International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Occupational Health Hazards of Pesticides Use among Commercial Vegetable Farmers of Kirtipur Municipality, Kathmandu

Saguna Thapa[1], Ashok Kumar Paudel[2], Alisha Basnet[3], Bindu Kumari Rokaya[4], Samiran Kafle[5]

[1]Department of Public Health, Manmohan Memorial Institute of Health Sciences, Nepal
[2,3,4,5]Department of Research and Development, National Open College, Nepal, Department of Public Health, Manmohan Memorial Institute of Health Sciences, Nepal

Abstract

Background: Occupational health and safety are the integral components of the general concepts of health. In Nepalese context, misuse of pesticides have been observed and practiced in several ways. Nepalese farmers use too much pesticide than needed with too little protection when using pesticides due to which many accidental poisonings occur annually. This study aims to assess the occupational health hazards related to pesticide use among commercial vegetable farmers of Kirtipur Municipality, Kathmandu.

Methodology: A community-based cross-sectional study was conducted among 107 randomly selected commercial vegetable farmers in Kirtipur Municipality of Kathmandu by using semi-structured questionnaire. Data were collected using face to face interview method. The questionnaire included socio-demographic characters, pesticide use practices, storage and disposal techniques and health effects among the farmers. Data were entered in Epidata and then analyzed in SPSS version 21. Frequency, percentage, mean, and standard deviation were calculated to measure the practice of pesticide use and occupational health hazards related to pesticide use among farmers.

Result: The study is comprised of 52% male and 48% female. About 89% of farmers were wearing Personal Protective Equipment (PPE) during spraying of pesticides. Maximum numbers of farmers changed clothes and took a bath right after the application of pesticide i.e. 87% and 88% respectively. Almost half of the vegetable farmers (45.1%) used burn method for disposal of empty pesticide containers. However, 45.6% of the respondents experienced health problems within 48 hours of pesticide application.

Conclusion: The study concluded that almost half of the pesticide users had shown various symptoms of health hazards. Unsafe equipment and condition, inadequate training, limited availability and use of PPE all contributed to the health hazards of pesticide users.

Keywords: Pesticides, Vegetable farmers, Personal Protective Equipment, Health hazards, Public Health

1. Introduction

The general health of the people is related with occupation in which they are engaged. Occupational health and safety are the integral components of the general concepts of health. The World Health Organization

(WHO) states occupational health as "an area of work in public health to promote and maintain highest degree of physical, mental and social well-being of workers in all occupations". Occupational health issues are often given less attention than occupational safety issues. However when health is addressed, so is safety because a healthy workplace is also a safe workplace. Both health and safety must be addressed in every workplace. Occupational health in agriculture sector is a new concept. According to the International Labor Organization (ILO, 2006) the agricultural sector is one of the most hazardous to health worldwide (1). Agriculture workers have a multitude of health problems which may be zoonotic, physical hazards, respiratory disease, accidents and toxic hazards.

Pesticide is any material designed to stop, eliminate, or manage any pest, including human or animal vectors that harm or obstruct the production, processing, storage, transportation, or marketing of food, agricultural products, animal feed products, or substances that can be given to control insects, arachnids, or other pests (2). About two million tons of pesticides are used globally among which 45 %, 24% and remaining 25% are consumed in Europe, USA and in the rest of the world respectively and this use is in increasing trend (3; 4). Pesticide use in agriculture has been preferred form of pest control strategy since 1950s in Nepal (5). The major pesticides used in Nepal are organochlorines, organophosphates, carbamates and some synthetic pyrethroids (6). There is a five-fold increase in pesticides import from 132 tons in 2007-08 to 635 tons in 2017-18 in Nepal (6). The average use of pesticide in Nepal was 142g/ha which is now increased to 396 g/ha but a much greater use of pesticide i.e. (1600 g/ha) is used in commercial vegetable production (6). 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 (7).

The ill effect of pesticide on human health and environment is barely realized and is greatly undermined. Pesticide misuse has become the serious problem throughout the world, in agriculture as well as in public health sector. The World Health Organization reported 30 million cases of pesticides poisoning in the developing countries per year with 220,000 deaths (6). Various studies have warned against the high risk of poisoning, abortion, dermal and nervous system complications, cancer, and even mortality related to pesticide use (8). Similarly in developing regions of South –East Asia, about 25 million cases of mild pesticides poisoning occur annually among agricultural workers (4). The series of problems could inauspiciously emerge as we continue to make use of modern agronomic practices combined with wider use of pesticide (9). Because of the hot and humid conditions in South –East Asia region, most farmers and pesticide applicators do not use proper protective gear, leading to exposure to the hazards of pesticide poisoning (10). Furthermore, in the Nepalese context, misuse of pesticides have been observed and practiced in several ways. Nepalese farmers use too much pesticide than needed with too little protection when using pesticides due to which many accidental poisonings occur annually. Unsafe equipment and conditions, inadequate training and limited availability and use of personal protective equipment all contribute to pesticide related health hazards (11).

Most of the hilly rural areas of Nepal still lack effective environment and policy programs for the assessment of farmers' knowledge, attitude, and practices of pesticide use (12). Farmers are less aware of the risk and rarely follow proper safety procedures while using pesticides due to limited training and education programs by industry and government for safe use (12). The widespread misuse and consequence of pesticides suggested the need for more research, better instruction, and more effective control (12) .Even though most of people from Kathmandu are not working as commercial vegetable farmers due to the dense urbanization and population structures, most of the people from Kirtipur

Municipality, Kathmandu, however, are still involved in agriculture. Furthermore, very limited studies have been performed among the commercial farmers from Kathmandu on occupational health hazards and pesticides. Therefore, this research aims to identify the various occupational health hazards related to pesticide use among commercial vegetable farmers of Kirtipur Municipality, Kathmandu.

2. Methodology

The community based Cross Sectional Study was conducted among the commercial vegetable farmers who were registered in agriculture department of Kirtipur municipality, Kathmandu. The total 107 samples were taken and it was calculated using 50% prevalence with confidence limit of 95% and 10% error using the formula:

$n = [Z^2 \times (p) \times (1-p)]/e^2$ (1)

Out of 10 wards in Kirtipur Municipality, two wards were selected purposively as they were the major production areas of vegetables and were able to fulfill the market demands of local areas of Kirtipur municipality through its production. The total number of commercial vegetable farmers from the selected wards were 629, which was obtained from agriculture sectors records, for the sampling frame. Then, Probability Proportional to Size (PPS) was used to allocate the required number of sample farmers from each wards and farmers were randomly selected through systematic random sampling method from the list available there. Those farmers living in the ward for at least one year and had handled the pesticides, and were willing to participate were included in the study.

The data was collected using pre-tested semi- structured questionnaire, which was translated in Nepali language during interview. Face to face interview technique and pictograms stated in pesticide packets, bottles and sachets was used for data collection. The questionnaire included socio-demographic characters, pesticide use practices, storage and disposal techniques and health effects among the farmers. The pesticides use practices was measured using certain questionnaires including amount of pesticides used, working hours, types, intervals, spraying time per season, trainings on handling, place of preparation, use of Personal Protective Equipment (PPE) and personal hygiene. Similarly, storage and disposal techniques were also measured. Farmers' health effects were measured by asking if they had any health problems within 48 hours of pesticides application due to pesticide use and symptoms.

Validity of the instrument was obtained from literature review. Pretesting of the questionnaire was carried out among 10% of the total sample to ensure reliability. Ethical approval was taken National Open College for the conduction of study. The ward authorities were contacted for permission to conduct the study. Participants were briefed about the study objectives and informed written consent was taken from each respondents before collecting the data. Participation in the study was fully voluntary and confidentiality of the collected information were ensured. Each filled questionnaire was re-checked just after completion of the interview.

Data entry was carried out in Epi-Data and analyzed using the IBM SPSS version 21. The data analysis was carried out using descriptive statistics where frequency, percentage, mean and standard deviation were calculated to find out the socio-demographic characteristics, pesticide use practices, storage and disposal techniques and health effects of pesticides among the farmers.

3. Results

Table 1 Socio-demographic characteristics of the respondents

Socio-demographic characteristics	Frequency (n=107)	Percent
Sex		
Male	57	52
Female	50	48
Age		
<30	7	6.5
30-46	71	66.4
>46	29	27.1
Mean	40.7	±9.28
Ethnicity		
Brahmin/ Chhetri	69	66
Janajati	29	28
Dalit	9	6
Educational level		
Illiterate	8	7
Can simply read and write	21	20
Primary level (1-5)	20	18
Lower secondary level(6-8)	14	13
Secondary level(9-10)	21	20
Higher secondary(11-12)	15	14
University degree	9	8
Experience of vegetable farming (years)		
1-5years	59	56.3
6-10years	31	28.2
>10years	17	15.5
Experience of pesticide use (year)		
1-5years	59	57
6-10years	29	27
>10years	19	16
Land ownership		
Leasehold	89	83.2
Own land	14	13.1
Both	4	3.7

Table 1 represents the descriptive statistics for socio-demographic characters of the respondents. It shows that 52% of the respondents were male and 48% of them were female with mean age 40.7 years and standard deviation of 9.28 years. The majority of respondent, that is, 66.4% is falling between 30 and 46 years, showcasing a relatively mature farming demographic. Most of the respondents were Brahmin/Chhetri (66%). Almost half of the respondent, that is, 55% have education levels beyond primary. Farming experience and pesticide exposure was also diverse, with most farmers engaged in

farming for 1-5 years was 56.3% and 57% have 1-5 years of pesticide use experience. The majority of farmers do not own the land on which they farm, with 83.2% having leasehold land.

Table 2 Practices related to the use of pesticides and Integrated Pest Management

Variables	Frequency (n=107)	Percent
Determine amount of pesticide to use based on		
Dealer's guide	73	68.2
Instruction label	15	14.1
Extension worker's guide	11	10.3
Noticed pest and disease incidence on crops	8	7.4
Working hours with pesticide in the field		
<2 hours	43	38
2-6 hours	44	43
>6 hours	20	19
Wait to harvest the vegetable after the pesticide application		
3-5 days	34	32
1-2 days	28	27
Wait for a week	28	27
10-15 days	13	12
Don't wait	4	2
Interval of using pesticides		
Alternate days	8	7
Once in a month	3	2
Twice in a week	33	32
Every week	34	33
10-15 days	29	26
No. of spraying time per cropping season		
1-2 times	7	5.8
3-4 times	17	15.5
5-6 times	23	21.4
> 6 times	60	57.3
Places for buying pesticides		
Authorized Shop/Retailers	107	100
Place for preparing pesticides		
In the field	46	42
In Home	33	32
Nearby water source	22	21
Others	6	5
Wash the pesticide sprayer equipment after use		
Yes	78	73
If yes, Place for washing the pesticide applicator equipment (n=78)		

Farm site	29	38.7
In the pond/river/well	25	33.3
In the tap	20	26.7
Others	4	1.3
Duration of re-enter the field after pesticide application		
0-2 days	61	58
3-5 days	28	26
6-8 days	12	11
> 8 days	6	5
Do you read the label in the bottle/package?		
Yes	58	56.3
If yes, follow the instruction given on the label (n=58)		
Yes	43	74
Determine the wind direction first and then spray		
Yes	76	71
Eat or drink or smoke during pesticide application		
No	92	88
Heard about Integrated Pest Management		
Yes	48	45
If yes, currently practice any IPM techniques (n=48)		
Yes	42	87.5
If yes, methods used (*Multiple choice)		
Trap	25	60
Organic production	19	45
Rotation of crop	4	10

Table 2 represents data on pesticides use practices as well as Integrated Pest Management. Majority 68.2% of the respondent relies on the dealer's guides for amount of pesticides use. Almost 43% of respondent spend 2-6 hours while working with pesticides in the field. Majority of respondent, that is, 32% waited for 3-5 days before harvesting vegetables after pesticide application. Pesticide application intervals ranged from weekly with 33% to alternate days with 7%, and most farmers sprayed pesticides more than six times per cropping season. All farmers purchased pesticides from authorized shops. Regarding pesticide preparation, 42% of farmers prepared pesticides in the field, 32% prepared at home and 21% in water sources, resulting in contamination of water. Almost three fourth of the respondents washed their sprayer equipment after use with most of them (38.7%) washed at the farm sites. About 58% of farmers reported that they re-enter in field within 0-2 days after pesticide application posing potential health risks. The study emphasized the importance of reading pesticide labels, as 56.3% of farmers did so, with 74% of them following label instructions. Most of the respondents, that is, 71% determined wind direction before spraying pesticides. Majority of the respondents (88%) reported about not eating, drinking or smoking during pesticides application. Awareness on Integrated Pest Management (IPM) was reported by less than half (45%) of the respondents with 87.5% of them using IPM techniques with more than half of them using trap methods.

Table 3 Use of Personal Protective Equipment (PPE) during pesticides handling and application

Variables	Frequency (n=107)	Percent
Wear PPE during pesticide handling and application		
Yes	93	89
If yes, PPE used (n=107) (Multiple choice)		
Masks	85	79.4
Gloves	84	78.5
Boots	51	47.7
Glasses	26	24.3
Hat/Head Cover	12	20.6
Full sleeves shirt	6	11.2
Full length trousers	6	5.6
Raincoat	22	5.6
If not, why? (Multiple choice) (n=14)		
Unnecessary	8	54.5
Uncomfortable	6	45.5
Change the clothes right after the application of pesticide		
Yes	92	87
Take a bath after the application of pesticide		
Yes	94	89
Wash clothes used during pesticides application separately		
Yes	85	79
Storage of pesticides containers		
Home	34	33
Farm site	24	22
Separate store room for pesticides	5	4
Buy and use it immediately	17	16
Separate area far away from children	27	25

Disposal of pesticides		
Burn	47	45.1
Bury on-farm	17	13.7
Handing to municipal waste transportation vehicles	32	31.4
Place in trash or dumpster	11	9.8

Table 3 represents the data regarding the use of Personal Protective Equipment during pesticides handling and application. It shows Personal Protective Equipment usage was encouraging with 89% using at least one or more PPE such as masks, gloves, boots, glasses, hat or head cover, full sleeves shirt, full length trousers or raincoat while handling pesticides. Among few respondents who were not using any PPE, almost half of them reported that PPE was not necessary or was uncomfortable to them. Different practices had been recorded after pesticides use, with 87% respondent changed clothes, 89% took bath after each episode of pesticides application, and 79% separately washed clothes used during pesticides application. Similarly, the storage practices were concerning, as 33% stored pesticides inside homes, leading to potential contamination. Furthermore, almost half of the respondents, that is, 45.1% burned empty pesticide bottles, as pesticides disposal practices.

Table 4 Knowledge about pesticides use effects and health problems within 48 hours of pesticide application

Variables	Frequency (n=107)	Percent
Knowledge		
Pesticides affect human health		
Yes	92	89
Pesticides affect environment		
Yes	97	91
Pesticides affect animal health		
Yes	89	83
Know the routes of pesticide entry to human body		
Yes	64	58.3
Routes (Multiple choice) (n=64)		
Routes of entry through Skin	28	44
Routes of entry through ingestion	10	16
Routes of entry through inhalation	47	73
Health problems		
Experience of health problems within 48 hours of application		
Yes	49	45.6
If yes, what are they? (n=49) (multiple choice)		
Eye irritation	25	23.4

Headache	40	37.4
Dizziness	20	18.7
Fever	2	1.9
Vomiting	5	4.7
Shortness of breath	15	14
Convulsion	5	4.7
Skin irritation	12	11.2

Table 4 represents the data regarding the knowledge about the pesticides effect and health problems experienced by the respondents within 48 hours of pesticide application. It shows that majority of the farmers exhibited knowledge of pesticide effects on health, the environment, and animal health with 89%, 91% and 83% respectively. Similarly, more than half (58.3%) of the respondents were known about the routes of pesticide entry into the human body where they reported route of entry through skin, ingestion and inhalation. Furthermore, almost half of the respondents, that is, 45.6% reported about experiencing health problems such as eye irritation, headache, dizziness, fever, vomiting, and shortness of breath, convulsion or skin irritation within 48 hours of pesticides application.

4. Discussion

Our study, involving 107 commercial vegetable farmers in Nepal, produces a meticulous interpretation of the complexity around pesticide use. By combining these findings with information from international organizations, especially studies conducted in Palestine (13), Uganda (14), Kenya (15) and Vietnam (16), the similar problems encountered be all of us are revealed while making clear that to solve them requires a global effort that is coordinated across countries doing things together for mutual benefit. In terms of demographic characteristics, our participant pool is heavily dominated by relatively mature farmers (60.4 % between 37 to 51 years), which matches the age distribution observed elsewhere in Palestine such as Nablus district (13). This congruency in terms of age profiles between different geographical areas means that interventions must be designed to deal with the precise needs and habits of this aging farming population. The big gap between the education levels of farmers in Nepal, from illiterate to university degree holders, is a universal problem. Its correlation with findings from Uganda (14) further accentuates the very pressing international problem of low rural awareness about correct use of pesticides. It is clear that this need for more attention through education and training exists, supporting the focus on raising awareness among farmers in Nepal of our study. The similarity in effects we observed between Nablus, Palestine (13) and the literature review reinforces our study's focus on widespread occurrence of pesticide-related health problems. This points to the urgent need for an overall approach in order jointly develop methods of dealing with challenges confronting farmers everywhere. In terms of health impact, these parallels reveal the need for concerted efforts to reduce differences in pesticide use patterns. Education and legislation are both pervasive themes, in sync with studies from Kenya (15) as well the regulatory frameworks of Nepal. The common thread among them is we need effective legislation, enforcement and education on a global scale to reduce health risks from pesticide use. This shared emphasis underscores the importance of international campaigns to promote education about existing legislation, as reflected in data from various regions.

In our study and from Uganda (14), of difficulties understanding pesticide labels underline the urgent need worldwide to improve farmers 'understanding about pesticides. This is consistent with the international demand for clearer labelling and intervention projects. The need also exists to develop global strategies

that will increase understanding of pesticides, reduce risks, enhance efficiency in their use and improve people's quality of life. The emphasis on Integrated Pest Management (IPM) in our study follows a trend found worldwide, according to results of another. Perhaps in Vietnam (16) the recognition of obstacles to pesticide use also indicates some kind of need for sustainability everywhere, and this is consistent with our strategy's opposition perspective. This shared point of view makes it clear that we must encourage environmentally friendly agricultural techniques on a world scale. The call for international cooperation in studies from California (17), Rwanda (18) and Iran (8) is consistent with our call to train many foreign trainees. Agricultural practices that are so interrelated and deeply shared become an even clearer demonstration of why cross-border collaboration is necessary to promote safer agricultural practices around the world. Therefore all parties have a shared responsibility in emphasizing the importance of collective efforts and knowledge exchange towards better, safer practices everywhere. Our study's emphasis on fine-tuning education and training is in line with the recognition of a gap between knowledge among farmers, but practice in Iran (8). This common awareness stresses that without practical experience, having knowledge doesn't equate with safe practices. This relates to the global call for effective bridging of gaps in agricultural techniques. Studies from Kenya (15), Iran (8) and Uganda (14) have combined thorough empirical knowledge with breakdowns of socio-economic factors to lend more weight to the point that local conditions must be understood. This global focus on socio-economic factors reminds us once again of the importance of integrated prevention, stressing preventive methods linked to conditions local to Nepal.

In conclusion, when linked with international data on the subject and viewed in light of our own study's findings, it becomes obvious that we must take collective multidisciplinary measures if farmers around the world are to be protected from occupational health risks arising out of pesticide use. Similarly, the common difficulties faced by different regions highlight that effort to achieve responsible agriculture and food production at an international level is of great urgency. All the results of this study are consistent with a cohesive story: we must not only avoid selectively limiting attention to isolated cases, but on an international level must take comprehensive and collective action in order to prevent pesticide pollution from further harming human health.

5. Conclusion

Commercial vegetable farmers from two wards of Kirtipur Municipality took part in the study that accesses their occupational health hazards related to pesticide use. Demographic features of the vegetable growers showed that majority of them were literate and among them majority had secondary level school education. Most of the respondents had work experience as pesticide applier ranged from 1 year to 5 years. Four fifth of the farmers had leasehold farmland.

The study showed that extremely hazardous pesticides were used in vegetables which were banned for normal agriculture use by Government of Nepal. Majority growers did not receive any training on pesticides and IPM techniques. Four fifth farmers used at least one PPE during the application of pesticide. The study showed that almost half of the farmers were known about health impacts of pesticide. Similarly, three-fourth farmers were familiar with route of exposure. Around half of the pesticide users had shown various symptoms of health hazards such as headache, vomiting, shortness of breath, skin and eye problem.

Many farmers are still suffering from different health hazards. For this, there is a need of the promotion of effective cultivation practices .The hygiene and sanitation practices of the pesticide users require much

improvement. To effect change, the health and agriculture sector should work together. The agriculture sector should develop and build on ways of working with framers to grow vegetables that promote healthier cultivation practices and reduce the exposure to the pesticide. The health sector should document the health problems and identify the health hazards. Furthermore, it help explain the reasons for such changes and monitor changes in health with improved production method.

Limitations

This study did not cover a large population and was limited in two wards of Kirtipur Municipality, so the findings from the study could not be generalized and hence a proper estimation of the problem was not possible. Moreover, this study was limited to both time and resources and did not cover all the aspect of the occupational health and safety among the commercial vegetable farmers. However, it focused on some of its important aspects.

Data Availability

The datasets and materials used and/or analyzed during this study can be obtained from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest. This research was not funded.

Authors' Contribution

ST was the principal investigator. ST, AB, BKR and SK developed the paper and performed critical revision. AB, BKR and SK wrote the manuscript. AKP was responsible for supervision and guidance. All authors revised the draft critically and approved the final text.

Acknowledgement

Before moving into thick of things, we would like to add a few words of appreciation for the people who have been in the part of this study right from the beginning. We owe our credit to all the helping hands whose invaluable help, support, patience and guidance has made the completion of this research possible. Foremost, it is a privilege to conduct the study on "Occupational health hazards of pesticides use among commercial vegetable farmers of Kirtipur Municipality, Kathmandu". Our earnest gratitude is expressed towards our research supervisor, Dr. Ashok Kumar Paudel with whom it was our immense pleasure and honour to work. Without his kind supervision, guidance, and continuous help, our research would not have taken this shape.

Similarly, we would like to thank to all those respondents who gave their valuable time and information without whom this study would not have been completed. With the sincere attempt, we have tried to do our best and hope that this research will be of help and reference for future attempts. Lastly, our acknowledgement extend to all those who helped us directly and indirectly for accomplishment of this study.

Thanking All

Alisha Basnet, Ashok Kumar Paudel, Bindu Kumari Rokaya, Saguna Thapa, Samiran Kafle

References

1. *ILO, 2006. Understanding the Link between Agriculture and Health .*
2. *FAO, 1990. Personal Protection when working with pesticide in Tropical Climate. .*
3. *Sushma D, Dipesh R, Lekhendra T, Shalik Ram S. A Review on Status of Pesticides Use in Nepal. Res J Agric For Sci Res J Agric For Sci. 2015;3(3):2320–6063.,4. Lamichhane R, Lama N, Subedi S, Singh SB, Sah RB, Yadav BK. Use of Pesticides and Health Risk am.*
4. *Lamichhane R, Lama N, Subedi S, Singh SB, Sah RB, Yadav BK. Use of Pesticides and Health Risk among Farmers in Sunsari District, Nepal. J Nepal Health Res Counc. 2019;17(1):66–70. Available from: https://doi.org/10.33314/jnhrc.1204.*
5. *Dahal, L., 1995. A Study on Pesticide Pollution in Nepal (Kathmandu: National Conservation Strategy Implementation Project, IUCN).*
6. *GC S, Neupane J. Pesticides Use in Nepal and its Effects on Human Health – A Review. Acta Sci Agric. 2019;3(11):114–7. https://doi.org/10.31080/asag.2019.03.0694.*
7. *Rijal JP, Regmi R, Ghimire R, Puri KD, Gyawaly S, Poudel S. Farmers' knowledge on pesticide safety and pest management practices: A case study of vegetable growers in Chitwan, Nepal. Agric. 2018;8(1). https://doi.org/10.3390/agriculture8010016.*
8. *aghdisi MH, Besheli BA, Dehdari T, Khalili F. Knowledge and practices of safe use of pesticides among a group of farmers in Northern Iran. Int J Occup Environ Med. 2019;10(2):66–72. Available from: https://doi.org/10.15171/ijoem.2019.1479.*
9. *K. Park, 2005. Preventive and Social Medicine, 17th edition, page 606-621. .*
10. *Gupta A. Pesticide use in South and South-East Asia: Environmental Public Health and Legal Concerns. American Journal of Environmental Sciences, 2012;8(2):152-157. https://doi.org/10.3844/ajessp.2012.152.157.*
11. *Manadhar. D.N, 2006. Pesticides in Nepal (Kathmandu: The Rising Printer).*
12. *Chand Thakuri L, Sharma S, Bhattarai K, khatri D, BK A. PERCEPTION OF FARMERS ON HANDLING PESTICIDE AND ADOPTION OF IPM IN WEST RUKUM OF NEPAL.*
13. *Zyoud SH, Sawalha AF, Sweileh WM, Awang R, Al-Khalil SI, Al-Jabi SW, et al. Knowledge and practices of pesticide use among farm workers in the West Bank, Palestine: safety implications. Environ Health Prev Med [Internet]. 2010 Jul 10;15(4):252–61. Availab.*
14. *Okonya JS, Kroschel J. A Cross-Sectional Study of Pesticide Use and Knowledge of Smallholder Potato Farmers in Uganda. Biomed Res Int [Internet]. 2015;2015:1–9. Available from: http://www.hindawi.com/journals/bmri/2015/759049/.*
15. *Macharia I, Mithöfer D, Waibel H. Health Effects of Pesticide Use among Vegetable farmer in Kenya. 4Th Int Conf African Assoc Agric Econ. 2013;1–21. .*
16. *Nguyen TM, Ranamukhaarachchi SL, Nguyen PDA. Pesticide use and health hazards among small-scale commercial vegetable growers in the central highland region of Vietnam. Res Crop. 2017;18(3):497–507. Available from: https://doi.org/10.5958/2348-7542.2017.00.*
17. *Thao C, Burke N, Ha S, Joyce A, Royer T. Pesticide Knowledge, Attitudes, and Practices among Small-Scale Hmong Farmers in the San Joaquin Valley of California. J Integr Pest Manag. 2019;10(1):1–6. Available from: https://doi.org/10.1093/jipm/pmz030 .*
18. *Ndayambaje B, Amuguni H, Coffin-Schmitt J, Sibo N, Ntawubizi M, Vanwormer E. Pesticide application practices and knowledge among small-scale local rice growers and communities in rwanda: A cross-sectional study. Int J Environ Res Public Health. 2019;16(23.*