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KNOWLEDGE OF VEGETABLE GROWERS ABOUT THE SIDE EFFECTS OF PESTICIDE USE IN RUPANDEHI DISTRICT OF NEPAL

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ABSTRACT
Pesticides are widely used among farmers, so their adequate knowledge of pesticides is crucial. This study aims to assess the knowledge about side-effects of pesticide use among vegetable growers, factors affecting their knowledge, major pesticides used, and safe handling procedures followed by them. A total of 60 vegetable growers from the Rupandehi district were selected randomly and interviewed using a semi-structured questionnaire. Results showed that the majority (98.3 percent) of growers were aware of the side effects of pesticides. However, fewer i.e., 21.7 and 25 percent were known about the types of pesticides and banned pesticides respectively. Age, education level, involvement in the organization, extension services, and training were the major factors found to affect the knowledge of farmers significantly where only 26.7 percent of growers were found to receive training on pesticide use. Chemical pesticides were the primary choice of over 85 percent of growers for pest management where Emamectin benzoate was the most purchased pesticide. A significant relation was found between the safe handling procedures adopted by vegetable growers and the health issues experienced by them. Mask was the most used personal protective equipment, i.e. by 91.7 percent while only 25 percent of respondents have experienced health issues, headache being a major acute symptom. This study highlighted a need for effective training, programs, and policies regarding the safe use of pesticides at the farmers' level, strong legislative measures to avoid entrance of banned, highly hazardous, and outdated pesticides.

KEY WORDS
Pesticide, knowledge, vegetable growers, side-effects, training.

Agriculture is the backbone of the Nepalese economy that contributes 26.98% of the nation's GDP (MOALD, 2020). Nepalese people engaging in agriculture as a primary occupation is 65.6% of the total population (CBS, 2013). Vegetables and nurseries share about 9.71% of the total Agricultural Gross Domestic Product (AGDP) (MOAD, 2015). Worldwide, above 45% of loss in crops is due to pest infestation (Abhilash & Singh, 2009). Pesticides have been an integral part of the process by reducing losses from the weeds, diseases, and insect pests that can markedly reduce the amount of harvestable produce (Aktar, Sengupta, & Chowdhury, 2009). They include insecticides, fungicides, herbicides, nematicides, acaricides, rodenticides, and molluscicides. WHO classified them into 4 classes: extremely dangerous, highly dangerous, moderately dangerous, and slightly dangerous based on their toxicity level (WHO, 2009). The worldwide consumption of pesticides is about two million tons per year, of which 24% is consumed in the USA alone, 45% in Europe, and 25% in the rest of the world (Abhilash & Singh, 2009).

The domestic consumption of pesticides in Nepal is very low i.e., 0.396 kg a.i./ha (PPD, 2018). The trend of pesticide use in Nepal is increased by 10 to 20% and this expense is one of the major factors in increasing the cost of fruits and vegetables (Diwakar, Prasai, Pant, & Jayana, 2008). More than 90 % of the pesticides imported in the country are used in vegetable farming (Atreya & Sitaula, 2011). Fungicides remain the most imported as well as mostly consumed pesticide in terms of quantity i.e., more than 48 % of the pesticides (PRMS, 2012). Till now, 24 most hazardous pesticides have been banned in Nepal (MOALD, 2020).

Due to easy availability, quick response, and preference of consumers to visually appealing products, the use of chemical pesticides is popular among farmers (Bhandari, Paneru, Pandit, Rijal, Manandhar, & Ghimire, 2020). The majority of the farmers are not aware of the different types of pesticides, safety precautions, its hazardous level on the health of the consumer and environment (Yassin, Mourad, & Safi, 2002). Less than 0.1% of pesticides applied for pest control reach their target pests and more than 99.9% of pesticides used move into the environment where they adversely affect public health and beneficial biota and contaminate soil, water, and the atmosphere of the ecosystem (Pimentel, 1995). Pesticides cause human health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive harm, and endocrine disruption due to inappropriate use and handling of pesticides by inadequately trained farm workers (Jagdisbhai, 2015). Pesticide safety education is necessary to induce protective behavior among agricultural workers (Salameh, Baldi, Brochard, & Saleh, 2004).

Rupandehi district is one of the major vegetable production areas and pesticides were used excessively by the farmers for vegetable production (Sapkota, 2019). The majority of farmers in Rupandehi had a low level of awareness regarding the health effects of pesticide use (Gurung & Kunwar, 2017). This study assesses the status of pesticide use, farmer's knowledge about the side effects of pesticides and factors affecting it, health issues experienced by them, and the safety precautions applied in the Rupandehi district.

MATERIALS AND METHODS OF RESEARCH

The study was carried out in the Rupandehi district, located in the terai region of Nepal and lies in Lumbini Province. Prime Minister Agriculture Modernization Project (PMAMP) was launched in 2016, with the objective of specialized production (DVN, 2018). The study area includes Tikuligadh village of Tilottama municipality ward no. 14 of Rupandehi district which was declared as a vegetable block in 2019 and started to work as one of the programs of PMAMP for vegetable production (Figure 1).

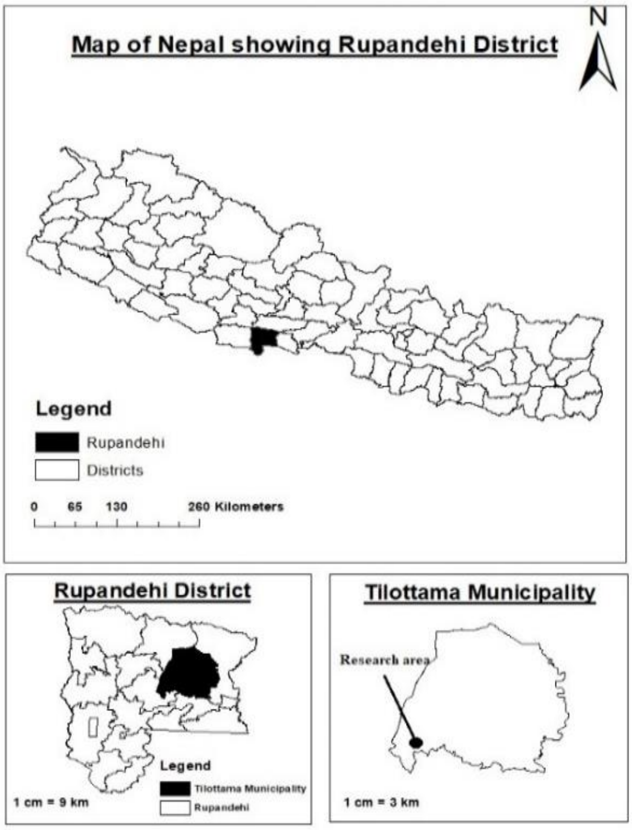

Figure 1 – Study area: Tikuligadh, Tilottama Municipality

A total of 60 vegetable growers were selected based on simple random sampling and interviewed using the semi-structured type of questionnaire considering the purpose of the study as well as the availability of resources and time frame of the study. The vegetable growers using pesticides were the targeted population of the study.

Research instruments include Preliminary Field Visits, Pre-testing of interview questionnaires, Household interview / Field survey, Key informant interview (KII), and Focus group discussion (FGD). Data were obtained from primary sources and secondary sources.

The dependent variable in this study was the knowledge of the vegetable growers about the pesticide that includes knowledge about different types of pesticide, botanical pesticides, banned pesticides, waiting period of vegetables, awareness about the negative effects (side-effects) of pesticides, read/see hazard label of pesticides, read, understand and follow literature present in pesticide container, and think pesticide indispensable for crop yield.

All these variables were dummy variables i.e., those who have the knowledge or are aware were coded with yes (1) and those who didn't know were coded as no (0).

The age group was categorized into 3 groups; ≤42 years old, 43-59 years old, and >59 years old using statistical tool percentiles. Education level was categorized into illiterate, primary level, and secondary level. The landholder category was categorized into smallholder and large holder using the statistical tool (median). The occupation was categorized into 3 groups namely farming only, farming and animal husbandry, and farming, animal husbandry, and services. The dummy variable was assigned for the involvement in the organization, yes (1) for membership, and no (0) for non-membership. Those respondents who are accessed to extension services and training in time-related to vegetable production or pesticide use were assigned with yes (1) and those not getting access were assigned with no (0). The respondents were categorized into 4 groups having an interval of 10 years each based on the years they have been using pesticides.

The data were coded, entered, and analyzed using MS-Excel and Statistical Package for Social Science (SPSS) program (Version 25.0). Descriptive statistics and frequency distribution analysis were used to describe socio-demographic parameters. Chi-square test was used to determine the association between socio-demographic characters, extension services, the pesticide used years with knowledge, and perception of vegetable growers.

Preferential ranking of health issues experienced by vegetable growers was done by indexing. Qualitative data are taken into account and based on the respondent frequencies; weighted indexes were calculated. Different health issues which were most experienced were ranked by a 7-point scale using scores; 1, 0.86, 0.71, 0.57, 0.43, 0.29, and 0.14. The formula given below was used to find the index:

$$I\ imp = \sum S_i F_i / N$$

Where: I imp = index of importance; ∑ = summation; Si = ith scale value; Fi = Frequency of ith importance given by the respondents; N = total number of respondents.

RESULTS AND DISCUSSION

Most of the respondents (35%) were in the young age group of ≤42 years. A majority (67%) had a secondary level of education followed by primary (27%), undergraduate (3%), and the remaining 3% were illiterate. The average landholding was 36.05 kattha and the mean area under vegetable farming was 12.18 kattha where 52% were large holders (≥10 kattha) and 48% were smallholders (<10 kattha). Most (91.7%) of the respondents were involved in at least one organization, farmers club being the major (83.3%). The majority (96%) were engaged in farming along with animal husbandry. The major involvement of females was seen in the harvesting of agricultural produce whereas that of the male was found in the application of pesticides.

The majority of respondents (86.7%) were found to have access to extension services in time, more access being in services related to vegetable farming as compared to pesticide use and the major source of service as government extension and community-based organizations (CBOs) respectively. Training on vegetable farming (68.3%) was found higher in comparison to training on pesticide use (26.7%) which shows a lack of adequate information on pesticide use.

The majority of the respondents (95%) usually purchase pesticides from the agro vet which was reported as the major source of information about pesticide application and its dose. This indicates that agro vet being the farmers' dominant source of technical guidance. A study (Rijal, Malla, Tiwari, Rawat, & GC, 2006/8) also reported that the agro vets were the primary source of information regarding selection and other information on pesticide use. Most of the respondents (98.3%) sprayed pesticide only after the damage by the insect. About 88% of the respondents reported evening time as an appropriate time for application where all apply pesticides by spraying technique. About 25% of respondents have been using pesticides for 0 to 9 years, 35% for 10 to 19 years, 20% for 20 to 29 years, and 20% for more than 30 years. Most of the pesticide is applied in spring vegetables such as cowpea, okra, brinjal, etc.

Chemical pesticide was found to be the primary choice of 85% of respondents over the biological pesticide. Most insecticides were purchased among which Emamectin benzoate was bought by 78.3% of respondents. The majority of pesticides consumed were of the yellow label and liquid formulation (Table 1). A similar finding was reported in Dhading, Nepal in which insecticides were identified as the major form of pesticides used by the farmers (Bhandari, Paneru, Pandit, Rijal, Manandhar, & Ghimire, 2020).

Table 1 – Major pesticides used in vegetables in the study area

Name of Pesticides	Frequency (%)	Recommended dose (ml or gm /l)	Used dose (ml or gm/l)
Insecticides			
Emamectin benzoate	47 (78.3)	0.4	0.36
Chlorpyrifos + cypermethrin	45 (75)	2	1.47
Dichlorvos	8 (13.3)	2	2.15
Imidacloprid	17 (28.3)	0.5	0.58
Cartap hydrochloride	10 (16.7)	2	1.15
Chlorantraniliprole	8 (13.3)	1	0.57
Fungicide			
Mancozeb	5 (8.3)	2.5	1.84
Herbicide			
Quizalofop-ethyl	9 (15)	2.5	2.53

Source: Field survey 2020. The figure in parentheses indicates the percentage.

More than half of the respondents (63.33%) experienced medium (25-50%) levels of disease, insect, and pest infestation. Among different forms of pests, insects caused the highest damage (78.3%) followed by diseases (11.7%), weeds (6.7%), and rodents (3.3%).

Table 2 – Ranking of health issues experienced by respondents after pesticide application

Symptoms	The intensity of health issues							Total	Index	Rank
	1	0.86	0.71	0.57	0.43	0.29	0.14			
Headache	9	2	3	1	0	0	0	15	0.89	I
Nausea	0	1	1	0	1	9	3	15	0.34	VI
Vomiting	0	1	1	0	0	1	12	15	0.24	VII
Skin Itching	6	5	3	1	0	0	0	15	0.87	II
Eye rashes	0	1	0	6	5	3	0	15	0.49	IV
Irritation of nose and throat	0	5	7	1	2	0	0	15	0.71	III
Dizziness	0	0	0	6	7	2	0	15	0.47	V

Source: Field survey, 2020.

Only 25% of respondents were found to experience health issues. The major acute symptoms with their frequency reported by them are ranked in Table 2. Scoring was given as 1=most experienced, 0.86= most to moderate, 0.71= moderately experienced, 0.57= moderate to little experienced, 0.43= little experienced, 0.29= very little experienced and

0.14= not so experienced. Headache (I=0.89) seemed to be the major problem among the farmers in the study area. A similar finding of headache as the most common health problem was reported in Dhading, Nepal (Bhandari, Paneru, Pandit, Rijal, Manandhar, & Ghimire, 2020).

All the respondents (100%) were found to practice at least chemical method for pest management practices among which 66.7% used chemical method only, 11.7% used chemical along with botanical method, 20% used chemical along with mechanical method and 1.7% used all chemical, mechanical and botanical method. A similar finding was reported in a study in Chitwan (Rijal, Regmi, Ghimire, Puri, Gyawaly, & Poudel, 2018) in which the majority of the farmers used chemical pesticides and a negligible number used other methods for insect pest control.

Pesticide handlers should know all potential hazards of the chemical pesticides and should wear appropriate, leak-proof, and well-maintained protective equipment (Rijal, Regmi, Ghimire, Puri, Gyawaly, & Poudel, 2018). A study showed that about 30% of vegetable farmers in Nepal do not use any form of PPE (Koirala, Tamrakar, Bhattarai, Yadav, Humagain, & GC, 2010). Mask was mostly used PPE by 91.7% of the respondents. More than 90 % of the respondents were found to follow the cleanliness procedures after the pesticide application. All these safety measures were found significant with the experienced health issues (Table 3).

Table 3 – Safe handling procedures taken during pesticide application in the study area and its relation with experienced health issues

Category	Frequency		Chi-square value
	Yes	No	Experienced health issues
Use masks	55 (91.7)	5(8.3)	16.364*** (0.00)
Use gloves	40 (66.7)	20 (33.3)	25.6*** (0.00)
Wash your body after spray	58 (96.7)	2 (3.3)	6.207** (0.013)
Wash your clothes after spray	56 (93.3)	4 (6.7)	5.714** (0.017)
Clean spraying equipment after use	59 (98.3)	1 (1.7)	3.051* (0.081)

*Source: Field survey 2020. Values in parenthesis represent p-value and *, **, *** represent level of significance at 10%, 5% and 1% respectively (df=1).*

More than 90 % of respondents knew about the negative effects of pesticides on human health and the environment. About 80 % of respondents have heard about botanical pesticides and see, read the pesticides label while buying them but only 46.7% read, understand, and follow the literature given with pesticide containers. This was per the national scene where the majority of respondents were about the negative effects of pesticides and also the majority of respondents were familiar with botanical pesticides (PPD, 2018). Only 21.7 % of respondents knew about different types of pesticides and only 25% knew about banned pesticides (Table 4).

Table 4 – Knowledge of vegetable growers about the pesticides in the study area

Descriptive	Frequency	
	Yes	No
Know different types of pesticide	13 (21.7)	47 (78.3)
Aware of the negative effects of pesticide	59 (98.3)	1 (1.7)
Know agrochemicals can contaminate vegetables	59 (98.3)	1 (1.7)
Heard about botanical pesticides	48 (80)	12 (20)
See, read pesticides label while buying pesticides	49 (81.7)	11 (18.3)
Read, understand and follow the literature given with pesticide container	28 (46.7)	32 (53.3)
Know about the waiting period of vegetables	43 (71.7)	17 (28.3)
Know that pesticides affect soil	58 (96.7)	2 (3.3)
Know pesticides affects water	58 (96.7)	2 (3.3)
Know pesticides affect human health	59 (98.3)	1 (1.7)
Know banned pesticides	15 (25)	45 (75)

Source: Field survey 2020. The figure in parentheses indicates the percentage.

The majority (71.7%) of the respondents perceive that the pesticide goes to the plant after spraying. About 58% perceive that the improper and excessive use of pesticides results in both health issues and degradation of the environment, 65% sprayed by mixing chemicals, none of them store mixed chemicals, and 70% of respondents think pesticide indispensable for crop yield (Table 5).

Table 5 – Perception of vegetable growers towards different aspects of pesticide use

Descriptive	Frequency	Percent (%)
Pesticide goes where after spraying		
Air	6	10
Plant	43	71.7
Human	2	3.3
Do not know	9	15
Result of improper and excessive use of pesticides		
Health issues	22	36.7
Degrade environment	2	3.3
Both	35	58.3
Do not know	1	1.7
Consider wind direction during application	60	100
Spray by mixing pesticides	39	65
Store mixed chemicals	0	0
Thinks pesticide indispensable for crop yield	42	70

Source: Field survey 2020.

The major factors leading to increased use of chemical pesticides over biological pesticides were easy to use and easily available which was reported by 56.7% of the respondents. A study in Rupandehi (Bhandari G. , 2014) found that easy access to pesticides due to the location of the district near the border between Nepal and India has encouraged individuals to depend on chemicals instead of organic manure.

A Chi-square test was performed to test the independence of the dependent variables with independent variables. The result of the test is mentioned in Table 6 and Table 7.

Table 6 – Association between dependent and independent variables using chi-square test

Chi-square test				
Variables	Know types of pesticide	Aware of negative effects	Know about botanical pesticides	Know waiting period
Age group	3.292(0.193)	2.034(0.362)	0.516(0.773)	0.406(0.816)
Education level	1.448 (0.694)	0.508 (0.917)	2.344 (0.504)	8.167**(0.043)
Landholder category	2.050 (0.152)	0.951 (0.329)	0.601 (0.438)	0.202 (0.653)
Involvement in organization	1.509 (0.219)	0.092 (0.761)	5.455**(0.020)	2.694 (0.101)
Occupation	4.519 (0.104)	0.471 (0.790)	0.862 (0.650)	1.939 (0.379)
Extension services	0.457 (0.499)	0.156 (0.692)	1.767 (0.184)	5.307**(0.021)
Training on vegetable farming	0.566 (0.452)	0.471 (0.492)	8.492***(0.004)	8.085***(0.004)
Training on pesticide use	3.223*(0.073)	0.370 (0.543)	2.578 (0.108)	2.694 (0.101)
Pesticide used years	5.050 (0.168)	1.889 (0.596)	0.804 (0.849)	2.251 (0.522)

*Note: Values in parenthesis represent p value and *, **, *** represent level of significance at 10%, 5% and 1% respectively.*

From Tables 6-7, the association between the age group and read, understand, and follow literature was found statistically significant (P<0.01) but found an insignificant association with others aspects of knowledge. In a study of South Gujarat ((Jagdisbhai, 2015), it was found that the age group had an insignificant influence on the knowledge of farmers.

The results signify that the education level had a positively significant (P<0.05) impact on knowledge about the waiting period, read, understand and follow the literature. Better educated farmers were found to spray less (Khan, Mahmood, & Damalas, 2015) as they have more knowledge about pesticide use.

The result showed that there is no statistically significant association between the knowledge of respondents and the landholder category. A similar finding was reported in a study of Pakistan (Khan, Mahmood, & Damalas, 2015) in which farm size was found to be insignificant with knowledge and the probability of pesticide overuse.

The result showed that the association between knowledge about botanical pesticides and involvement in the organization was found statistically significant (P<0.05). The association between social participation and knowledge of farmers was found positive and significant in a study of South Gujarat (Jagdisbhai, 2015).

Table 7 – Association between dependent and independent variables using the chi-square test

Chi-square test				
Variables	Read/see hazard label	Read, understand and follow the literature	Know banned pesticides	Think pesticide indispensable for crop
Age group	0.361(0.835)	9.361***(0.009)	0.033(0.983)	1.861(0.394)
Education level	2.978 (0.395)	9.375**(0.025)	1.467 (0.690)	5.238 (0.155)
Landholder category	0.208 (0.648)	1.721 (0.190)	0.556 (0.456)	1.681 (0.195)
Involvement in organization	1.224 (0.268)	0.097 (0.755)	1.818 (0.178)	2.338 (0.126)
Occupation	0.142 (0.931)	2.048 (0.359)	4.132 (0.127)	5.962*(0.051)
Extension services	2.265 (0.132)	1.741 (0.187)	3.077*(0.079)	0.110 (0.740)
Training on vegetable farming	3.258*(0.071)	2.543 (0.111)	5.777**(0.016)	5.021**(0.025)
Training on pesticide use	2.128 (0.145)	14.616***(0.00)	4.091**(0.043)	1.964 (0.161)
Pesticide used years	3.499 (0.321)	5.883 (0.117)	1.676 (0.642)	4.751 (0.191)

*Note: Values in parenthesis represent p value and *, **, *** represent level of significance at 10%, 5% and 1% respectively.*

The association between the belief of pesticide as indispensable for crop yield and occupation was found statistically significant (P<0.1).

In a study of South Gujarat (Jagdisbhai, 2015), extension contact and knowledge of farmers were found positively and significantly associated and correlated. Likewise, the result showed that the knowledge about the waiting period (P<0.05) and knowledge about banned pesticides (P<0.1) with access to extension services were found statistically significant.

The training on vegetable farming had a positively significant impact on knowledge about botanical pesticides (P<0.01), knowledge about waiting period (P<0.01), knowledge about banned pesticides (P<0.05), the belief of pesticide as indispensable for crop yield (P<0.05), and read/see hazard label (P<0.1).

The training on pesticide use had a positively significant impact on knowledge about different types of pesticide (P<0.1), read, understand, and follow literature given with pesticide container (P<0.01), and knowledge about banned pesticides (P<0.05).

The result showed that there is no significant association between pesticide used years and the knowledge of respondents.

CONCLUSION

The study found that most of the vegetable growers' have limited knowledge on pesticide types, banned pesticides, and overall handling procedures. Although most of them are aware about the negative effects of pesticides on human health and the environment, they seem to use them often. Even though masks and gloves were common PPE used by the respondents, the safety measures used by them were not satisfactory. Improper handling and indiscriminate use of pesticides can increase the health risk to both producers and consumers. As a pest management strategy, insecticides were mostly used without considering the beneficial natural enemies. Along with the age and education level of vegetable growers, the more their active participation in the organization, extension services, and training, the more they know about pesticides. So, wider extension and dissemination programs via trainings and workshops are a dire need to raise the awareness level of vegetable growers. The influence of the government extension program on training related to pesticide use appears insufficient, and growers solely depend on the agro vet for technical guidance. An intensive package regarding Integrated Pest Management (IPM) should be implemented and widely disseminated to reduce the use of chemical pesticides. Understanding the farmers' local situation, they should be educated on several aspects of pesticide use, disposal, and consequences of improper and illegal use through different training at both national and local levels.

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REFERENCES

1. Abhilash, P. C., & Singh, N. (2009). Pesticide use and application: An Indian scenario. Journal of Hazardous Materials , 165(1-3), 1-12.
2. Aktar, M. W., Sengupta, D., & Chowdhury, A. (2009). Impact of pesticides use in agriculture; their benefits and hazards. Interdisciplinary Toxicology , 2(1), 1-12.
3. Atreya, K., & Sitaula, B. (2011). Mancozeb: Growing risk for agricultural communities. Himalayan Journal of Sciences , 6 (8), 9-10.
4. Bhandari, G. (2014). An Overview of Agrochemicals and Their Effects on Environment in Nepal. Applied Ecology and Environmental Sciences , 2, 66-73.
5. Bhandari, S., Paneru, S., Pandit, S., Rijal, S., Manandhar, H. K., & Ghimire, B. P. (2020). Assessment of pesticide use in major vegetables from farmers' perception and knowledge in Dhading district, Nepal. Journal of Agriculture and Natural Resources , 3 (1), 265-281.
6. CBS. (2013). National sample census of agriculture Nepal, 2011/12. Kathmandu: Central Bureau of Statistics (CBS), National Planning Commission, Government of Nepal.
7. Diwakar, J., Prasai, T., Pant, S. R., & Jayana, B. L. (2008). Study on Major Pesticides and Fertilizers used in Nepal. Scientific World , 6 (6), 76-80.
8. DVN, D. V. (2018). Inter Provincal Dependency for Agricultural Development. Department of Agriculture.
9. Gurung, S., & Kunwar, M. (2017). Awareness regarding health effects of pesticides use among farmers in a municipality of rupandehi district. Journal of Universal College of Medical Sciences , 5 (2), 18-21.
10. Jagdisbhai, D. A. (2015). Knowledge of Vegetable growers about the side effects of Pesticides in Tapi district of South Gujarat. Navsari Agricultural University, Extension Education. Navsari: Navsari Agricultural University.
11. Khan, M., Mahmood, H. Z., & Damalas, C. A. (2015). Pesticide use and risk perceptions among farmers in the cotton belt of Punjab, Pakistan. Elsevier , 67, 184-190.
12. Koirala, P., Tamrakar, A. S., Bhattarai, B. P., Yadav, B. K., Humagain, S., & GC, Y. D. (2010). Use and Handling Practice of Pesticides in Vegetables: A Case Study on Some Selected Districts of Nepal. Journal of Food Science amd Technology Nepal , 6, 105-109.
13. MOALD. (2020). Krishi Diary. Hariharbhawan, Lalitpur: GoN, MoAD, Agriculture Information and Communication Centre, Hariharbhawan, Lalitpur.
14. Pimentel, D. (1995). Amounts of Pesticides Reaching Target Pests: Environmental Impacts and Ethics. Journal of Agricultural and Environmental Ethics , 8 (1), 17-29.

15. PPD. (2018). Final Report on Study on National Pesticide Consumption Statistics in Nepal. Department of Agriculture, Pesticide Registration and Management Section. Harihar Bhawan, Lalitpur: Government of Nepal, MOAD.
16. PRMS. (2012). Pesticide Statistics Booklet (in Nepali Pesticide Registration and Management Section (PRMS). Ministry of Agriculture Development.
17. Rijal, J. P., Regmi, R., Ghimire, R., Puri, K. D., Gyawaly, S., & Poudel, S. (2018). Farmers' Knowledge on Pesticide Safety and Pesticide Safety and Pest Management Practices: A Case Study of Vegetables Growers in Chitwan, Nepal. Agriculture .
18. Rijal, J., Malla, R. K., Tiwari, S., Rawat, P. R., & GC, Y. D. (2006/8). A preliminary study on the practices of insect pest management at Sukranagar VDC, Chitwan. Proceedings of National IPM Workshop of Plant Protection Society of Nepal , 25, 297-307.
19. Salameh, P. R., Baldi, I., Brochard, P., & Saleh, B. A. (2004). Pesticides in Lebanon: a knowledge, attitude and practice study. Environmental Research , 94 (1), 1-6.
20. Sapkota, R. (2019). Banned pesticides are widely used in Nepal. Himal Khabarpatrika.
21. WHO. (2009). The WHO Recommended Classification of Pesticides by Hazard and guidelines to classification. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/44271/9789241547963_eng.pdf?sequence=1&isAllowed=y
22. Yassin, M. M., Mourad, T. A., & Safi, J. M. (2002). Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. Occupational and Environmental Medicine , 59 (6), 387-393.