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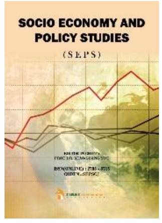

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RESEARCH ARTICLE

PERCEPTION OF FARMERS ON HANDLING PESTICIDE AND ADOPTION OF IPM IN WEST RUKUM OF NEPAL

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ABSTRACT

The survey was conducted to study the perception of farmers on the handling of pesticides and the adoption behaviours of Integrated Pest Management (IPM) in western Nepal. For this study, 60 farmers involved in the registered cooperative were selected by using a simple random technique. Focused Group Discussion (FGD) was done with farmers of three different agriculture cooperatives of Rukum west regarding agricultural pests and pesticide use along with the adoption behaviours of IPM practices. Our findings revealed that most of the households had better knowledge about major diseases and insects of vegetable crops that cause economic damage every year. The households ranked damage caused by insects as first followed by disease infestation and damage caused by rodents. More than half of the households had been practising chemical methods of pest control followed by organic methods (23.67%) and integrated chemical and organic methods (21%). Cow urine, *jhol mol*, and *Neem*-based pesticides were some of the common organic pesticides used by the farmers there. More than half of the farmers used masks only and 38% of the farmers used all the protective measures like masks, gloves, boots, and protective cloth while spraying pesticides. Around 60% of the farmers had not taken any training related to IPM and only 30% of the households followed IPM practices for the control of diseases and pests. The study revealed that lack of technical support, the low market price for organic products and lack of technical knowledge required for pest management were the major constraints regarding the adoption of IPM practice.

KEYWORDS

Carcinogenic, Chemicals, Human safety, Organic Agriculture, Pollution

1. INTRODUCTION

The total area under vegetable production in Nepal is 2,86,864 ha, and previous year total production was 39,58,230 metric tons with the productivity of 13.79 tons/ha (Krishi Diary, 2021). Around 89% of the people of Rukum are directly involved in fresh vegetables and vegetable seed production, cereal crops, spice crops and fruit production (Krishi Diary, 2021). There is a high risk of lower production due to pests and disease upsurgence. Pesticide is a mixture of substances intended for destroying, repelling, or mitigating different pests. Insecticide, fungicide, herbicide and various other chemicals are used to manage the prevailed pests on vegetables (Sharma et al., 2012). Globally around two million tons of pesticides are sprayed on different crops. Particularly pesticide consumption is high in tropical and sub-tropical regions to gain a high net profit by growing different off-season fruits and vegetables (Dhital et al., 2015; Sharma et al., 2012). In past, the majority of pesticides were consumed in Europe (45%) followed by the USA (25%) and 25% are consumed by the rest of the world (Dhital et al., 2015; Reigart and Roberts, 1999). The use of pesticides in Nepal started along with import of Dichloro Diphenyl Trichloroethane (DDT) to control malaria in 1950 AD.

Then other different categories of a pesticide such as organochlorines (Benzene Hexachloride, Dieldrin), Organophosphate (Ethylene, Parathion, Malathion), Carbonates, and synthetic pyrethroids were introduced in Nepal (Atreya, 2008). At present farmers are using 500 different brands of pesticides which are available to control different types of insects like fruit flies, worms, beetles, leaf minor, bugs, and different plant diseases such as late blight of potato and tomato, mildews, Anthracnose and many more (Khanal and Singh, 2016; Atreya, 2008). In Nepal, the pesticide application rate is increasing

by 10-20% each year (Khanal and Singh, 2016). IPM is the strategy of encouraging an assemblage of bio-pesticides and chemicals to manage pests in an integrated way increase the yield of crops without minimizing the quality of lifeforms of terrestrial and aquatic systems. IPM has been supported by the Nepalese government since 2002 as an alternative to chemical pesticides for managing the target insect, as indicated by academic scholars. The practical concept of IPM was implemented to control brown planthopper of spring rice in Kumroj and Kathar area of Chitwan in 1997.

The trend of using pesticides haphazardly on crops, more specifically on vegetables and fruits has increased human health and other life forms in danger (Khanal and Singh, 2016). However, a greater proportion of farmers are unaware of pesticide type, poison level, safety precautions, and pesticide effect on health and the environment (Yassin et al., 2002). The recent pattern of pesticide use has resulted in several health hazards for farmers, consumers, and other non-target species. Farmers have experienced the symptoms of vomiting, weakness, eye burning sensation skin irritation, teary eyes, weakness, and other infirmities (Mew et al., 2017). Chronic cancer, endocrine disruption, neurological effects, and respiratory disorders may result due to long-term exposure to pesticides (Yassin et al., 2002). According to the report of the world health organization (WHO), about 3 million poisonings, 220 thousand deaths and 750 chronic illnesses occur around the world annually (WHO, 2006).

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Furthermore, only a small amount of applied pesticide reaches the target species and the rest of it ends up dispersed in the environment (Pimentel and Burgess, 2014). Pesticides are used by both subsistence and commercial farmers haphazardly without following proper guidelines. On the other hand, Agrovets are only focusing on selling different brands of pest

They have less concern about guiding farmers on time dose and systematic disposal of pesticides. Chemical Pesticides are mostly used to control, manage and complete eradication of different types of pests which cause economic loss in seeds, plants, animals, and human beings as well (PQPMC, 2077; WHO, 2006). According to the WHO, moderately hazardous pesticides are in the highest quantity. Israel uses most of its pesticides at 11.6 kg/ha, Nepal 15th Rank with 396 active ingredient g/ha (Sharma et al., 2012). Pesticide imports and compositions in Nepal surged from 35000 kg in 1997/1998 to 350 thousand kg in 2011/2012, a six-fold rise in 15 years (Kafle et al., 2015). The expenditure for pesticide imports and formulation in 1997/1998 was about 51 million Nepalese rupees which rose to more than 374 million NRS in 2011/2012 (Dhital et al., 2015). In the facial year, 2020 Nepal has spent a total of 747 million NRs to import and formulation of pesticides (PQPMC, 2077).

Table 1: Registered Pesticides in Nepal

S.N.	Type of Pesticide	Trade Name	Common Name
1.	Insecticide	1635	60
2.	Acaricide	28	6
3.	Fungicide	746	42
4.	Bactericide	17	1
5.	Herbicide	436	30
6.	Rodenticide	38	2
7.	Molluscicide	2	1
8.	Biopesticide	113	14
9.	Nematicide	1	1
10.	Herbal	19	13
Total		3035	170

Source: (PQPMC, 2077)

In Nepal, out of total pesticide consumption, vegetables occupy around 89% of total pesticide used followed by cash crops, and pesticide consumption is found least in cereal (Rijal et al., 2018). Food monitoring and regulation programs on testing pesticide residue levels are not performing so well in Nepal. Most of the hilly rural areas of Nepal still lack effective environment and policy programs for the assessment of farmers' knowledge, attitude, and practices regarding pesticide use. Very little research has been carried out on this topic in the district and much more is still to be done for solving the problems from the grass-root level. Farmers are not much aware of the risk and rarely follow proper safety methods while using pesticides due to a lack of training and education programs by industry and government for safe use. The widespread misuse and consequence of pesticides suggested the need for more research, better instruction, and more effective control. Our objective was to study farmers' perception on pesticide use and the adoption behaviors of IPM. We tried to explore the pests of vegetable crops and the types of pesticides used along with the impact of chemical pesticides in Nepal (Adhikari, 2017; Kafle, 2015).

2. Methodology

2.1 Study Area

The Annual average maximum and minimum temperatures were 24 °C and 13 °C respectively and relative humidity was 79% along with annual rainfall of 1400 to 3200 mm which was best for organic vegetable production. The survey research was carried out in 3 different areas of the Rukum (west) district. An equal proportion of the sample was taken from Musikot Municipality ward 3, *Xeda* where the pesticide consumption pattern is high, Musikot municipality-13, Chautara (Where the IPM program was implemented in the past), and from Triveni rural municipality-3, Simrutuat where people were heading towards organic farming.

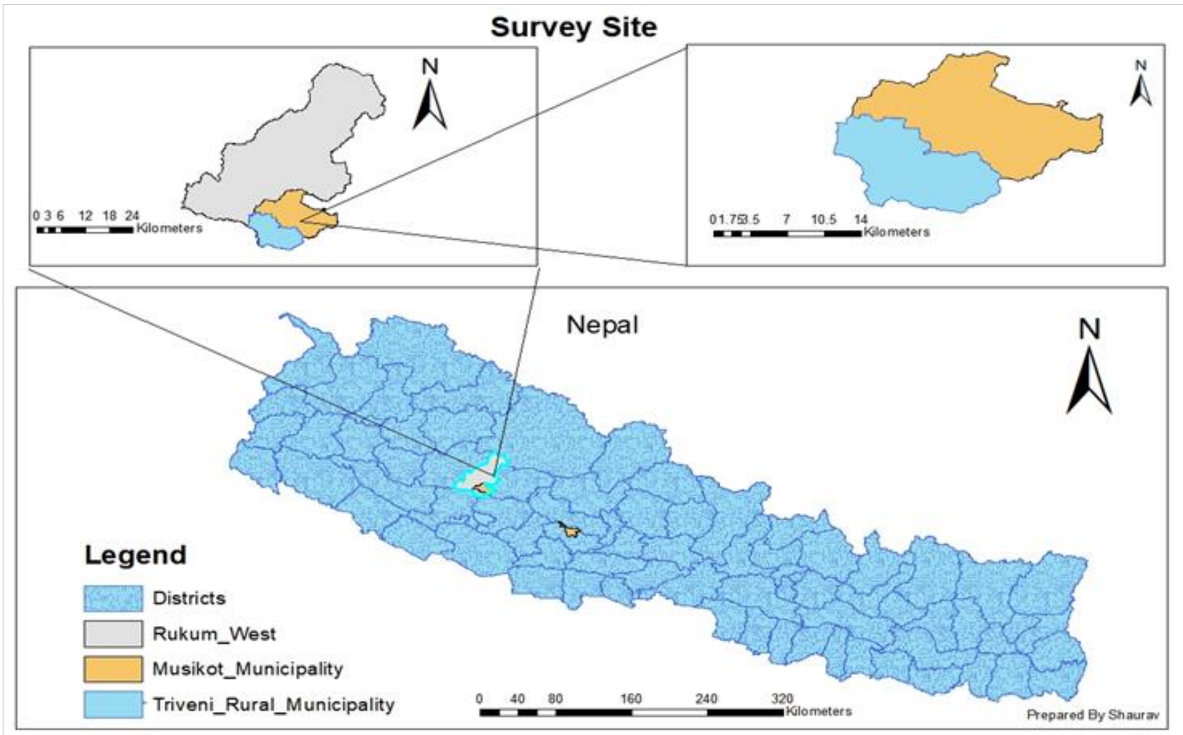

Figure 1: Map of Nepal and Rukum (West) Musikot Municipality, Triveni rural municipality

2.2 Sample and Sampling Technique

There were 12 registered vegetable-producing farmers' co-operatives under which about 600 farmers were directly engaged in the production of fresh vegetable crops and their seeds. A sampling frame of 200 was made from each of the Musikot, Chautara, and Triveni from which 10% of the representative sample was taken for the study. Primary data was collected through direct interaction with the farmers and the trader of the study site using Research instruments like household surveys, Focus group discussion and key informant interviews, and telephone surveys. The interview schedule was prepared in the English language and the question was asked in the Nepali language. Pre-testing of the interview schedule was done to test the validity and effectiveness of the interview schedule. Key Informants Interview (KII) was carried out with progressive or model farmers, Agriculture Information Center (AIC) officers, zone officers, JT/JTA, etc. Secondary data was obtained through the detailed literature review of annual ADO reports, and research articles, published in national and international journals. The obtained data were coded, tabulated, and analyzed using Micro Soft Excel 2021, SPSS (Statistical Package for Social Science) v.24, and STATA.

Problem ranking of vegetable pests was done by using the following formula:

$I_{imp} = \Sigma (S_i \times F_i/N)$

Where I_{imp} = Index of importance

S_i= Scale value

N= No. of households

F_i= Frequency of importance given by households

Chi-Square test for independence attributes was done for the factor affecting the adoption IPM. Common health problems like diarrhoea, abdominal pain, headache, nausea, vomiting, etc. and other chronic effects like skin disease, cancer, depression, neurological effects, diabetes, genetic disorder, or even death may occur due to haphazard use of pesticides (Anderson et al., 2014). Further, pesticides inhibit the different groups of microorganisms while another group of pests becomes outnumbered by releasing them from the competition (Hussain et al., 2009). IPM-FFS has been widely accepted as the technology transfer platform for policymakers, academicians, technicians, and many more. By participating in IPM-FFS, farmers are got high yield of crops, and more annual income from agriculture, and they had developed better leadership than non-practitioners.

3. Result and Discussion

The result showed that out of 60 household heads 65% were male and 35% were female of which the majority of the population were from the Chhetri ethnicity (54%). This showed the satisfactory participation of women in agriculture activities.

3.1 Education Level of the Households

The education level of the farmers affects the way of vegetable farming and practice of pesticide use along with alternative methods of pest management. The result showed that most of the household heads had completed secondary level of education (48.67%) followed by the Primary level (16.33%) and only 15% had graduated from university in the study area. One of the studies had concluded that the involvement of farmers with a higher level of education helps to increase the production of crops and decrease in fragmentation of land to some extent (Guo et al., 2015).

The minimum age of the farmer involved in vegetable production was 23 years and the maximum age was 60 years with a mean age of 38.03. The study revealed that the majority of the households i.e., 37 (61.67) were between the ages of 29 and 47. The landholding of 37(61.7 %) farmers was between 11-20 ropani (0.5 to 1 hectare). The occupation pattern of the study area showed that 78% of the respondent involved in agriculture followed by 13.33% of the households were involved in different government and non-government services and only 8.33% of the respondent were involved in business activities.

Most Nepalese farmer depends on the natural rainfall for the cultivation of different crops. Irrigation plays important role in crop production. The lack of irrigation facilities at the critical stage of crop growth is one of the major reasons behind the low production of vegetable crops in Nepal. In Rukum west around 64% of the households use canal irrigation followed by pipeline irrigation (33%) and very few (3%) of the respondent found pond irrigation.

Vegetable growers have many problems related to the production aspect out of which the main problems are insects, diseases, rodents, and weeds that occur in the field. The severity of the problems in vegetable production was studied using the Likert scale. The severity index showed that insect was the most severe problem with an index value of 0.84 followed by disease with an index of 0.70. The decrease in the production of vegetable crops due to various diseases and insects was observed during the field survey in the study area as mentioned in the table. Every year these diseases and insects cause around 50% and, in some areas, up to 90% economic loss in the production of fresh vegetables (ADO, 2021).

The households used different types of pest management strategies. More than 50% of the households used Chemical methods for the control of disease and pest problems. Similarly, around 23% of the households used organic methods like cow urine, jhol mol, neem oils and other different botanicals for pest control and around 21% of the households use both chemical and organic methods of pest control. The increasing use of chemical pesticides may be due to their easy availability, easy to use, and quick response. A similar study conducted in Dhading and Chitwan districts revealed the high dependency of farmers on chemical pesticides for the control of insects and pests (Atreya, 2008).

3.2 Types of Pesticides Used by the Households

Among the chemical pesticide using farmers, insecticide was found to be used by around 60% of the households followed by fungicide (40%). However, none of the households uses chemical pesticides the control rodents and weeds. They have manually or physically controlled the weeds and rodents. Cypermethrin (II)

was found to be the most often used pesticide in West Bengal, India, followed by Methyl parathion (Ia), Imidacloprid (II), Dichlorvos (Ib), and Phorate (Ia) (Banerjee et al., 2014). We had already mentioned that pesticides like Dichlorvos, Phorate, and Methyl parathion have been already banned in Nepal. Likewise, another study carried out on farmers in the Gaza strip showed that Methamidophos was the most commonly used pesticide followed by Chlorpyriphos (Yassin et al., 2002). Differences in the list of commonly used pesticides might be due to divergence in pest type, pest population as well as the availability of pesticides in the market.

3.3 Toxicity Class of Pesticides Used by The Households

Only 66.67% of the households were familiar with the toxicity label of the pesticides, and the remaining 33.33% do not have any idea about the toxicity class of pesticides. This showed that many farmers were still unaware of pesticide labelling. Lack of training on pesticide use could be one of the reasons for poor knowledge of pesticide use among vegetable growers. The result also revealed that around 41% of the households used yellow (moderately hazardous) levels of chemical pesticides. Additionally, 18% of the respondent used the blue (slightly hazardous) level followed by the green (non-hazardous) level 8%. No one of the households used the red level of pesticides as they were not available in the market.

3.4 Practices of Pesticides Used by the Households

It has been found that around 55% of households used the spraying technique for applying chemical pesticides. Similarly, only 10% of the households used the dusting technique for applying chemical pesticides followed by 35% of the households using both spraying and dusting techniques for applying chemical pesticides. The study revealed that around two-thirds of the households followed instructions like doses, application frequency, application time, and waiting period given by the Agro-vets or the extension agents while applying pesticides. Regarding personal protective measures taken by the farmers while applying pesticides, more than half (62%) of the households reported using only masks and only 38% of the households use all protective measures like gloves, boots, glass, and body cover.

Similarly, around 60% of the respondent wash their hands after applying chemical pesticides and only 40% of them take baths and change cloth after applying pesticides to their fields. This shows that there is no good handling of pesticides in Rukum west, which may be due to insufficient training and proper extension facility on the safe handling of pesticides. From the study, it had been observed that around 23% of the households applied pesticides less than three times a year. Similarly, around 67% of the households applied pesticides up to 6 times a year and around 9% of the households applied pesticides above six times a year.

A similar study performed in West Bengal, India showed covering the nose, and mouth with cloth combined with a bath after spraying was the most commonly practised (27%) personal protective measure.

Furthermore, 21.2% of farmers did not wear any protective equipment while spraying, and another 18% casually washed their clothes afterwards (Banerjee et al., 2014). This shows that there is no good handling of pesticides in Rukum west, which may be due to insufficient training and proper extension facility on the safe handling of pesticides.

A study conducted in the Bhaktapur district showed that around 75% of the households use only mask and almost 22% of the respondent use nothing while applying chemical pesticides and only 6% of the households use all the protective measures (Pudasaini et al., 2016). Additionally, the frequency of applying chemical pesticides is also high (above 8 times) in a year in comparison to west Rukum (Rani et al., 2021). This may be due to differences in farmers' perception of pest management and types of pest and pesticide use.

Table 2: Practice of Pesticides Used by the Households

Follow Instruction	Frequency	Methods of Application	Frequency
Yes	44 (73.33)	Foliar spray	33 (55)
No	16 (26.67)	Drenching	6 (10)
Personal protective measures		Both	21 (35)
Only mask	37 (62)	**Application frequency (Per year)**	
Use all protective measures	23 (38)	Below 3 times	14 (23.33)
Personal sanitation		3 to 6 times	40 (67.67)
Wash hand	35 (58.33)	Above 6 times	5 (9)
Take bath+ change cloth	25 (41.67)		

Figures in the parenthesis indicate the percentage
Source: Field survey, 2021

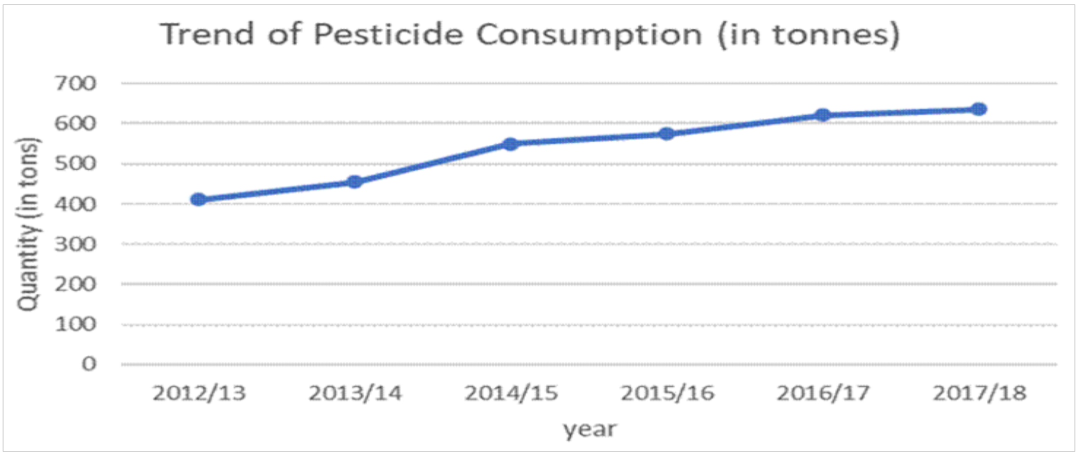

Figure 2: Trend analysis on the import and consumption of pesticides in Nepal (Source: (PQPMC, 2020)

3.5 Effects of Chemical Pesticides

The results showed that most of the farmers have experienced headaches with an index value of 0.88 followed by eye and skin irritation with an index value of 0.77 and so on. Vomiting is ranked last with an index of 0.42. However, no chronic complications such as neurological problems, cancer, or genetic disorders have been reported in any of the families. This might be due to either fewer numbers of years of pesticide application or most of the farmers do not relate different chronic effects with pesticides. Similar results were also found by Atreya (2008). Excessive and indiscriminate use of chemical pesticides not only increases the cost of production but also causes serious health problems like headache, skin irritation, vomiting, and dizziness (Sharma et al., 2012).

Similarly, a group of researchers from Ethiopia revealed that nearly 42% of farmers had never used any personal protective equipment (PPE) to protect themselves against pesticide exposure. However, no one in the households had suffered from long-term consequences such as neurological diseases, cancer, or genetic disorders. Continuous and unsystematic long-term use of chemical pesticides causes serious issues and effects on the environment, for example, degradation of the soil surface and groundwater table, crop production, micro and macro flora and fauna of terrestrial and aquatic systems (Pimentel and Burgess, 2014). The other impacts are loss of ecosystem resilience, biodiversity loss, pest resistance and resurgence, bioaccumulation, and bio-magnification of pesticides along with the tropic level (Raven et al., 2012).

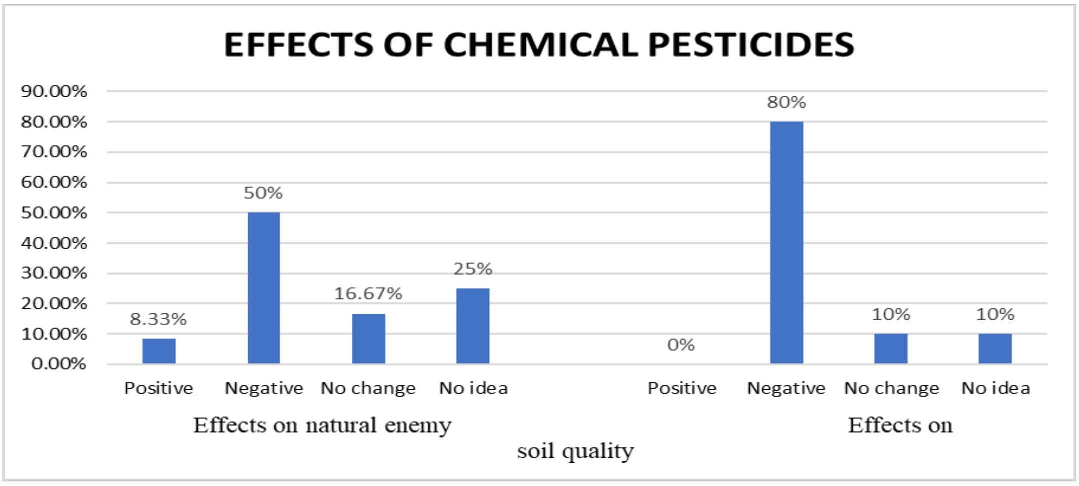

Figure 3: Effects of chemical pesticides on soil and natural enemies (Source: Field survey, 2021)

The study showed that out of 60 households 50 % of them said that there are negative effects of chemical pesticides and almost 80% of the households have experienced a negative impact on soil fertility and productivity due to the continuous application of chemical pesticides. Similarly, around 10% of the respondent do not feel any impact on soil qualities and around 25% of the households do not have any idea whether chemical pesticides affect the natural enemies or not. The difference in the perception of the farmers regarding the impact of pesticides may be due to differences in the level of education and general awareness. This is also in line with the findings (Umanath et al., 2016).

4. Farmers' Perception of Ipm Approaches

The result showed that out of 60, 60% of households had never heard about IPM and knew nothing about IPM and only 40% of the respondent has knowledge about IPM. The majority of the respondent has not taken any IPM training or any other training related to it reflecting a lack of training on IPM among vegetable growers. From the research, it has beenfound that around 58% of the respondent indicated that they incorporated at least one IPM practice. Botanical pesticides, crop mulching, and soil amendment are the most popular methods of IPM that have been used by the farmers in the study area. Similarly, the use of pheromone traps and crop rotation were the least adopted techniques due to the higher level of training and input required for the successful adoption. Figure 10 shows the percentage of households adopting five different IPM techniques. The results were also in line with the findings (Khanal et al., 2020).

4.1 Problems of Adopting IPM Techniques

The household understudy pointed to a lack of technical support for the major constraints of adoption of IPM practice with the index value of 0.87. Similarly, High costs with slow response and lack of market price for IPM products were ranked second and third most severe problems with the index value of 0.83 and 0.79 respectively. Lack of detailed knowledge of IPM was ranked as the fourth most severe problem with an index value of 0.61 whereas, no control of disease and pests was the least severe problem with the adoption of IPM practices (table 3).

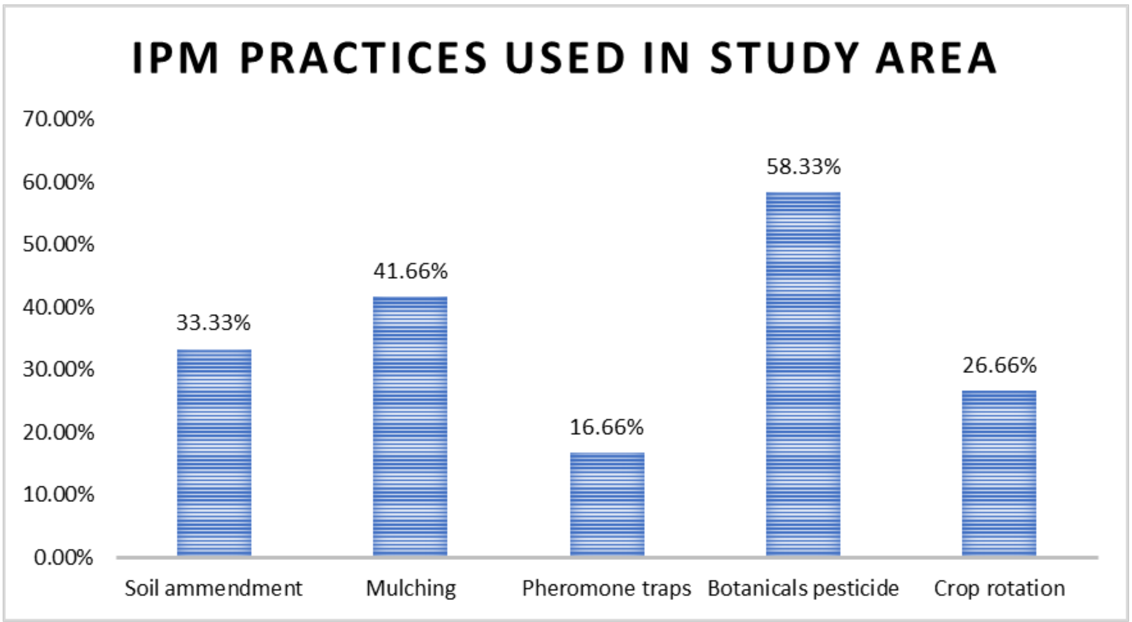

Figure 4: IPM practices used in the study area (Source: Field survey, 2021)

Table 3: Chemical Effects and Problems of Adopting IPM Practices in the Study Area

Health Problems	Index	Rank	Constraints of Adoption of IPM Technology	Index	Rank
Headache	0.883	I	Lack of technical support	0.87	I
Eye and skin irritation	0.733	II	High cost with slow response	0.83	II
Dizziness	0.516	III	Lack of market	0.79	III
Fever	0.467	IV	Lack of detailed knowledge	0.61	IV
Vomiting	0.420	V	No control of disease and pest	0.45	V

Source: Field survey, 2020

The major reason behind the adoption of IPM technology might be the easy availability and quick response of chemical pesticides and the lack of proper extension services. The result is also supported (Paudel et al., 2020). Parajuli researched upper mustang and also revealed almost the same conclusion where lack of IPM tools was ranked as the most severe problem whereas weak extension service was ranked as the least severe problem in the adoption of IPM technology (Parajuli, 2020).

4.2 Factors Affecting the Adoption of IPM Technology

A Chi-square test for independent attributes was done to determine whether different variables like gender, age group, education level of the households, land holdings, and years of vegetable farming affect the adoption of IPM technology or not. The results obtained were as shown in the table below.

The results showed that the age of the households, vegetable farming land, and years of vegetable farming have significantly affected the adoption of IPM technology. IPM practice was adopted in a high proportion in the age group between 29-47 years. This may be due to young farmers may be interested in trying out innovations in their farming activities and the farmers getting progressively may not believe in using chemical pesticides that's why they were adopting the alternative methods of pest management. Similar results were also found in organic research (Parajuli et al., 2020). Similarly, training or the extension service has been found a highly significant relation between adoptions of IPM practice which might be due to changes in farmers' perception towards pest management after getting training. This result is in line with the findings (Kafle, 2015). A study conducted among wheat growers of Iran also revealed that lack of knowledge is the key obstacle in the widespread use of IPM practices and therefore extension programmers needed to increase the knowledge level of the farmer about IPM techniques (Samiee et al., 2009). Similarly, the proportion of IPM adoption was found higher in those farmers having more than 15 years of experience in vegetable farming this may be due to old and experienced farmers were quite familiar with the practice of pesticide use and were aware of the negative impact of chemical pesticides on health and environment so they were trying to adopt the environment-friendly methods of pest management. The results are in line with the findings (Khanal et al., 2020).

On the other hand, the Gender and education level of the farmer does not have any significant association with the adoption of IPM practices. The reason might be due to less orientation of the program towards gender

roles and the educational background of the farmer. However, a study conducted in Thailand reported that the adoption of IPM was found high in females than in males. Similarly, a group of researchers from Bangladesh revealed that the Education level of the farmer has not any significant association with the adoption of IPM technology (Gautam et al., 2017). This finding is in contradiction with the findings of Korir (2015) where knowledge levels of the farmers have positive effects on the adoption of IPM technology.

Table 4: Statistical Analysis of Factors Affecting the Adoption of IPM Technology

Age Group	**Overall n=60**	**IPM Adoption**		**Chi-Square Value**
		Yes (n=18)	No (n=42)	
Below 29 year	13 (21.67)	7 (38.89)	6 (14.28)	8.772* (df=2 p=0.012
29 to 47	37 (61.67)	6 (33.33)	31 (73.80)	
Above 47	10 (16.67)	5 (27.78)	5 (11.90)	

Vegetable Farming Land area	**Overall n=60**	**IPM Adoption**		**Chi Square Value**
		Yes (n=18)	No (n=42)	
Below 5 *Ropani*	6 (10)	1 (5.56)	5 (11.90)	6.65 * (df=2 p=0.035
5 to 13 *Ropani*	39 (65)	16 (88.89)	23 (54.76)	
Above 13 *Ropani*	15 (25)	1 (5.56)	14 (33.33)	

EducationLlevel	**Overall n=60**	**IPM Adoption**		**Chi Square Value**
		Yes (n=18)	No (n=42)	
Primary level	10 (16.67)	4 (22.22)	6 (14.28)	1.984^{ns} (df=2 p=0.37
Secondary level	41 (68.33)	10 (55.56)	31 (73.80)	
University level	9 (15)	4 (22.22)	5 (11.90)	

Training Received	**Overall n=60**	**IPM Adoption**		**Chi Square Value**
		Yes (n=18)	No (n=42)	
Yes	17 (40)	11 (61.11)	6 (14.28)	13.60*** df=1 p=0.0002
No	43 (60)	7 (38.88)	36 (85.71)	

Year of Vegetable farming	**Overall n=60**	**IPM Adoption**		**Chi-Square Value**
		Yes (n=18)	No (n=18)	
Below 7 years	7 (11.67)	1 (5.56)	6 (14.28)	7.82* (df=2 p=0.020
7 to 15 years	41 (68.33)	12 (66.67)	29 (69.04)	
Above 15 years	12 (20)	5 (27.78)	7 (16.67)	

Note: Figure in parenthesis indicates the percentage and * indicates significant at 5% level of significance and ns indicates non-significant at 5% level of significance

The results showed that the age of the households, vegetable farming land, and years of vegetable farming have significantly affected the adoption of IPM technology. IPM practice was adopted in a high proportion in the age group between 29-47 years. This may be due to young farmers may be interested in trying out innovations in their farming activities and the farmers getting progressively may not believe in using chemical pesticides that's why they were adopting the alternative methods of pest management. Similar results were also found in organic research (Parajuli et al., 2020). Similarly, training or the extension service has been found a highly significant relation between adoptions of IPM practice which might be due to changes in farmers' perception towards pest management after getting training. This result is in line with the findings (Kafle, 2015). A study conducted among wheat growers of Iran also revealed that lack of knowledge is the key obstacle in the widespread use of IPM practices and therefore extension programmers needed to increase the knowledge level of the farmer about IPM techniques (Samiee et al., 2009). Similarly, the proportion of IPM adoption was found higher in those farmers having more than 15 years of experience in vegetable farming this may be due to old and experienced farmers were quite familiar with the practice of pesticide use and were aware of the negative impact of chemical pesticides on health and environment so they were trying to adopt the environment-friendly methods of pest management. The results are in line with the findings (Khanal et al., 2020).

On the other hand, the Gender and education level of the farmer does not have any significant association with the adoption of IPM practices. The reason might be due to less orientation of the program towards gender roles and the educational background of the farmer. However, a study conducted in Thailand reported that the adoption of IPM was found high in females than in males. Similarly, a group of researchers from Bangladesh revealed that the Education level of the farmer has not any significant association with the adoption of IPM technology (Gautam et al., 2017). This finding is in contradiction with the findings of Korir (2015) where knowledge levels of the farmers have positive effects on the adoption of IPM technology.

5. Conclusion

The local farmers had moderate level of knowledge about diseases and insects preveling in vegetable crops. Around two-thirds of the households had not been following the instruction and proper safety measures while applying pesticides. Malathion, Mancozeb, Spinosad, Carbendazim, and Chlorpyriphos were some of the major pesticides used in the study area. Regarding the adoption of IPM practice, only one-third of the farmers follow Integrated Pest management among which most of the farmers prefer botanical pesticides whereas Pheromone traps were the least preferred. Local people had perceived the importance of organic agriculture. They were aware of sustainable production due to less use of chemicals in their field. Age group, land holdings, experience in vegetable farming, and training had a significant effect on the adoption of IPM in comparison to gender and education level of the farmer. The government and I/NGO programs related to IPM had moderate positive impact on pest management practices adapted by people of Karnali province of Nepal.

Recommendation and Suggestion

Farmers should be made aware of the consequences due to the misuse of chemical pesticides on personal health and the environment. Farmers should also require training on how to apply insecticides safely. A training package regarding IPM with community participation should be developed to ensure the effectiveness of the IPM approach as well as to reduce pesticide use. As research regarding extent of damage caused by insect pests to the vegetable has not been made in the present study, new researchers are recommended to conduct future detailed study with sufficient time and space in this field.

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