Lalitpur and Bhaktapur districts indicated a gap between farmers' awareness regarding pesticide use and their practices (Humagain, 2024; Khanal et al., 2016; Rijal et al., 2018). For instance, nearly all of the farmers were aware that pesticides were bad for human health and the environment; however, they did not observe all of the recommended guidelines such as wearing gloves and masks, understanding toxicity levels, and disposing of containers in an appropriate manner. Knowledge is a prerequisite to safe behavior, but knowledge alone is not enough for safe behavior. The attitudes, socio-economic background and access to information are amongst the major determinants of farmer's behaviors.

In this context, the knowledge, attitudes, and practices related to pesticide use among farmers need to be assessed in depth. It is essential to understand concurrent KAP status and identify socio-demographic and training-related factors that influence it, which will help in designing effective educational and policy interventions for sustainable farming.

Objective of the Study

The objectives of the study are:

- To examine farmers' knowledge, attitudes, and practices related to safe pesticide use in Mandandeupur, Kavrepalanchok.
- To identify factors that influence farmers' KAP regarding safe pesticide use.

Research Question

This study seeks to answer the following key research questions:

1. What is the level knowledge, attitude and practice on safe use of pesticide in Mandandeupur, Kavrepalanchok?
2. What are the potential factors that may influence KAP of farmers regarding chemical pesticide use?

Limitation of the Study

The study has budget and resource constraints to conduct a large sample survey. The study collects data through the face-to-face interview, so health effects of pesticide use are self-reported. Neither do we conduct physical health check-ups, nor do we use any biological marker for assessing exposure to chemical pesticides. The study focused on understanding the knowledge, attitude, and practice of chemical pesticide use and related influencing factors.

Significance of the Study

This study is important from academics and practical implications. It fills the gap in research in terms in understanding KAP relating to safe pesticide use. Previous studies have looked into those dimensions separately and overlooked important perspectives such as socio-demographic. programmatic and gender. By combining these dimensions, the study provides evidence-based comprehensive and fresher perspective in KAP. Moreover, it also contributes in local empirical data for global discussions platform on sustainable agriculture relating with environments and public health.

Furthermore, this study provides valuable perspectives in terms of designing effective and practical interventions and policies that promote safe use of pesticides. The study identifies the effectiveness of IPM training relating to KAP, which helps development professional and policymakers in designing training modules and make the training effective.

Summary of Chapter

Pesticide use in agriculture is important aspect to study for sustainable development as it is essential for food security and threat human health and environment upon mishandling. Pesticide use is in increased trend and developing countries like Nepal is more vulnerable in terms of haphazard use of pesticide use. In Nepal, use of pesticide us increasing in commercial farming. However, farmers often use protective measures despite having knowledge. The haphazard use of pesticides affects in human health and environment. Moreover, even though IPM is an alternative method to reduce pesticide use, its effectiveness is uncertain. Furthermore, there are research gaps in terms of inclusion of socio-demographic and gender perspectives. In this context, it is crucial to conduct more studies in this area for evidence generation. Hence, this study aims to assess knowledge, attitude and practice of pesticide use among farmers in Mandandeupur, Kavrepalanchok. The study will be valuable contribution in academics and intervention designing due to its inclusion of contexts and variables to fill the research gaps identified.

CHAPTER II
LITERATURE REVIEW

Overview of the Chapter

This chapter focuses on the different literature perspectives. The chapter describes trend of pesticide use in Nepal with the data support in increasing consumption of commercial farming and import of pesticide. It also explains the health impacts due to haphazard use of pesticide and link to pesticide poisoning, chronic illness, and suicide link due to pesticide exposure. Moreover, the chapter highlights environmental contamination linking to soil degradation, water pollution and pesticide residual in vegetables exceeding safety limits. The previous studies conducted in knowledge, attitude and practice of pesticide use is elaborated. Furthermore, the chapter introduces the Knowledge-Attitude-Practice (KAP) mode as a framework to understand the knowledge, attitude and practice of farmers.

Trends of Pesticide Use in Nepal

Pesticide use in Nepal has shown a consistently increasing growth over the past two decades, with average national consumption at 396g active ingredient per hectare, rising to 1,600g a.i./ha in commercial vegetable production (Ghimire & GC, 2018; Kalauni & Joshi, 2019). The Terai plains and mid-hills of Nepal experienced rising pesticide usage during the last thirty years because these areas support vegetable cultivation. Nepal saw an increase in pesticide use in 1980s due to the growing market for fruits and vegetables. Farmers were attracted to high-yielding crop varieties for commercial purposes (Atreya et al., 2022). The use of chemical pesticides has become more prevalent, while non-chemical methods for pest control receive less attention. The extensive availability of synthetic pesticides at agrovet outlets across multiple locations combined with unregulated informal imports has produced an atmosphere where pesticide consumption continues to rise (Gautam, 2022). The import data show that the active ingredient in pesticides has been increasing in quantity by 30.48 tons per annum on average over the twenty-two years and fungicides are the prevalent pesticide group, then insecticides and herbicides which make up more than 90% of total imports (Khanal et al., 2021). The scenario of pesticide has changed drastically from simple constituents such as Paris green in 1950s to 117 chemically characterized pesticides under 2,186 formulation types by

2018 (Kalauni & Joshi, 2019). Although new chemical classes such as synthetic pyrethroids and neonicotinoids are increasing, bio-pesticide imports are on a decline (Khanal et al., 2021). Despite Nepal's relatively low pesticide use compared to global averages, the effects are more hazardous, highlighting the need for stronger policy implementation and regulation (Khanal et al., 2021). These studies show that the rising trends of pesticide use. It is the crucial time to understand the trend and study farmers' knowledge, attitude and practice for formulating policies and strategies so that food production is sustainable and human health and environment are not compromised.

Health Impacts

Occupational exposure is still the most significant risk for applicators and their families. Acute pesticide poisoning is commonly seen in hospitals, and neurological and reproductive problems are believed to be altered by chronic exposure (Zhou et al., 2025). A study conducted in Tokha found that around three quarters of farmers reported having health problems from pesticide use; headache, skin irritation and burning eyes being the most common complains. Those complains were higher among older farmers, females, illiterate and the farmers who spend more time for pesticide use, spraying and did not consider wind direction while spraying pesticide. (Karki & Dangol, 2023). Pesticide-related illnesses are under reported as the farmers never visit a doctor unless the conditions become acute (Ghimire et al., 2021). Chronic exposure to pesticide use is also associated with long term diseases such as cancers, neurological disorders and respiratory related diseases (Ghimire et al., 2025). Moreover, a high rate of suicides in rural regions is attributed to pesticide self-poisoning, which has been a primary public health issue (Bonvoisin et al., 2020).

Environmental Contamination and Food Safety

Pesticide use has significant environmental consequences if used haphazardly. Pesticide can penetrate in soils and change the microbial communities, reduce the soil quality and impair nutrient cycling threatening sustainable agriculture as a whole (Nurika et al., 2022; Supanekar, 2022). But pesticide is also a potential contaminant of surface and ground water following runoff and leaching, which impacts aquatic life and may also be part of the human food chain (Carvalho, 2017; Safdar et al., 2022). Similarly, volatilization and spray drift as airborne transport mechanisms can disseminate pesticides to off target areas including remote ecosystems and wildlife (Carvalho, 2017).

Numerous studies reveal pervasive pesticide residues in food and environmental media, which has implications for human health. Residues were found in around 60% of tested vegetable samples from Kathmandu markets, and many samples exceeded residue limits (Bhandari et al., 2020). Research comparing conventional and IPM farms revealed that residue levels were much lower in IPM fields. This suggests that contamination outcomes are directly influenced by farmer awareness and training (Khanal et al., 2021; Sapkota et al., 2025). Organophosphates and pyrethroids were also found to be above recommended levels in soil and water monitoring in the districts of Chitwan and Kaski, confirming off-target contamination through spray drift and runoff (Atreya et al., 2022). Environmental impacts can ruin the future of many generations. The long-term health effects costs many lives from lethal diseases, which has many socioeconomic consequences. Strong advocacies are needed to communicate about the impact and safe alternatives.

Farmer Knowledge, Attitudes, and Practices on Pesticide Use in Nepal

Many studies have measured farmers' KAP of pesticide use in Nepal and found that, although farmers are becoming more aware of pesticide-use-associated risks, actual practices diverge from safety protocols (Atreya et al., 2022). There are many dimensions from the point of knowledge, attitude and practice perspective:

Knowledge Levels and Information Sources

The haphazard use of pesticides is mainly due to the lack of knowledge on pesticides and its harmful impact to health and environment. Farmers still have a limited understanding of pesticide toxicity, safety symbols, and label instructions. According to a recent KAP survey, only 37% of vegetable farmers in Bhaktapur knew what color-coded toxicity labels on pesticide containers meant (Suwal et al., 2025). Similarly, less than half of farmers were able to accurately identify highly hazardous pesticides or articulate appropriate disposal methods, according to Karki & Dangol. (2023). Instead of consulting agricultural extension agents or product labels, the majority of respondents seek advice from peer farmers and pesticide dealers (agrovet shops) (Atreya et al., 2022). This reliance on unofficial information networks leads to misinformation and pesticide misuse, including overdosing, improper pesticide selection, and improper application timing.

Knowledge acquisition has been demonstrated to be significantly influenced by education and training. Researchers in Kavrepalanchok, Kaski, and Chitwan concluded that farmers with IPM training possess much higher levels of knowledge and are more likely to recognize classes of toxicity and pre-harvest intervals (Sapkota et al., 2025; Vaidhya et al., 2017). However, low literacy and a lack of labels understanding make it harder to convert knowledge into safer behavior. Having knowledge is crucial to have positive attitude and safe practices of pesticide use. To get the right knowledge, right platforms and methods need to be explored by concerned stakeholders for sustainability.

Attitudes toward Pesticide Risks and Alternative Methods

Attitude towards the pesticide along with the knowledge determine the options farmers select. Negative attitude might be possessed due to the lack of knowledge on different dimensions of pesticides use. Most farmers acknowledge that pesticides can have negative effects on the environment and human health, but opinions on risk varies. Though only about 60% of the respondents in Bhaktapur agreed that pesticides can have a negative effect on non-target organisms like fish, birds, and bees, 83% of the respondents agreed that pesticides have a negative effect on human health (Humagain, 2024). This suggests limited knowledge of ecological impacts. Furthermore, farmers see chemical control as quicker, more effective, and less time-consuming than the others available alternatives, although they themselves often say they would prefer to use fewer pesticides (Atreya et al., 2022). Along with knowledge, the attitude needs to be changed in the same way.

Pesticide Handling and Safety Practices

Safe practices are crucial for the positive results. However, in reality, most farmers still take risks. In Kavrepalanchok, farmers mostly reused plastic containers, usually for food or water storage, and over 80% of farmers kept pesticides indoors (Sapkota et al., 2020). Full personal protective equipment was utilized by a minority. People are more exposed to pesticides due to ignorance about the waiting period following application (Gyawali, 2018). Application of pesticides with bare hands, spraying with the wind blowing in the direction of spraying, and consuming or smoking while applying pesticides are all examples of common unsafe practices (Atreya et al., 2022; Suwal et al., 2025). Heat, discomfort, or the expense of personal protective equipment are commonly quoted reasons by farmers for such practices (Kafle et al., 2021). This is one example of the gap between knowledge and practice, which is a common observation noted in behavioral research (Sapkota et al., 2025). It shows that having knowledge and positive attitude is not enough to change practices. The other related factors must be considered to transform from knowledge to practice.

Research shows that commercial vegetable farmers apply chemical pesticides excessively during inappropriate times according to their current practices. The survey conducted by Kafle et al. (2021) showed that more than half of Chitwan farmers who had complained having acute symptoms experienced headaches and skin irritation after pesticide application. According to Sapkota (2020), potato farmers in Kavrepalanchok applied fungicides for early and late blight control throughout their entire growing season without protective equipment and without understanding fungicide toxicity levels. The research findings from Humagain (2024) show that farmers in Bhaktapur recognized environmental dangers but only 58% of them followed recommended safety measures including mask and glove use.

The use of pesticides is not the only instance of unsafe handling. Many farmers keep pesticides in their homes and repurpose old containers for household use, according to Suwal et al. (2025). Also, inappropriate residues and container disposals lead to contamination of soil and surface water. Atreya et al. (2022) reviewed data from 20 prior studies conducted in Nepal and came to the conclusion that some of the most common harmful activities are poor storage, reusing containers, and disposal of waste in fields or rivers. The evidence shows that farmers are having consequences of unsafe handling of pesticide use. The consequences could have been stopped if the right and effective messages were communicated. The repetitive patterns suggest that there are errors in pesticide related regulations, policies and advocacies.

Gender and Socio-economic Dimensions

Farmers' knowledge, attitude and practice regarding safe pesticide use differ based on the gender and socio-economic status. Male farmers are more likely to have access to training and safety equipment (Suwal et al., 2025). On the other hand, female farmers are less likely to have access to these resources even though they are involved in pesticide use (Suwal et al., 2025). Yet, the female farmers have greater knowledge to the risk of health effect from pesticide use as a result of their household chores and parenting role which makes them feel more vulnerable (Humagain, 2024). Socio-economic factors including education, family size and household food security are the good practice determinants. Household with access to adequate food are more willing to invest in protection and follow with recommended safe practices (Atreya et al., 2022). Those evidences show that knowledge itself does not guarantee safe practice and attitudes and practices are largely influenced by those kind of contextual factors. It is important to understand these disparities to take account into.

Building Conceptual Framework of the Study

Socio-economic and gender dimensions affect knowledge, attitude and practice. Gender is an important factor in access to agricultural training and information. Several studies have shown that male is more likely to participate in extension training activities, farmer field schools, and pesticide training programs concerning handling, resulting in greater knowledge regarding safe handling of pesticides (Damalas & Koutroubas, 2017). Male farmers are likely to be more involved directly with the use of pesticides, and female are likely to be more involved with planting, weeding, or post-harvesting, which restrains their access to technical training (Ngowi et al., 2007). Therefore, it is presumed that male farmers will have more knowledge, favorable attitudes, and safer practices regarding the use of pesticides.

Age has also been highly documented as a determinant of the uptake of agricultural innovation. Farmers who are young are more receptive to new technology and risk-reducing behavior, for instance, IPM and protection adoption. On the other hand, older farmers would be more reliant on traditional practices and conservative, thus would not readily adopt change (Damalas & Hashemi, 2010). South Asian and Sub-Saharan African studies have also proved to have negative associations between age and practice of new pest control methods (Mengistie et al., 2015). Younger farmers are thus expected to attain higher levels of KAP for the use of safe pesticides.

Education is a good and reliable predictor of farmers' knowledge and behavior regarding pesticide use. Educated farmers can read and understand pesticide labels, toxicity symbols, and safety measures and use correct dosages (Galli et al., 2022). Moreover, formal education enhances the ability to interpret extension information and make good choices (Damalas & Hashemi, 2010). Certain studies in India, Bangladesh, and Nepal have confirmed that improved educational levels have a significant positive association with improved pesticide-handling practices and attitudes towards IPM (Atreya et al., 2012). Therefore, education would also tend to have a positive impact on knowledge, attitudes, and practices.

Ethnicity often reflects socio-cultural identity and availability of information network access. Evidence has shown that ethnic minority or indigenous communities may possess distinct traditional knowledge for managing pests, yet limited access to formal agricultural extension or modern pest management knowledge (Rijal et al., 2018). So-called upper-caste or mainstream groups (e.g., Brahmin/Chhetri/Thakuri in Nepal) have better access to training and institutional resources. Thus, ethnicity can propel inequalities in pesticide use behaviors. Here, it is anticipated that ethnic minorities will have lower KAP scores because of restricted exposure to institutions.

Enrollment in Integrated Pest Management training programs has always been pinpointed as the foremost determinant of enhanced KAP toward pesticide use. IPM-trained farmers are better informed about pesticide risk, have better attitudes towards alternative pest control, and apply safer handling procedures (Damalas & Koutroubas, 2017). Part of the evaluations of Farmer Field Schools in Asia has shown that IPM training has a significant influence on the prevention of pesticide misuse and improving safety behavior. Therefore, IPM training is said to have a strong positive effect on knowledge, attitude, and practice levels.

Family structure may affect the exchange of knowledge, division of labor, and decision-making around pest control. Joint families have more than one generation and diverse experiences, which can benefit sharing traditional farming knowledge. But nuclear families would be more responsive to new technologies and information since the decision-making is faster and less top-heavy. Joint family systems were less adaptable to behavioral change according to some research (Damalas & Hashemi, 2010). Hence, in the current study, it is hypothesized that there is a negative relationship between joint family type and KAP, i.e., nuclear families would fare better at adopting safe pesticide practice.

Household food sufficiency is a reflection of economic viability as well as production sustainability. Food-insecure farmers tend to sacrifice yield maximization for safety and thus, higher reliance on chemical pesticides (Atreya, 2007). Food-secure families, by contrast, are able to indulge in more flexibility when employing environmentally friendly practices and purchasing safer forms of pest control (Wilson & Tisdell, 2001). Economic hardship has been proven to have a critical influence on pesticide use. Therefore, it is taken for granted that food-sufficient families will have better KAP scores because economic stability enables better adaptation of safe pesticide practices.

The Knowledge–Attitude–Practice Model

One of the behavioral models that is most frequently used in agricultural and public health research is the KAP model. The Knowledge–Attitude–Practice model was created in the 1950s and 1960s as a public health and social science behavioral model. It was originally developed to describe the ways in which individuals' awareness and beliefs influence their action, particularly in disease prevention, nutrition, and family planning. These early publications highlighted the fact that an increase in people's knowledge about a particular issue would lead to more favorable attitudes, which would give rise to favorable practices or changes in behavior (Launiala, 2009). This sequential and linear process of knowledge to attitude to practice became a required framework for planning and evaluating health education and awareness interventions.

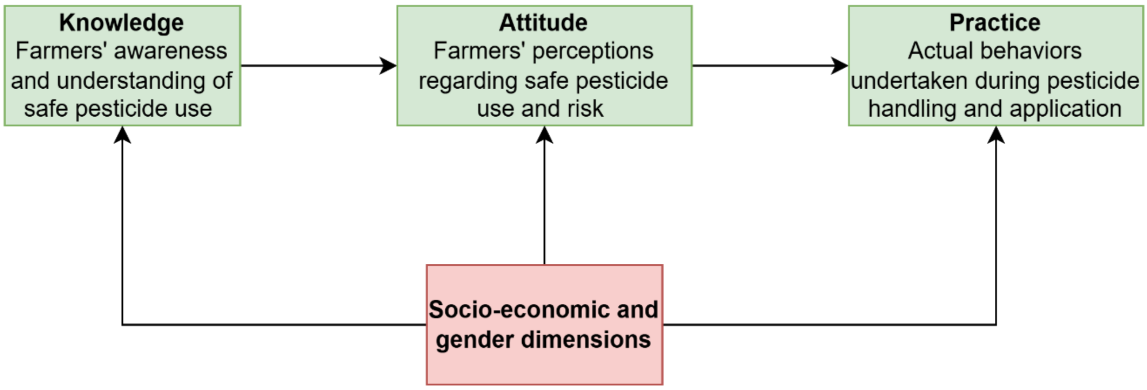
The KAP model was widely used in the study of health behavior, including on hygiene, vaccination, occupational health, and disease prevention in 1970s to 1980s (Launiala, 2009). The model has been used in different fields from public health to other fields such as agriculture, environmental management, and development studies, where behavior and choice are pivotal in technology adoption and risk management. Researchers such as Damalas & Koutroubas (2017) and Yassin et al.(2002) have also used the KAP model to examine farmers' knowledge of pesticide hazards, attitudes toward safety, and actual practices in agriculture sector. The KAP model (Launiala, 2009) suggests that the knowledge people possess forms the basis of their attitudes, and these attitudes in turn influence their actions or behaviors. Practice is the farmers' real behaviors of pesticide handling, storage and application; attitude is the farmers' opinions, belief and willingness on practice package (Atreya et al., 2022) safety measures; and knowledge denotes the farmers' understanding of pesticide toxicity, safe handling, and environmental hazards of pesticides (Atreya et al., 2022). It adds up to significant information to guide the future of pesticide use.

The knowledge-practice gap, where farmers are aware of risks but practical knowledge has not been integrated into everyday farming practices, has been identified repeatedly by empirical research in Nepal (Humagain, 2024; Suwal et al., 2025). For example, a very low portion of farmers wear gloves, masks or respect the pre-harvest interval even if more than 90% of them claim to be aware that pesticides are dangerous for human health (Paudel et al., 2024). This persistent disparity reveals that there is a need for focused pesticide interventions that combine gender-sensitive and socio-economic factors to increase the likelihood that knowledge will lead to safe and regular pesticide use.

The discrepancy emphasizes how important mediating elements like social norms, perceived control, and perceived vulnerability are in altering behavior; knowledge alone is not enough. Figure 1 shows how knowledge, attitude and practice is linked to each other and with socio-economic and gender dimensions.

Figure 1

Knowledge-Attitude-Practice Model



Summary of the Chapter

The chapter analyzes the trends of pesticide use, impacts and KAP model. Pesticide use has increased steadily in the last 30 years, especially in the Terai plains and mid-hills, and on commercial vegetable production. Use is dominated by synthetic pesticides, although the share of biopesticides is increasing and residues in food and the environment regularly surpass safe limits. Occupational exposure continues to be a major health hazard, leading to acute poisoning and chronic diseases and playing a role in pesticide-related suicides. Environmental pollution is also high as pesticides contaminate the soil, water bodies and non-target organisms and this leads to jeopardizing the sustainability of agriculture and human health in the long run. “Knowledge,” “attitude,” and “practice” of farmers are associated with risk awareness and safe handling, but it is a common to store pesticides in an unsafe manner, to over-apply pesticides, and to dispose of pesticide-containing materials improperly. KAP results are influenced by gender and other socio-economic factors; women are usually more aware of health risks but have less opportunity to receive training/ protective gear and thus been observed to have higher exposure risks. The chapter underscores that having the knowledge is not enough to result in safe behaviour, as attitudes and contextual factors moderate it. The Knowledge–Attitude–

Practice model serves as a conceptual lens to examine how farmers' knowledge and attitudes towards pesticides affect their practices.

CHAPTER III
RESEARCH METHODOLOGY

Overview of the Chapter

This chapter covers methodology, study sites, sampling, study tools and data analysis methods. The study used a cross sectional, explanatory research design to assess KAP regarding pesticide use. The study was conducted in ward no. 2 of Mandandeupur municipality, Kavrepalanchok. The study was conducted among 151 farmers from the study sites.

Methodology

This study used a cross sectional, explanatory research design to investigate farmers' knowledge, attitudes, and practices regarding pesticide use. A quantitative approach was used and structured in-person interviews were used to gather data. To objectively evaluate the current situation and examine the connections between research variables, the study was conducted using a positivist paradigm.The data was analyzed using descriptive, chi-square and regression model.

Study Site

The study was conducted in ward no. 2 of Mandandeupur municipality. Mandandeupur municipality is located in Kaveplanchowk district. The study area is known for agricultural export hub for Kathmandu valley. Many KAP survey conducted in this area were focused on the pesticide use in agriculture (Atreya et al., 2012; Sapkota et al., 2020; Sapkota et al., 2025). Pesticides are used in commercially grown vegetables such as tomatoes, potatoes, chilies, eggplant, cauliflower (Karmacharya, 2012). Sapkota et al. and Atreya et al. conducted rigorous studies on pesticide in the municipality.

Population and Sample

The target population was the households involved in vegetable farming activities. The data was collected between December 18, 2022, and January 21, 2023.

The sample size was calculated using the finite population correction formula for proportions, as the total population was under 5,000. Cochran's formula (Singh & Masuku, 2014) was used to determine the initial sample size as shown below:

$n = n_0 / [1 + \{(n_0 - 1) / N\}]$

$n_0 = \frac{Z^2pq}{e^2}$

Where:

- Z = 1.96 (for 95% confidence level)
- p = 0.5 (assumed prevalence)
- q = 0.5 (1 – p)
- e = 0.1 (margin of error)

The required size is at least 93. Usually, the suggested margin of error is $\pm5\%$ for any study. However, if there is limitation of resources in the study, it can be 10%. Standard published tables for calculating sample size also calculate sample size based on $\pm5\%$, $\pm7\%$, and $\pm10\%$ precision level. Due to resource constraint in conducting the study, margin of error was kept as $\pm10\%$ for the study (Singh & Masuku, 2014).

From each household, one family member who was involved in regular pesticide application was selected for the study. Equal number male and female respondent was the priority of the study. So, household respondents were selected based on gender in every alternative household. The inclusion criteria for selecting households was that the family members should have engaged in vegetable farming and use pesticide in last season. A total of 151 farmers were interviewed for the study.

Tools and Data Collection Methods

Standardized questionnaire was used based on the pertinent literature. The questionnaire was divided into socio-demographic section, knowledge section, attitude section and practice section. Socio-demographic section includes basic information about the respondents such as name, address, age, gender, ethnicity, education, occupation, type of family and food sufficiency. Knowledge section includes questions related to knowledge on pesticides such as meaning of toxic level, effect on health and environment, pesticide use and waiting period. Attitude section includes questions related to attitude toward pesticide use and preferences of pesticide use. Practice section includes questions related to practice of pesticide use and post use activities

The questionnaire was translated into Nepali following expert validation to guarantee participant comprehension. Pre-testing was done in the study site to ensure that the questions were in flow and contextualized. KoBoCollect was used to collect the data. Data access was controlled to preserve the quality of the data; only the researchers could log in or alter the platform. The completed data was kept safely on a computer that was encrypted and password protected. SPSS version 25 was used to analyze the dataset. For data analysis, the collected data was categorized into 10 questions each in knowledge, attitude and practice as shown in Appendix 1.

Data Analysis and Meaning Making

KAP survey data were analyzed using descriptive and inferential statistics to respond to the study's research questions. The findings are presented in tables to illustrate trends, patterns, and relationships. Descriptive statistics described a general picture related to students' KAP, and inferential statistics determined factors that were important in waste management practices. Descriptive analysis was carried out to get the basic information and overview about the study site and respondents. The chi-square test was used to examine gender-based pesticide use knowledge, attitudes, and practices focusing on the KAP items developed as shown in Appendix 1.

The regression model was used to identify the socio-demographic and contextual factors influencing farmers' knowledge, attitudes, and practices related to pesticide use. The dependent variables were questions related to knowledge, attitude, and practices. The answers of those questions were coded either 0 or 1 and total range is 0 to 10. These questions are listed in Appendix 1. The independent variables included seven explanatory variables. The Table 1 shows the socio-demographic variables that were used in this study to describe farmers' personal, social, and economic background factors. These include respondents' sex (female or male), age in years, and education level (the highest grade attended). The ethnicity is either Brahmin/Chhetri/Thakuri (BCT) or Non-BCT. The variable IPMTRAIN describes whether the participant has been trained on Integrated Pest Management or not, and FAMILY indicates the family type (nuclear or joint) they live in. FOODSUF measures household food sufficiency for 12 months.

This study investigates how various socio-demographic and contextual factors influence the knowledge, attitude, and practice regarding pesticide use. Table 1 shows the factors included in the regression analysis, along with their definition, rationale and the expected direction of influence (hypothesis):

Table 1

Factors Affecting Knowledge, Attitude and Practice of Pesticide Use

SN	Factors	Definition	Explanation	Expected Hypothesis
1	Gender	Gender of the respondents (1 male; 0 female)	Men are often more likely to be involved in agricultural extension services and receive training on pesticide use, resulting in greater knowledge about safe handling (Damalas & Koutroubas, 2017).	+
2	AGE	Age of the respondents (years)	Younger farmers might be more open to adopting new technologies and practices, including safer pesticide use, while older farmers might be more resistant to change (Damalas & Hashemi, 2010; Mengistie et al., 2015).	-
3	EDU	Highest attended school grade	Higher levels of education are often associated with greater awareness of potential risks and safer handling practices (Galli et al., 2022; Hashemi et al., 2012; Atreya et al., 2012).	+
4	ETHNICITY	Ethnicity of respondents (1 BCT; 0 Non-BCT)	Indigenous and minor groups may have unique traditional knowledge systems and cultural practices related to pest management (Rijal et al., 2018).	-
5	IPMTRAIN	Whether participant	Participation in training programs like Integrated Pest Management significantly	+

		attended IPM training	improves knowledge, attitude and practice (Damalas & Koutroubas, 2017).	
6	FAMILY	Type of family of respondents (1 Nuclear; 0 Joint)	Joint family is more likely to have diverse pest management knowledge, attitude and practice (Damalas & Hashemi, 2010).	-
7	FOODSUF	Whether food sufficient for 12 months (1 Yes; 0 No)	Farmers concerned about food security might be hesitant to reduce pesticide use, even if they are aware of the risks, fearing that it will lead to lower yields and reduced income (Atreya, 2007; Wilson & Tisdell, 2001).	+

These hypotheses are literature-driven and based on previous empirical findings in the literature of agriculture as well as health. The expected signs reflect assumptions about how each factor relates to safer and more informed pesticide use.

Ethical Consideration

All respondents provided their verbal informed consent. The study's goals, the fact that participation was voluntary, the anticipated length of the interview, and the respondents' freedom to discontinue participation at any moment without facing any repercussions were all explained in detail to the respondents. Each respondent was interviewed at a time that worked for them.

Strict confidentiality protocols were implemented. The final dataset and reporting did not include identifiable personal information. The study procedure was created to guarantee that respondents would not suffer any physical or mental harm.

Validity and Reliability

Expert review and compatibility with standardized survey instruments from related studies bolstered the tool's validity. Conducting a pre-test and reordering the questions were done to guarantee reliability. Prior to extensive data collection, it was also carried out to find and fix any problems with the tool. These actions were taken to guarantee that the tool's efficacy and rigor could be preserved when it was replicated in subsequent studies.

Summary of Chapter

This study used cross-sectional, explanatory research design to assess farmers' knowledge, attitude and practices regarding pesticide use in Mandandeupur, Kavrepalanchok. A quantitative survey was conducted using structured in-person interviews. Data was collected in KoBoCollect and analyzed in SPSS using descriptive statistics, chi-square tests (Fisher's exact test for frequency less than 5) and regression analysis. In regression analysis, socio-demographic variables were tested. Ethical protocol was followed to ensure confidentiality, informed consent and data integrity.

CHAPTER IV
FINDINGS

Overview of the Chapter

This chapter presents a detailed analysis of the demographic characteristics, knowledge, attitudes, and practices associated with pesticide use among 151 farmers. Respondents' ethnicity, age distribution, education level, family structure, and household food security are presented first to provide a background to their pesticide activities. The demographic information reveals a solid representation of respondents from the Brahmin/Chhetri/Thakuri caste groups and an age concentration on middle-aged respondents. Education was on the whole low to moderate among respondents, with the majority have only attended primary school. Subsequently, the chapter analyzes gender differences in knowledge about reading pesticide labels, knowledge of toxicity, impacts on health and on environmental hazards. Although males and females knowledge of label colors was limited, females had greater worry about the effects of pesticides on their health and that of their children. Attitudinal measures suggest a convergence in preference for chemical pesticides linked to convenience and familiarity, and little gender- variation with the exception of views on the decline in beneficial organisms. Differences between males and females in pesticide application, storage and safety were minimal, with women more likely to have been advised on safety and to have better compliance for some practices. The chapter illustrates persistence in unsafe behaviour such as storing pesticides in the home, and using homes grown on contaminated land or personal protective equipment or adequate storage facilities. The regression analysis identifies determinants of KAP, and shows that IPM training, ethnicity, and food sufficiency are significant predictors of multiple KAP indicators across the different domain. The chapter ends by arguing that while knowledge and attitudes differ slightly among demographic groups, training-based interventions are critical in influencing safer pesticide-use behaviour.

Demographic Information of Study Respondents

A total of 151 respondents were interviewed during the survey. The basic socio-demographic information was collected to examine KAP with different societal strata. Ethnicity, age, education, type of family, and food sufficiency for one year were collected. Table 2 depicts the socio-demographic information of the respondents:

Table 2

Socio-demographic Information

	Male (n=75)		Female (n=76)		Total (n=151)	
Ethnicity						
BrahminChhetri, Thakuri	45	60%	54	71.1%	99	65.6%
Janajati	15	20%	14	18.4%	29	19.2%
Dalit	15	20%	8	10.5%	23	15.2%
Age group						
21-30 years	3	4%	8	10.5%	11	7.3%
31-40 years	7	9.3%	22	28.9%	29	19.2%
41-50 years	19	25.3%	32	42.1%	51	33.8%
51-60 years	27	36.0%	13	17.1%	40	26.5%
>60 years	19	25.3%	1	1.3%	20	13.2%
Education						
Never attended	2	2.7%	5	6.6%	7	4.6%
Primary education	45	60.0%	54	71.1%	99	65.6%
Secondary education	26	34.7%	17	22.4%	43	28.5%
Bachelor and above	2	2.7%	0	0%	2	1.3%
Family Type						
Nuclear	30	40%	33	43.4%	63	41.7%
Joint	45	60%	43	56.6%	88	58.3%
Food sufficiency for a year						
Yes	57	76%	49	64.5%	106	70.2%
No	18	24%	27	35.5%	45	29.8%

The Table 2 depicts majority of members from Brahmin, Chhetri or Thakuri groups, slightly higher proportion of females (71.1%) than males (60%). Male Dalits

(20%) were higher than female (10.5%). Regarding age groups, male above 50 years old were comprised of 60% while female (42.1%) were between age 41 and 50 years. Nearly three quarter of female completed primary school than males (60%). Almost similar proportion of male and females lived in join families (60% male and 56.6% female). More males (76%) reported having enough foods for a year compared to 64.5% females.

Knowledge Regarding Pesticide Use

Knowledge of farmers related to pesticide use disaggregated by gender is provided in Table 4. Males (37.3%) and females (36.7%) indicated identical understanding when asked if they comprehend the meaning of harmful labels (colors) on pesticide containers; there was no statistically significant difference (p=0.542). This indicates that almost two-thirds of both groups are ignorant of label meanings, indicating that understanding of these meanings is still low and equivalent between genders.

Yet two important beliefs were strongly linked to gender and statistically significant. Female respondents were more likely than males to agree that chemical pesticides are detrimental to their own health (100% vs. Several of these outcomes indicate that women may have greater health-related risk perceptions compared to men. In the end, although gender disparities were slight for the majority of areas of pesticide knowledge, and perception on the pesticide induced damage to the environment, women showed significantly higher levels of worry on the health implications of pesticide exposure to both themselves and their children.

Table 3

Knowledge of Pesticide Use by Gender

	Male (n=75)		Female (n=76)		Total		p-value
Do you understand the meaning of toxic labels (color) in the pesticide containers?							0.542
Yes	28	37.3%	28	36.8%	56	37.1%	
No	47	62.7%	48	63.2%	95	62.9%	
Do chemical pesticides negatively affect your health?							**0.003**
Yes	67	89.3%	76	100%	143	94.7%	

No	8	10.7%	0	0%	8	1.5%	
Do chemical pesticides negatively affect your children's health?							**0.015**
Yes	65	86.7%	74	97.4%	139	92.1%	
No	10	13.3%	2	2.6%	12	7.9%	
Are you aware of the waiting period for vegetable harvest after pesticide spay?							0.376
Yes	56	74.7%	54	71.1%	110	72.8%	
No	19	25.3%	22	28.9%	41	27.2%	

Attitude Regarding Pesticide Use

Table 4 shows the findings of attitude regarding pesticide among respondents. The only statistically significant finding was the difference in perception of ecological impacts. The findings shows that 89.3% of male respondents and 77.6% of female respondents agreed that pesticide application leads to a decline in natural enemies in the field ($p = 0.042$). This indicates that men were more likely than women to recognize or perceive the loss of beneficial organisms due to pesticide use. All other measured attitudes—such as pest thresholds, ease of use, dealer recommendations, insect resistance, health risks, pollution, preference for chemical versus biopesticides, and timing of application—showed no statistically significant gender differences.

Table 4

Attitude towards Pesticide Use by Gender

	Male (n=75)		Female (n=76)		Total (n=151)		p-value
Chemical pesticides should be used only if pest population is greater than the natural enemies.							0.518
Agree	58	77.3%	58	76.3%	116	76.8%	
Disagree	17	22.7%	18	23.7%	35	23.2%	
Chemical pesticides are more familiar and easy to apply than other methods of insect pest control.							0.142
Agree	73	97.3%	70	92.1%	143	94.7%	
Disagree	2	2.7%	6	7.9%	8	5.3%	

Chemical pesticides are more easy to apply than biopesticides.							0.171
Agree	68	90.7%	64	84.2%	132	87.4%	
Disagree	7	9.3%	12	15.8%	19	12.6%	
Pesticides dealers/agrovets can suggest appropriate alternative methods for insect pest control							0.558
Agree	18	24.0%	18	23.7%	36	23.8%	
Disagree	57	76.0%	58	76.3%	115	76.2%	
Insects can grow resistance due to excessive chemical pesticides application							0.484
Agree	60	80.0%	62	81.6%	122	80.8%	
Disagree	15	20.0%	14	18.4%	29	19.2%	
Throwing of emptied pesticide in the river/field causes pollution. 0.619							
Agree	70	93.3%	71	93.4%	141	93.4%	
Disagree	5	6.7%	5	6.6%	10	6.6%	
Do you observe the loss of beneficial organisms in the environment after chemical pesticide use?							0.042
Yes, greater loss	67	89.3%	59	77.6%	126	83.4%	
No	8	10.7%	17	22.4%	25	16.6%	

Practice regarding Pesticide Use

Table 5 depicts the findings of practice of pesticide use by respondents. The analysis revealed two statistically significant gender differences in pesticide-related practices. Female farmers were substantially more likely than males to identify as non-smokers during pesticide application (68.4% vs. 44%), underscoring a marked disparity in smoking behavior (p=0.002). In addition, a higher proportion of women (72.4%) reported receiving safety advice compared to men (54.7%), suggesting that female farmers may be more frequently reached by extension programs or more proactive in adopting recommended precautions. These findings highlight important gender-specific patterns in health-related behaviors and access to safety information.

Table 5

Practice of Pesticide Use by Gender

	Male (n=75)		Female (n=76)		Total (n=151)		p-value
Do you take account of wind direction at spraying and adjust accordingly?							0.226
Yes	63	84.0%	68	89.5%	131	86.8%	
No	12	16.0%	8	10.5%	20	13.2%	
Do you always take bath after pesticide use?							0.318
Yes	61	81.3%	65	85.5%	126	83.4%	
No	14	18.7%	11	14.5%	25	16.6%	
Do you wash your clothes immediately after pesticide use?							0.273
Yes	67	89.3%	71	93.4%	138	91.4%	
No	8	10.7%	5	6.6%	13	8.6%	
Do you eat during the pesticide handling/application?							0.336
Yes	7	9.3%	4	5.3%	11	7.3%	
No	68	90.7%	72	94.7%	140	92.7%	
Do you drink during the pesticide handling/application?							0.380
Yes	8	10.7%	6	7.9%	14	9.3%	
No	67	89.3%	70	92.1%	137	90.7%	
Are the utensils used for preparing pesticides also used for other purposes?							0.514
Yes	11	14.7%	12	15.8%	23	15.2%	
No	64	85.3%	64	84.2%	128	84.8%	
Do you smoke during pesticide handling/application?							**0.002**
Yes	2	2.7%	0	0.0%	2	1.3%	
No	40	53.3%	24	31.6%	64	42.4%	
I am a non-smoker	33	44.0%	52	68.4%	85	56.3%	
Have you received safety precautions advice for pesticide application?							0.018
Yes	41	54.7%	55	72.4%	96	63.6%	
No	34	45.3%	21	27.6%	55	36.4%	

Regression Analysis

Table 6 depicts the descriptive statistics of the seven independent variables used for the regression analysis. Ordinary Least Squares regression was used. These variables capture the demographic, educational, and socioeconomic characteristics of the respondents.

Assumption Checks for Ordinary Lease Square Regression

To make it valid to predict Knowledge, Attitude, and Practice, all assumptions of OLS regression were tested. Linearity was evaluated visually by examining scatterplots of each predictor with the outcome, and the relationships were sufficiently linear. The kurtosis and skewness of the dependent variables were considered to examine the normality of residuals.

To assess homoscedasticity, residuals versus fitted values were plotted, and the variance appeared to be constant across values of the independent variables.

The independence of observations was guaranteed in the design of the study, and was further substantiated by the Durbin–Watson statistics which are in the acceptable range (approximate values, d = 1.5 to 2.5).

Multicollinearity was investigated with variance inflation factors (VIF), all were beneath the well-known threshold of 5 (VIF < 5), suggesting the absence of serious collinearity among the predictors. Outliers were evaluated by examining standardized residuals, leverage, and Cook's distance; there were no cases above critical values, indicating the models were not excessively driven by outliers. Together, these diagnostics also support the consistency of the OLS estimates reported for the Knowledges, Attitudes and Practices regressions. Full tables are in Appendix 2.

Table 6

Descriptive Statistics of the Independent Variables Used in the Ordinary Least Squares Regression Analysis (N=151)

Variables	Minimum	Maximum	Mean	Std. deviation
Sex	0	1	0.50	
Age	23	79	47.63	10.99
Education	0	16	6.75	4.07
Ethnicity	0	1	0.66	
Ipmtrain	0	1	0.36	

Family	0	1	0.42
Foodsuf	0	1	0.70

The descriptive statistics of the independent variables used in the regression analysis indicate a gender (SEX) with well-matched representation coded as 0 (female) and 1 (male) with a mean of 0.50, showing the equal distribution of males and females in the sample. The age of the respondents ranges from 23 to 79 years, with a mean of roughly 47.63 years and a standard deviation of roughly 10.99, demonstrating moderate variation and a midlife sample by and large.

Educational level (EDU) is continuous variable, varying from 0 years to 16 years of schooling, with a mean of 6.75 years and a standard deviation of 4.07, indicating a generally low-to-moderate educational level with substantial variability in respondents. Ethnicity (ETHNICITY), coded 0 (non-BCT) and 1 (BCT), has a mean of 0.66, which means that nearly two-thirds of the sample can be coded in the ethnic category coded as 1 i.e. BCT. Non-BCT is base and BCT is comparison group.

Regarding IPM training, only about 36% of the respondents (mean = 0.36) reported that they received Integrated Pest Management (IPM) training (IPMTRAIN). Similarly, only about 42% live in nuclear family (FAMILY). The food sufficiency mean (FOODSUF) is 0.70, showing that about 70% of the respondents reported having sufficient food in the year.

Table 7 shows the summary of regression analysis. Analysis was conducted for knowledge, attitude and practice, separately. Different factors have a statistical significance on pesticide knowledge, attitude, and practice among respondents. For knowledge, the analysis explains about 23% of the variance (R^2=0.229), significant overall. The age predictor is a positive one, and older respondents have somewhat lower knowledge scores. Ethnicity was also significant as respondents who self-identified as belonging to the Brahmin, Chhetri or Thakuri (BCT) groups had higher knowledge than others. The strongest positive predictor of the knowledge score was IPM training (β = 0.249), indicating the role of training in increasing knowledge. In the end, food sufficiency also positively influence knowledge, implying food sufficient households tend to be more knowledgeable. Gender, education, and type of family did not predict knowledge in this analysis.

Table 7

Regression Coefficients for Factors Influencing Knowledge, Attitude and Practice of Pesticide Use

Variables	Knowledge Unstandardized Coefficients		Standardized Coefficients	Attitude Unstandardized Coefficients		Standardized Coefficients	Practice Unstandardized Coefficients		Standardized Coefficients
	Coeff	Std. Error		Coeff	Std. Error		Coeff	Std. Error	
Constant	8.336***	0.916		5.616***	0.755		5.522***	0.754	
SEX[a,b]	-0.157	0.348	-0.045	0.021	0.287	0.008	-0.352	0.287	-0.119
AGE	-0.032*	0.017	-0.198	0.003	0.014	0.023	-0.016	0.014	-0.120
EDU	-0.006	0.058	-0.011	0.088*	0.048	0.197	0.041	0.048	0.085
Ethnicity[a,c]	0.826**	0.345	0.224	-0.428	0.284	-0.149	0.623**	0.284	0.199
Ipmtrain[a,d]	0.909***	0.302	0.249	0.798***	0.249	0.281	0.717***	0.248	0.231
Family[a,e]	-0.280	0.264	-0.079	-0.110	0.217	-0.040	0.065	0.217	0.022
Ffoodsuf[a,f]	0.551*	0.305	0.144	0.281	0.251	0.094	0.644***	0.251	0.198
Analysis Summary	N=151, R^2=0.229, Adjusted R^2=0.129, Standard Error of Estimate=1.582, F-test=6.083, p<0.001			N=151, R^2=0.131, Adjusted R^2=0.089, Standard Error of Estimate=1.304, F-test=3.087, p value=0.005			N=151, R^2=0.272, Adjusted R^2=0.237, Standard Error of Estimate=1.302, F-test=7.647, p<0.001		

Notes: *, ** and *** indicates significance at the 10%; 5% and 1% level of significance, respectively.

[a]Dummy variable, [b]basecategory=female; [c]basecategory=Respondents other than BCT; [d]basecategory=Respondents not trained on IPM; [e]basecategory=Joint family; [f]basecategory=Food production not sufficient for 12 month

For attitude, the explanatory power of the analysis is weaker but significant. The regression analysis predicting farmers' attitudes toward pesticide use was significant, $F(7,143) = 3.087$, $p = 0.005$, explaining 13.1% of the variance (Adjusted $R^2 = 0.089$). Education emerged as a significant positive predictor ($\beta = 0.197$, $p < 0.05$), indicating that farmers with higher educational levels demonstrated more positive attitudes toward safe pesticide use. IPM training showed the strongest effect in the analysis ($\beta = 0.281$, $p < 0.001$), with trained farmers scoring substantially higher in attitude compared to those without training. Other variables—including sex, age, ethnicity, family size, and food sufficiency—did not significantly influence attitudes.

The analysis predicting pesticide use practices was also significant and explained the most variance of the three analysis, $F(7,143) = 7.647$, $p < 0.001$, R2 = 0.272 (Adjusted R2 = 0.237). Ethnicity ($\beta = 0.199$, $p < 0.01$) and food sufficiency ($\beta = 0.198$, $p < 0.001$) were notable positive predictors, indicating that participants of a few ethnicities and those who were able to afford food for their households engaged in safer and more correct pesticide-use practices. IPM training was once again a clear positive predictor ($\beta = 0.231$, $p < 0.001$) with farmers who had received training clearly showing better practice. No other background characteristic – sex, age, education, or family size – was a significant predictor of pesticide use.

Summary of the Chapter

This chapter presents the result from 151 respondent farmers and outlines their socio-demographic characteristics which are imperative to read pesticide related KAP. Then, results of the socio-demographic profile and farm characteristics of the farmers essential to read their pesticide related KAP are presented. The majority of the respondents were from Brahmin/Chhetri/Thakuri groups followed by farmer were of joint family and were food sufficient. The assessment of knowledge showed that there was insufficient knowledge of pesticide toxicity classification among males and females, while females had better awareness on health problems caused by pesticides. The majority of respondents were aware of pesticide effects on humans, cattle/farm animals, rodents and aquatic organisms, but determining colour codes and Safe handling was still a problem. Attitudinal data revealed high dependence on chemical pesticides for convenience, and there was little gender difference in opinions on resistance, contamination, and thresholds for pesticide use. Only one difference was significant, that is, the males had a significantly higher awareness of ecological consequences with regard to the loss of the beneficial organisms. Practice associated results revealed common poor storage habits, minimal use of PPE, and infrequent utensil sharing while mixing. Females behaved marginally safer and were more likely to have received advice on precautions. Results of the regression analysis indicated that IPM education was the most influential factor that contributed to higher knowledge level, positive attitudes, and safer practices. Pesticide practice was predicted by ethnicity and food sufficiency, but education was only a positive predictor of attitudes. In sum, the chapter stresses profound deficiencies in knowledge and practice in the context of high risk perception, thus calling for learning-focused training and safer practice promotion.

CHAPTER V
DISCUSSION

The chapter investigates the knowledge, attitudes and practices of farmers on pesticide use and is interested in gender-based and other differences in determinants of pesticide-related behaviour. It explains that only a small proportion of farmers were aware of the pesticide toxicity color labels, indicating a vast gap between the regulatory labelling systems and the farmers' capacity to properly decode them. The chapter underscores that they are frequently not tailored to the local levels of literacy, cultural contexts, and/or cognitive requirements, and thus cannot be considered as effective communication instruments. Although there were no significant gender differences in knowledge concerning signs and symptoms of poisoning, some minor trends were identified such as recognition of low-toxicity labels being higher among women and men mentioning more field-based observations about ecology, including decreases in beneficial insects. This chapter also notes that farmers had a better knowledge of short-term and directly observable effects of pesticides on their own fields than they did of longer-term, indirectly observable effects at the scale of ecosystems. The regression analysis results indicate that IPM training, ethnicity, and food sufficiency were the strongest positive predictors of farmers' knowledge, emphasizing the theoretical significance of formal education and socio-economic stability. When it comes to attitudes, the chapter demonstrates that most farmers were knowledgeable about high risks to human and child health through pesticide exposure, with women being particularly concerned. Contrary to these views, the dominant practice with chemical pesticides at the time was to spray them based on convenience and market imperatives, not on the best available scientific knowledge. The fact that education and the training on integrated pest management (IPM) positively influenced opinions regarding safer use of pesticides also suggests that exposure to information such as this can have an impact on perception. On practices, the chapter describes that hazardous practices were norm such as storing pesticides inside the house, reusing pesticide containers, eating while spraying, using PPE inconsistently. Farmers demonstrated a strong preference for chemical pesticides, and it was common for them to spray during the daytime, in direct violation of suggested safety regulations. The chapter concludes with a discussion of how instrument-related barriers (lack of storage, cost of PPE, inadequate disposal options) often prevent farmers from translating knowledge and attitudes into practice, revealing significant cracks in the traditional KAP model.

Knowledge of Pesticide Use

The study showed that just 37 % of men and women farmers understood the meaning of toxic color labels on pesticide containers (p = 0.542), and more than 60 % could not accurately identify these indicators. Several studies from Nepal have similar findings that although farmers possess some awareness of general pesticide toxicity, their understanding of technical hazard classifications—particularly color coding and labeling—is often partial or inaccurate (Atreya et al., 2022; Suwal et al., 2025). These findings highlight a persistent gap between the regulatory intention of labeling systems and farmers' actual ability to interpret them.

Poor comprehension indicates that the existing labeling instructions were not sufficiently user-friendly, context-specific, or farmer friendly to address farmers differing literacy background. Aridi et al. (2025) stress that pesticide labels – in particular, pictograms and hazard color codes – must be culturally adapted, field tested, and elaborated based on the cognitive and linguistic abilities of farmers. If the farmers do not perceive the labeling systems as being designed for their local realities, they might still disregard or misinterpret them, weakening their power as tools to communicate risk.

Notably, although male and female farmers did not differ statistically in their general knowledge scores, female farmers were more knowledgeable than males about the least toxic color label—green—(85.7% vs. 60.7%; p = 0.063). It's a trend reminiscent of the results of Humagain (2024) who stated that women are generally more cautious when it comes to reading product labels and safety signals due to their inhibitive roles in cooking, maintaining the household, and protecting children. This means that fundamental features of communication, such as color, may be especially useful in conveying safety information. As Aridi et al. (2025) confirmed the finding that an appropriate colour coding and pictograms can enhance significantly the level of understanding of farmers on toxicity of pesticides and as a consequence the occurrence of misapplication can be reduced. However, validity, design processes that focus on the farmer and complementary training to ensure that farmers are able to understand and make decisions based on the symbols and use them in the field are crucial aspects for the success of these tools.

While the overall knowledge scores were similar between men and women, there were some gender related patterns. For example, although women were more accurate in identifying low-toxicity labels, men engaged in more dangerous activities, including spraying without wearing adequate personal protective equipment. These conclusions are in line with Humagain (2024), which claims that due to the caregiving roles, women tend to hold more health-protective views and men emphasize perceived efficacy and speed when applying pesticides. Nevertheless, the differences detected in this study were minimal and not statistically significant, and it was concluded that measures need to be targeted at both sexes and that they should not rely on any assumption of a large difference in baseline knowledge between the two genders.

A majority of respondents for all types of audience were aware of the detrimental impacts of pesticides on animals, birds, fish, and other natural allies including friendly insects, from 86% to 98% were willing responses. Yet, respondents expressed a relatively less concern for wider environmental impacts outside the farm (p-values=0.076–0.179). This is certainly consistent with Atreya (2022) who quoted that farmers generally are more sensitized when they perceive direct and immediate effects such as their livestock getting sick, or an immediate death of bees as opposed to far-reaching effects on the ecosystems like soil degradation, loss of bio-diversity, or contamination of water. Of note, male farmers reported higher awareness of decreases in beneficial insects compared with female farmers ($p = 0.042$), which could be related to the greater participation of men in fieldwork and pesticide application, thus they have greater contact with and are more aware of the ecological effects of spraying.

The regression analysis further consolidates the determinants of knowledge score. Integrated Pest Management training ($\beta = 0.909$), ethnicity ($\beta = 0.826$), and food security ($\beta = 0.551$) were the best predictors of having higher knowledge scores. These findings are in agreement with other studies that reported the necessity of farmers training and education to increase pesticide safety awareness (Vaidhya et al., 2017; Sapkota et al.,2 025). Indeed, IPM strategies have been associated with enhanced farmer knowledge of pest biology and ecology and improved risk assessment and risk reduction strategies, allowing them to make more informed decisions. In line with this, well-nourished household might have also attained net benefit from greater exposure to the information/training/what not on how to safely use pesticides, which would be yet another datapoint holding livelihoods secure and knowledge gaining together.

Overall, the level of awareness among both male and female farmers is aligned with the findings from Nepal and the agricultural sector in other developing countries. Although the majority of farmers were aware that pesticides are dangerous for human and animal health, they were less knowledgeable about specific toxicity classifications and environmental consequences. This is consistent with the stage of the "knowledge acquisition" within the KAP model, which indicates general awareness but not enough detailed information to result in northeast behavioral outcomes. The findings from this study continue to highlight formal sources of information (IPM training), as well as socio-economic security (e.g., food sufficiency) as key factors in knowledge improvement, indicating that these are areas requiring focus from the policy and program perspectives.

Attitudes toward Pesticide Use

The harmful effect of pesticides was well known to the gardeners (male 89.3%, female 100% farmers) on the human body (p = 0.003). Almost just as many thought there were risks specifically to children's health (men 86.7%, women 97.4%, p = 0.015). These results suggest a strong awareness of both short-term and long-term health risk of pesticide exposure. The findings are in line with Karki and Dangol (2023) that stated health issues such as headaches, dizziness, skin problems, and breathing issues were a common health problem farmers in Nepali experiencing after pesticide exposure. The greater risk perception of female farmers may reflect their greater concern for home and children's safety, as reported in other studies on gendered patterns in the perception of environmental health risks.

Regarding attitudes on alternative pest control strategies, the majority of farmers expressed that chemical pesticides should only be employed when pest numbers go beyond the natural enemies to bring them under control and that it should act as the last-resort option. A more threshold-dependent use of the concepts of application of control and biological control of pests would indicate conceptual knowledge of ecological pest management. Yet when it came sources of advice on other pest control methodologies, most farmers stated that they could not trust on agrovet store owners to provide such information. This is consistent with Atreya (2022) who found that although farmers hold positive ecological values, their pest management choices are influenced by market actors - primarily agrovets - who are more likely to advocate the use of chemical pesticides. Added to these reasons is the influence of the convenience and rapid effects of the chemicals and the farmers' anchor in their chemical-based habits, which hinders the dissemination of alternatives like biopesticides or mechanical methods.

Regression analysis also revealed that education positively predicted attitudes of safer pesticide use ($\beta = 0.088$, $p < 0.05$), suggesting that a better-educated farmer was more likely to have cautious and protective attitudes. Likewise, positive attitudes toward safe pesticide- handling practices were greatly influenced by the IPM training. These results are in line with the findings of Sapkota (2025), who further observed that IPM interventions can change farmers' perspectives to focus on ecological balance, risk reduction, and sustainable goals for the long run, rather than the short-term pest "eradication" goals.

In the general domain of attitudes, the study results indicated a general negativity of the respondents towards pesticide risk-related issues, more so for human and child health. This suggests that information is making a difference in farmers' perceptions, lending support to one of the key assumptions of the KAP model: that knowledge is a precursor to attitudes. The high level of acknowledgement of health risks reveals successful transmission of information within community networks, learning from peers and most recently public debate surrounding pesticide related disease.

These favourable perceptions, however, exist alongside a strong and persistent preference for synthetic pesticides and the opinions that biopesticides are less effective or slow in their action, revealing the boundaries of knowledge-based attitude change. It seems that risk perceptions alone do not dictate farmers' attitudes, and other factors, including external pressures from markets where a visually perfect crop commands the best price, accessibility and affordability of chemical pesticides, and ease of application, also come into play. These results mirror criticisms with regard to the linearity assumption underlying the KAP model—that knowledge acquisition will result in better attitudes, which in turn will result in safer practices. But the truth is that behavioral intentions are influenced by an interplay among the cognitive, economic and structural aspects.

The disconnect identified in this study implies that while information can enhance vigilance, vigilance in itself may not lead to changes in behavior in the absence of enabling factors, such as resources, economic incentives, and an effective system of regulation. This finds echoes with more general discussions in the literature that behaviour with regard to pesticides is not simply rational or information based but situated within social and economic contexts and mediated by perceived effectiveness, profitability and market pressures.

Practices regarding Pesticide Application

Although at the practice level, over 90% of the farmers kept the pesticides inside the home, typically in plastic bags as they were collected from the shop instead of using locked metal boxes or separate containers. These types of storage greatly increase the risk of accidental poisoning, contamination of household items and exposure to children. The predominance of in house informal storage behavior is consistent with findings from Kavrepalanchok and Bhaktapur where unsafe storage emerged as a key and enduring behavioural risk (Suwal et al., 2025; Sapkota et al., 2020). Such trends indicate that unsafe storage is not a "one off" occurrence but rather a systematic problem that pervades farming communities in Nepal, and is likely influenced by inadequate storage infrastructure, a lack of ability to conceptualize long-term effects of exposure, and the belief that pesticides are simply household items as opposed to chemicals that require special consideration.

Regarding safety, 80% of farmers said they practiced some of the recommended protective behaviors (bathing immediately after spraying, washing contaminated clothing as soon as possible, not smoking or eating while applying pesticides, among others). These are signs of a partial translation of knowledge into safer practices. But risky practices persisted: many farmers said they ate or drank while applying pesticides and that they rinsed out containers or equipment, but didn’t clean them well enough. These are in direct opposition to safety recommendations, and could result in acute exposure. The positive and negative practices concurrently observed in the current study resonate with earlier studies by Karki (2023) and Humagain (2024) that good practices of farmers are mixed with bad ones. This pattern reiterates the well-known divide between knowledge and practice, indicating that even having accurate knowledge does not necessarily mean that users were always fully compliant with safety guidelines.

Farmers preferred chemical pesticides over biopesticides (≈95%). Chemical pesticides were frequently described as having advantages such as ease of application, affordability, availability, and rapid visible effects, which may explain their dominance in farming practices. The majority of farmers (88–92%) sprayed pesticides during daytime hours, despite established recommendations promoting early morning or late afternoon spraying to minimize environmental drift and personal exposure. Similar findings were reported by Sapkota (2020) and Karki (2023), further emphasizing that behavior change interventions must focus not only on promoting the benefits of biopesticides but also on reshaping spraying habits and correcting entrenched working routines.

The IPM training (β = 0.717) and the food sufficiency (β = 0.644) were the best indicators for the improvement of pesticide-handling activities in the regression model. Those results imply that the provision of practical training along with the necessary implements and materials greatly enhances farmers' capacity and willingness to adopt the recommended safety practices. On the other hand, socio-demographic factors, including sex and number of household members, did not significantly predict levels of practice. This is consistent with the findings of Vaidya et al. (2017) as they pointed out that behavioral adoption of safer pesticide-use practices is influenced more by the enabling environment namely training, availability of resource, and institutional support than own or inherent demographic characteristics.

In addition to these predictors, the study observed widespread participation in risky handling practices, including storing weapons inside the home, unsafe disposal, and nonuse of PPE. These findings are in line with a large body of literature from Nepal and other low and middle income countries that consistently reports high knowledge but low practice (Atreya, 2007; Rijal et al., 2018; Ngowi et al., 2007). The current results confirm the idea of "knowledge–practice dissociation," as proposed by Damalas and Eleftherohorinos (2011), i.e., cognitive risk perception is not translated into behavioral modification.

The lower usage is due to the cost of PPEs, unavailability and negative attitudes towards them.Importantly, the regression analysis results also suggested that knowledge and attitudes were not adequate for predicting safe practices. Even well-informed farmers would still practice unsafe habits. This is in line with prior findings by Yassin et al. (2002) and Damalas & Koutroubas (2017) stating that knowledge interventions are compromised by structural and contextual constraints including non-PPE affordability, heat discomfort, cultural norms and time pressures in the periods of peak agricultural production. These contextual obstacles direct behavior via perceived control and feasibility, which are not extricably included in the conventional KAP model. Cost, lack of accessibility, and negative attitude towards use of the PPEs are the major contributing factors for underutilization (Damalas & Hashemi, 2010; Wilson & Tisdell, 2001; Galli et al., 2022).

Other risky practices, such as storing indoors and disposing improperly, are also influenced by poor infrastructure. As on record in Ethiopia, Vietnam and Nepal, farmers frequently do not have access to safe storage sheds or formal container disposal sites and as a result engage in risky practices that compound risks to health and environment (Mengistie et al., 2015; Bhandari et al., 2020). These results illustrate that environmental and structural constraints may supersede individual motives, and further attest to the limitations of solely cognitive-based explanatory variables.

The evidence suggests awareness-raising is necessary but not sufficient to bring about sustained changes in behaviour. Interventions should address structural obstacles such as availability of PPE, appropriate storage and disposal facilities, strengthening regulatory enforcement as well as cultural expectations related to pesticides use and safety. These insights unveil the blind spots of using only the KAP model and call for integrative behavioral frameworks with consideration of socioeconomic, infrastructural, and psychosocial determinants.

For the demographic analysis, none of the chi-square gender comparisons on knowledge, attitude and practice items were significant and regression analysis also indicated that sex was not a significant predictor of KAP scores. However, in the case of knowledge and practice, ethnicity was a significant determinant, suggesting that BCT and non-BCT farmers have different awareness and safe handling practices. Age showed no significant bivariate difference in knowledge, yet regression analysis indicated that older farmers possessed significantly lower levels of knowledge, suggesting generational disparities in exposure to training or education. Education also demonstrated mixed effects: while chi-square results showed only minor variation, regression analysis confirmed that higher education levels significantly improved attitudes toward pesticide safety.

Regarding IPM, the chi square test revealed that female were more likely than male to be counseled on precautions, and regression analysis confirmed a positive effect of IPM training on knowledge, attitude, and practice, the three KAP domains. This is in line with Adhikari et al. (2024), who suggested that IPM strategies are successful in mitigating pesticide-associated hazards and that they can contribute to enhancing the environment by reducing soil pollution. In addition, the chi-square results indicated that males reported higher food sufficiency than females, and household food sufficiency was a significant positive predictor of both knowledge and practice levels as revealed by regression analysis. This indicates that economic stability may empower farmers to implement safer pesticide use, thereby associating resource availability to behavioral outcomes.

Other Influencing Factors on Use of Pesticide use

There might be other social contexts that shape how the farmers make decision regarding use of pesticide use at household level and as a society. In communities, pesticide use is regarded as a normalized and socially acceptable practices; also, frequent spraying of pesticide is considered positive and necessary (Khanal & Singh, 2016). Farmers often learn practices of pesticide use from their peers and advices from their peers as well as local agrivets who favors chemical pesticides (Adhikari, 2018; Wilson & Tisdell, 2001; Vaidya et al., 2017). Moreover, social pressure to grow visibly attractive crops for markets lead farmers to use intensive pesticide use despite having less knowledge about long term impact (Aridi et al., 2025; Atreya, 2007).

Summary of the Chapter

The chapter describes that farmers know pesticides are dangerous, but they cannot read toxicity labels or take environmental factors into consideration, and only about 37% can read the color coded hazard information. This disparity mirrors broader rural urban differences in Nepal, where labelling formats do not align with the literacies and cultural contexts of farmers. Minimal gender variances in knowledge emerged, with women better recalling low-toxicity labels and men frequently seeing greater changes in the environment. The majority of the pesticides were effective, so most farmers were aware of pesticide impact on human and animals, but the impact on environment were less recognized. IPM training, ethnicity and food sufficiency were the strongest predictors of knowledge, suggesting that access to training and having enough food to eat are important facilitator of knowledge.

Attitude results showed a high level of concern for human and child health (particularly among women) and that pesticides were perceived to be used only when necessary. Alongside this, continued rather pragmatic dependence on chemical pesticides also persisted because of convenience, market logic, and limited trust in biopesticides. Awareness and training in IPM were shown to have a positive influence on attitudes for safer use of pesticides.

In practice, farmers practiced a combination of safe and unsafer practices, such as more than 90% keeping pesticides inside their homes and many coming into contact with pesticides without proper PPE. Chemical pesticides prevailed because they were accessible and acted quickly, and nearly all farmers applied them in the daytime, contrary to the safety advisories. For IPM training, the availability of agricultural inputs, gender, and other socio-demographic factors were included as predictors in the regression analysis to predict the likelihood of engaging in more safe practices. The chapter ends with the assertion that knowing and feeling is not enough for safe practice, as the infrastructural constraints, the economic pressures and cultural norms decisively shape the use of pesticides.

CHAPTER VI
IMPLICATIONS AND CONCLUSION

Implications

The findings of this study have important policy implications for pesticide policy, farmer education, and intervention in Nepal. Although most farmers are aware of the health risks of pesticides, knowledge on toxicity labels, environmental impacts, and pre-harvest intervals is limited (Atreya et al., 2022; Humagain, 2024). Improving farmer field schools, IPM training programs, and targeted campaigns helps in closing those knowledge gaps. The programs need to be contact with visual demonstration, localized situation and literacy friendly materials so as to enhance understanding and memorability (Sapkota et al., 2025).

There remains some unsafe practice in the face of such high awareness, such as reuse of utensils, application of pesticides without gloves, and ignoring wind direction when spraying. It implies that an intervention for the behavior is necessary to relax the practical constraints. The logistics and cost barriers could be addressed by providing access to affordable protective equipment or by establishing PPE sharing schemes at the community level, and on-site training may increase farmers' confidence in the safe use of pesticides (Suwal et al., 2025; Karki, 2023).

It is necessary to include gender sensitive approach as well. Female were able to identify toxicity label and male practiced risky behavior (Humagain, 2024). Training programs and campaigns need to be addressed at both females and males. The household dynamics and responsibilities divided needs to be understood. It should be focused on leveraging female's interest in family safety while recalling male farmers responsible for field application of safe procedures (Atreya et al., 2022).

It is essential to understand the importance of environmental awareness. Environmental awareness must be enhanced further. The findings suggest that farmers were able to distinguish negative impact of pesticide use to the wide ranges of species such as livestock, birds, fish, and bees; environmental awareness was moderate (Atreya et al., 2022). The Pesticide Management Act (MoALD, 2019) regulations must focus on ecosystem preservation and promote the application of biopesticides and integrated pest management for reducing environmental contamination and soil degradation in Nepal.

The study shows that training and policy should be aligned and give priority on. IPM training was associated with increased knowledge, improved attitude, and improved practice, highlighting its value as an important tool for policy action (Sapkota et al., 2025). IPM should be the core of the intervention, with a focus on how it can contribute to this field. Effective interventions must take an approach that includes education, behavior change facilitation, gender-sensitive strategies, and enforcement of regulations as the mandatory components. These approaches are able to fill the gap in the knowledge and practice, reduce pesticide-related health risks, and facilitate environmentally sustainable agriculture, which are in line with national goals of protecting health and the environment (MoALD, 2019).

Future research could explore the behavioral determinants from the cultural, economic, and psychological barriers that influence the continuation of unsafe pesticide use practice in high-awareness areas potentially employing qualitative or behavioral methods. Research also is needed on the comparative effectiveness of different training methods (e.g., visual demonstrations, training customized to local conditions, literacy-appropriate materials) in terms of their effectiveness in facilitating learning and adoption of safe practices. Additional investigation into gender dynamics is vital, specifically how household functions, decision-making processes, and risk perceptions vary between men and women as well as the impact gender-sensitive training can have on both. Also, farmers' environmental consciousness should be further inquired, particularly related to the questions on soil degradation in the long run, loss of biodiversity, contamination of water, and if wider IPM and biopesticides use among farmers can be proven to be actually minimizing such worries. Future research should also assess potential areas of weakness in the implementation and enforcement of national policies, including the Pesticide Management Act and the National IPM Policy, to explore connections between policy and practice at the ground level. In addition, assessing how IPM programs can be scaled, and field-testing community-based models (such as PPE-sharing programs or discounted protective gear) will be important in identifying sustainable, effective strategies that ensure safe pesticide use and that support environmentally sound agriculture.

Conclusion

The study indicated that there is a considerable gap between knowledge and practice among farmers, who knew about harmful impact of pesticides on animal and human health. This is a big problem to ensure safe use of pesticides and sustainable pest management in the country. Farmers had only a moderate understanding of pesticide toxicity, labelling and safe handling. Many farmers could not read the color-coded labels or made sense of the information (with the color codes indicating risks). Although there was a general high level of awareness related to health risks associated with pesticides, the level of awareness about toxicity classes and long term effects on environment was low. Female farmers' awareness of toxicity color codes was only slightly greater and males were more involved in pesticide preparation and application work. These two contrasts indicate that gender-based roles determine exposure and risk perception. Regression analysis indicated IPM training, ethnicity, and food sufficiency as the most critical knowledge associated predictors, i.e. education and socio-economic security play key roles in facilitate pesticide literacy.

Attitudes towards the use of pesticides were predicted by both socio-demographic characteristics and knowledge. Most farmers agreed that pesticides are harmful to human health and the environment; however, this awareness was not always applied in terms of safe handling. Most farmers depended on chemical pesticides due to its rapid efficiency, lower cost, and market demand, despite having concerns regarding the adverse effects. Farmers with formal education and IPM training had safer attitudes towards pesticide use. It indicates that formal education and involvement in IPM training programs can raise awareness and willingness to practice safer alternative methods.

As for the practices, unsafe handling behavior were common. Most of the farmers stored their pesticides in plastic bags or open containers at home. Although some of the respondents reported bathing and washing clothes after spraying and monitoring wind direction while spraying, use of PPE was poor and often neglected. Budget constraints, inconvenience, and unavailability of safety gear were main setbacks to proper use of PPE. Regression analysis indicated that IPM training and food adequacy of household had significant effects on safe practices, once again validating the relationship between training, economic status, and behavioral compliance.

The regression analysis reveals that while socio-demographic factors such as gender and age play insignificant roles, training, economic status, and social location (ethnicity) play parts in enhancing knowledge, developing positive attitudes, and practicing safety. The robust and consistent influence of IPM training on all KAP dimensions marks it as an important tool for behavioral intervention in future.

As per the KAP model, these results support that knowledge and attitude change may not always result in behavioral change in the absence of support from training availability, resource sufficiency, and ambient socio-economic conditions. Thus, while planning IPM training, it should be combined with targeted awareness, farmers' training, and overall policy support can effectively promote safe pesticide handling behavior among farmers and attain sustainability.

In conclusion, education, training, and access to information regarding safety are crucial to go from knowledge to practice. Socio-economic security and supportive policy environments also play key roles in helping farmers to adopt more sustainable and safer pest management practices. Unless causes of structural and behavioral difficulties are resolved, sensitization will remain inadequate to trigger considerable change. Without addressing the root causes of structural and behavioral issues, sensitization is not sufficient to bring about meaningful change.

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APPENDIX 1

Knowledge related Questions

S. N.	**Question**	**Options**	**Score**
1	Do you understand the meaning of toxic labels (color) in the pesticide containers?	Yes	1
		No	0
2	Do chemical pesticides negatively affect your health?	Yes	1
		No	0
3	Do chemical pesticides negatively affect your children's health?	Yes	1
		No	0
4	Do chemical pesticides negatively affect your livestock?	Yes	1
		No	0
5	Do chemical pesticides negatively affect the birds?	Yes	1
		No	0
6	Do chemical pesticides negatively affect fishes in the river?	Yes	1
		No	0
7	Do chemical pesticides negatively affect honeybees?	Yes	1
		No	0
8	Are personal protective equipment used during pesticide handling effective in reducing health effects or not?	Yes	1
		No	0
9	Are you aware of the waiting period for vegetable harvest after pesticide spay?	Yes	1
		No	0
10	Which color indicates the least toxic for human health?	Green	1
		Other Colors	0
		Total Score	**10**

Attitude related Questions

S. N.	Question	Options	Score
1	Chemical pesticides should be used only if pest population is greater than the natural enemies.	Agree	1
		Disagree	0
2	Chemical pesticides are more familiar and easy to apply than other methods of insect pest control.	Agree	0
		Disagree	1
3	Chemical pesticides are more easy to apply than biopesticides.	Agree	0
		Disagree	1
4	Pesticides dealers/agrovets can suggest appropriate alternative methods for insect pest control	Agree	1
		Disagree	0
5	Insects can grow resistance due to excessive chemical pesticides application	Agree	1
		Disagree	0
6	Lack of knowledge on safety measures of using pesticides can cause health problems	Agree	1
		Disagree	0
7	Throwing of emptied pesticide in the river/field causes pollution	Agree	1
		Disagree	0
8	What method do you prefer to use between chemical and biopesticide?	Biopesticide	1
		Chemical Pesticide	0
9	When do you prefer to spray pesticides in crops?	Early morning or evening	1
		Day	0
10	Do you agree that the beneficial organisms are lost in the environment after chemical pesticide use?	Agree	1
		Disagree	0
		Total Score	**10**

Practice related Questions

S. N.	Question	Options	Score
1	Where do you store pesticides at home?	Outside home	1
		Others	0
2	How do you store pesticide at home?	Wrapped in plastic bags	1
		Closed box/Others	0
3	Do you smoke during pesticide handling/application?	Yes	1
		No	0
4	Do you take account of wind direction at spraying and adjust accordingly?	Yes	1
		No	0
5	Do you always take bath after pesticide use?	Yes	1
		No	0
6	Do you wash your clothes immediately after pesticide use?	Yes	1
		No	0
7	Do you eat during the pesticide handling/application?	Yes	0
		No	1
8	Do you drink during the pesticide handling/application?	Yes	0
		No	1
9	Are the utensils used for preparing pesticides also used for other purposes?	Yes	0
		No	1
10	Have you received safety precautions advice for pesticide application?	Yes	1
		No	0
		Total Score	**10**

APPENDIX 2

Collinearity Checked for Knowledge

		Knowledge	Age	Education	Trained in IPM	Ethnicity	Sex	Type of family	Food sufficiency
Pearson Correlation	Knowledge	1.000	-.133	.196	.343	.348	-.144	-.046	.222
	Age	-.133	1.000	-.326	.100	.143	.434	-.103	.111
	Education	.196	-.326	1.000	.228	.277	.220	-.005	.230
	Trained in IPM	.343	.100	.228	1.000	.424	-.023	.013	.154
	Ethnicity	.348	.143	.277	.424	1.000	-.116	.020	.320
	Sex	-.144	.434	.220	-.023	-.116	1.000	-.035	.126
	Type of family	-.046	-.103	-.005	.013	.020	-.035	1.000	.023
	Food sufficiency	.222	.111	.230	.154	.320	.126	.023	1.000

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	106.504	7	15.215	6.083	.000[b]
	Residual	357.681	143	2.501		
	Total	464.185	150			

a. Dependent Variable: knowledge

b. Predictors: (Constant), Food sufficiency, Type of family, Sex of Participants, Trained in IPM SSF, 11. Education of respondent [highest enrolled class], Ethnicity of participants, 10. Age of the respondent

Collinearity Checked for Attitude

		Attitude	Age	Education	Trained in IPM	Ethnicity	Sex	Type of family	Food sufficiency
Pearson Correlation	Attitude	1.000	-.027	.223	.283	.066	.079	-.030	.128
	Age	-.027	1.000	-.326	.100	.143	.434	-.103	.111
	Education	.223	-.326	1.000	.228	.277	.220	-.005	.230
	Trained in IPM	.283	.100	.228	1.000	.424	-.023	.013	.154
	Ethnicity	.066	.143	.277	.424	1.000	-.116	.020	.320
	Sex	.079	.434	.220	-.023	-.116	1.000	-.035	.126
	Type of family	-.030	-.103	-.005	.013	.020	-.035	1.000	.023
	Food sufficiency	.128	.111	.230	.154	.320	.126	.023	1.000

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.856	7	4.551	2.882	.008[b]
	Residual	225.813	143	1.579		
	Total	257.669	150			

a. Dependent Variable: attitude
b. Predictors: (Constant), Food sufficiency, Type of family, Sex of Participants, Trained in IPM SSF, 11. Education of respondent [highest enrolled class], Ethnicity of participants, 10. Age of the respondent

Collinearity Checked for Practice

		Practice	Age	Education	Trained in IPM	Ethnicity	Sex	Type of family	Food sufficiency
Pearson Correlation	Practice	1.000	-.128	.252	.357	.382	-.156	.049	.290
	Age	-.128	1.000	-.326	.100	.143	.434	-.103	.111
	Education	.252	-.326	1.000	.228	.277	.220	-.005	.230
	Trained in IPM	.357	.100	.228	1.000	.424	-.023	.013	.154
	Ethnicity	.382	.143	.277	.424	1.000	-.116	.020	.320
	Sex	-.156	.434	.220	-.023	-.116	1.000	-.035	.126
	Type of family	.049	-.103	-.005	.013	.020	-.035	1.000	.023
	Food sufficiency	.290	.111	.230	.154	.320	.126	.023	1.000

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	90.699	7	12.957	7.647	.000[b]
	Residual	242.294	143	1.694		
	Total	332.993	150			

a. Dependent Variable: practice
b. Predictors: (Constant), Food sufficiency, Type of family, Sex of Participants, Trained in IPM SSF, 11. Education of respondent [highest enrolled class], Ethnicity of participants, 10. Age of the respondent

Independence Checked for Knowledge

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.479[a]	.229	.192	1.58154	.229	6.083	7	143	.000	2.029

a. Predictors: (Constant), Food sufficiency, Type of family, Sex of Participants, Trained in IPM SSF, 11. Education of respondent [highest enrolled class], Ethnicity of participants, 10. Age of the respondent
b. Dependent Variable: knowledge

Independence Checked for Attitude

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.352[a]	.124	.081	1.257	.124	2.882	7	143	.008	2.218

a. Predictors: (Constant), Food sufficiency, Type of family, Sex of Participants, Trained in IPM SSF, 11. Education of respondent [highest enrolled class], Ethnicity of participants, 10. Age of the respondent

b. Dependent Variable: attitude

Independence Checked for Practice

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.522[a]	.272	.237	1.30168	.272	7.647	7	143	.000	1.931

a. Predictors: (Constant), Food sufficiency, Type of family, Sex of Participants, Trained in IPM SSF, 11. Education of respondent [highest enrolled class], Ethnicity of participants, 10. Age of the respondent

b. Dependent Variable: practice

Multicollinearity Checked for Knowledge

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	8.336	.916		9.104	.000					
	Age	-.032	.017	-.198	-1.879	.062	-.133	-.155	-.138	.484	2.067
	Education	-.006	.058	-.011	-.108	.914	.196	-.009	-.008	.528	1.893
	Trained in IPM	.909	.302	.249	3.013	.003	.343	.244	.221	.792	1.263
	Ethnicity	.826	.345	.224	2.396	.018	.348	.196	.176	.617	1.620
	Sex	-.157	.348	-.045	-.452	.652	-.144	-.038	-.033	.546	1.832
	Type of family	-.280	.264	-.079	-1.062	.290	-.046	-.088	-.078	.980	1.020
	Food sufficiency	.551	.305	.144	1.811	.072	.222	.150	.133	.854	1.172

a. Dependent Variable: knowledge

Multicollinearity Checked for Attitude

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	5.883	.728		8.085	.000					
	Age	-.001	.013	-.010	-.087	.931	-.027	-.007	-.007	.484	2.067
	Education	.070	.046	.163	1.514	.132	.223	.126	.119	.528	1.893
	Trained in IPM	.781	.240	.287	3.259	.001	.283	.263	.255	.792	1.263
	Ethnicity	-.336	.274	-.122	-1.227	.222	.066	-.102	-.096	.617	1.620
	Sex	.072	.277	.028	.261	.795	.079	.022	.020	.546	1.832
	Type of family	-.087	.209	-.033	-.417	.678	-.030	-.035	-.033	.980	1.020
	Food sufficiency	.239	.242	.084	.989	.325	.128	.082	.077	.854	1.172

a. Dependent Variable: attitude

Multicollinearity Checked for Practice

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	5.522	.754		7.327	.000					
	Age	-.016	.014	-.120	-1.171	.243	-.128	-.097	-.084	.484	2.067
	Education	.041	.048	.085	.866	.388	.252	.072	.062	.528	1.893
	Trained in IPM	.717	.248	.231	2.886	.005	.357	.235	.206	.792	1.263
	Ethnicity	.623	.284	.199	2.195	.030	.382	.181	.157	.617	1.620
	Sex	-.352	.287	-.119	-1.228	.222	-.156	-.102	-.088	.546	1.832
	Type of family	.065	.217	.022	.298	.766	.049	.025	.021	.980	1.020
	Food sufficiency	.644	.251	.198	2.571	.011	.290	.210	.183	.854	1.172

a. Dependent Variable: practice

Normality Checked for Knowledge, Attitude and Practice

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Knowledge	151	2.00	10.00	7.8411	1.75914	-1.035	.197	1.782	.392
Attitude	151	2	9	6.52	1.311	-1.005	.197	1.768	.392
Practice	151	1.00	10.00	5.9934	1.48995	-.503	.197	.643	.392
Valid N (listwise)	151								

Outliers Checked for Knowledge

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	6.0923	9.2545	7.8411	.81308	151
Std. Predicted Value	-2.151	1.738	.000	1.000	151
Standard Error of Predicted Value	.294	.497	.340	.040	151
Adjusted Predicted Value	6.0386	9.3726	7.8392	.81531	151
Residual	-5.27720	3.11910	.00000	1.55996	151
Std. Residual	-3.315	1.959	.000	.980	151
Stud. Residual	-3.384	2.003	.001	1.003	151
Deleted Residual	-5.50014	3.26101	.00184	1.63598	151
Stud. Deleted Residual	-3.515	2.025	-.003	1.016	151
Mahal. Distance	4.133	13.644	5.960	1.721	151
Cook's Distance	.000	.078	.007	.013	151
Centered Leverage Value	.028	.091	.040	.011	151

a. Dependent Variable: knowledge

Outliers Checked for Attitude

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5.79	7.29	6.52	.416	151
Std. Predicted Value	-1.773	1.847	.000	1.000	151
Standard Error of Predicted Value	.235	.396	.271	.032	151
Adjusted Predicted Value	5.72	7.29	6.52	.421	151
Residual	-4.373	2.627	.000	1.243	151
Std. Residual	-3.448	2.071	.000	.980	151
Stud. Residual	-3.511	2.109	.000	1.004	151
Deleted Residual	-4.536	2.725	-.001	1.304	151
Stud. Deleted Residual	-3.659	2.135	-.004	1.016	151
Mahal. Distance	4.133	13.644	5.960	1.721	151
Cook's Distance	.000	.089	.007	.013	151
Centered Leverage Value	.028	.091	.040	.011	151

a. Dependent Variable: attitude

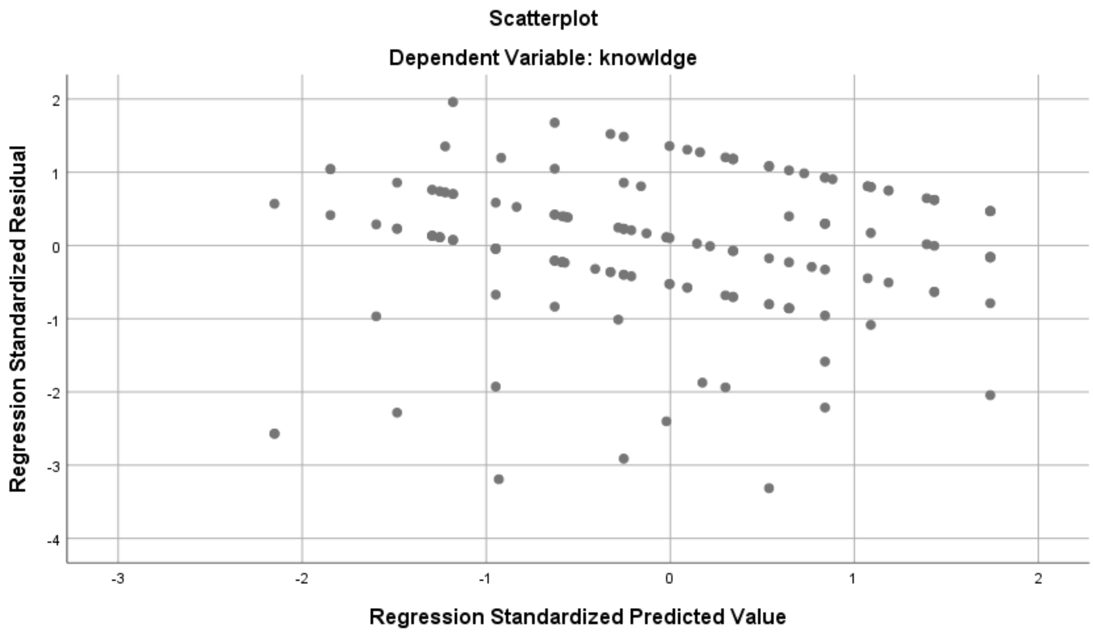
Outliers Checked for Practice

Residuals Statistics[a]

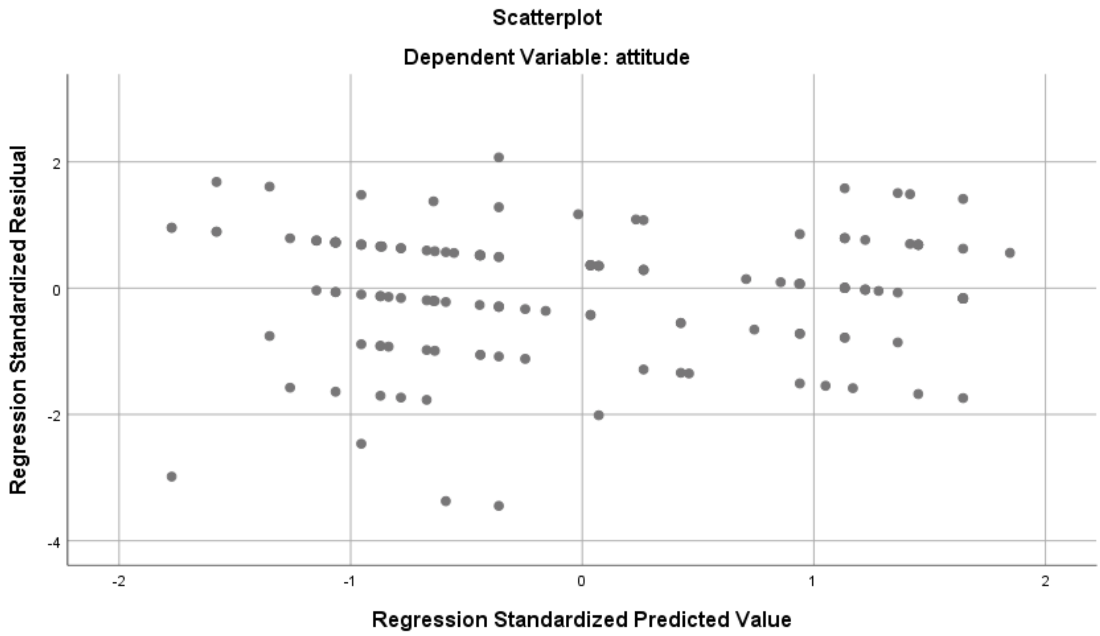
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.4577	7.2172	5.9934	.74839	151
Std. Predicted Value	-2.052	1.635	.000	1.000	151
Standard Error of Predicted Value	.243	.411	.281	.033	151
Adjusted Predicted Value	4.4311	7.3776	5.9937	.74987	151
Residual	-4.21719	3.92985	.00000	1.28836	151
Std. Residual	-3.207	2.989	.000	.980	151
Stud. Residual	-3.268	3.066	.000	1.004	151
Deleted Residual	-4.37758	4.13525	-.00036	1.35350	151
Stud. Deleted Residual	-3.384	3.160	-.002	1.016	151
Mahal. Distance	4.133	13.644	5.960	1.721	151
Cook's Distance	.000	.070	.007	.013	151
Centered Leverage Value	.028	.091	.040	.011	151

a. Dependent Variable: practice

Homoscedasticity Checked for Knowledge



Homoscedasticity Checked for Attitude



Homoscedasticity Checked for Practice