ORIGINAL ARTICLE

Knowledge of Farmers Regarding the Occupational Hazards due to Pesticide Use: A Cross Sectional Study in Rural Village

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ABSTRACT

Introduction: Unsafe handling practices and limited awareness about the health risks are associated with pesticide exposure which makes farmer's vulnerable to a range of occupational hazards, including acute poisoning, respiratory problems, neurological symptoms and long-term carcinogenic effects. Understanding farmer's knowledge levels on occupational hazards is essential for planning effective health education interventions, formulating safer agricultural policies, and reducing long-term health risks. **Aims**: To assess farmer's knowledge regarding occupational hazards associated with pesticide use. **Methods**: A descriptive cross-sectional study was conducted among 377 respondents in Rural Municipality Baijanath ward number two Digiya located in Banke District of Nepal through Systematic sampling selecting every 5th house as majority of people of that area are involved in farming. **Results**: The majority of respondents 171(45.40%) were in age group 41-55 years, 198(52.50%) were female, 168(44.60%) were illiterate. Majority 151(40.10%) were unaware that pesticides could enter the human body during spraying. The most common routes by which pesticides enter in the body were inhalation 163(43.20%), ingestion through mouth 144(38.20%) and 70(18.60%) skin contact. Although 126(33.40%) of them reported pesticide exposure causes immediate (acute) health effects and chronic disease 95(25.20%) majority 135(35.80%) were unaware about acute effect and 116(30.60%) disagreed. Similarly, 205(54.40%) were unaware and 77(20.40%) disagreed it cause chronic disease. Likewise, they agreed pesticides can contaminate surface and groundwater as 167(44.30%) agreed, 135(35.80%) were unaware and 75(19.90%) disagreed. **Conclusion**: The overall knowledge level can be categorized as poor because a majority of respondents lacked awareness of exposure routes, chronic effects and correct pesticide use. Attitude was also good as some respondents recognized risks but not consistently. Practices were generally poor particularly regarding personal protective equipment usage and safe handling behaviors.

Keywords**:** Awareness; Farmer; Occupational hazards; Pesticides; Rural village

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INTRODUCTION

A major source of livelihood in many developing countries remains Agriculture, however, pesticides are widely used to increase crop yield and control pests. The unsafe handling practices and limited awareness about the health risks are associated with pesticide exposure which makes farmer's vulnerable to a range of occupational hazards, including acute poisoning, respiratory problems, neurological symptoms and long-term carcinogenic effects.[1,2] Studies from South Asia have demonstrated that farmer's often lack adequate knowledge of pesticide toxicity, proper storage, and safe disposal methods.[3,4]

In many regions, personal protective equipment (PPE) use remains extremely low due to lack of awareness, high cost, or discomfort during fieldwork.[4] The World Health Organization estimates that millions of cases of pesticide poisoning occur globally each year, with small-scale farmer's being the most affected.[5] Understanding farmer's knowledge levels on occupational hazards is essential for planning effective health education interventions, formulating safer agricultural policies, and reducing long-term health risks. Despite the widespread use of pesticides, limited awareness about safe handling practices continues to expose farmer's to acute and chronic health hazards. Lack of knowledge increases the likelihood of unsafe practices such as mixing pesticides with bare hands, improper storage in households, non-use of PPE, and unsafe disposal of containers.[3,6,7] There is a need for evidence-based assessment of farmer's knowledge to guide targeted health education and governmental interventions. Therefore, this study aims to assess the knowledge of farmer's regarding occupational hazards associated with pesticide exposure and to identify factors associated with occupational hazards.

METHODS

A descriptive cross-sectional study was conducted in selected agricultural communities from December 2025 till March 2026 in Rural Municipality areas Tharu village, Baijanath ward number two Digiya located in Banke District of Nepal. Through Systematic sampling selecting every 5th household, as majority of people of that area are involved in farming. The farmer's aged 18 years and above who are involved in pesticide mixing, handling or application and atleast engaged farming for the last six months were included in the research. Those farmer's not willing to participate and have just started farming were excluded. After approval from the Institutional Review Committee (Reference number:50/082-083), Informed consent was obtained from participants. The data was collected through face to face interview using a semi-structured questionnaire after pretesting and revision. The questionnaire covering: sociodemographic details, knowledge of health hazards, safe handling practices, PPE usage, storage and disposal methods. Also, they were free to leave the study at any time. The questionnaire consisted of together 30 knowledge, attitude and practice questions. Each correctly answered question was awarded one point, while an incorrect or "Don't know" response received zero points. For questions with multiple response options, one point was awarded only when the correct responses were identified according to the predefined answer key. The maximum obtainable knowledge score was 30. Knowledge Scoring System was used based on mean value. Scores equal to or above the mean were considered good (knowledge above score ≥ 11.82 (approx.≥12)), and below the mean were considered poor (knowledge score < 11.82(approx. ≤11)).

Sample Size was calculated using a standard formula for cross-sectional studies:

$n=Z2p.q/ e^2$

Where:

Z = 1.96 (95% confidence),

p = estimated proportion from previous studies (43.2%)[4]

d = margin of error (0.05).

q=1-p= 0.568

So, the calculated sample size is 377

The data were collected and entered into Microsoft Excel 2016 and analysed using Statistical Package for Social Sciences(SPSS) Version 24. Descriptive statistics (mean, standard deviation, frequency, percentage) were calculated.

RESULTS

The highest proportion of respondents 171(45.40%) were in age group 41-55 years followed by 25-40 years 109(28.90%), more than 55 years 79(21%) and less than 25 years 18(4.80%). Majority 198(52.50%) were female and 179(47.50%) were male respondents. Majority 168(44.60%) were illiterate followed by primary education 141(37.40%), secondary education 56(14.90%) and 12(3.20%) higher secondary or above. The higher 164(43.50%) were involved in farming since 11-20 years followed by more than 20 years 112(29.70%), 5-10 years about 74(19.60%) and less than 5 years 27(7.20%). The types of farming practiced mostly were 187(49.60%) vegetables farming followed by mixed farming 166(44%) and crops farming 24(6.40%). According to respondent's majority 151(40.10%) were unaware that pesticides could enter the human body during spraying as depicted below in figure 1.

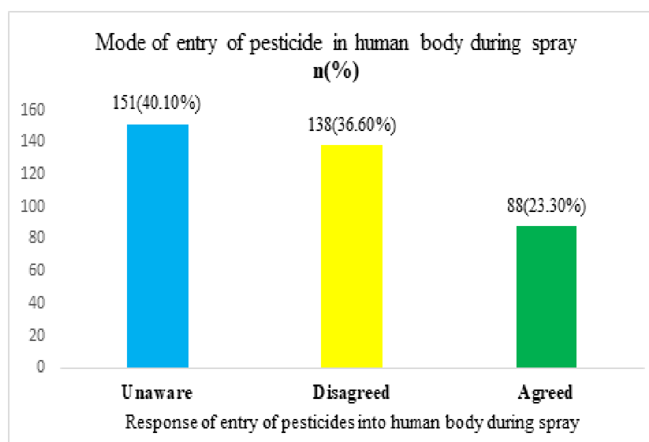

Figure 1: Mode of entry of pesticide in human body during spray

The most common route pesticides enter in the body were inhalation 163(43.20%), ingestion through mouth 144(38.20%) and 70(18.60%) skin contact among all respondent. Although 126(33.40%) of them reported pesticide exposure cause immediate (acute) health effects, followed by 135(35.80%) unaware about acute effect and 116(30.60%) disagreed however, clearly mentioned symptoms of immediate effect such as headache 129(34.20%) table I.

Farmer awareness regarding health effect	n (%)
Symptoms of Acute pesticide poisoning are	
Headache	129 (34.20)
Nausea and vomiting	128 (34)
Unaware	68 (18)
Dizziness	52 (13.80)
Does long-term pesticides exposure cause chronic diseases	
Unaware	205 (54.40)
Believed it does	95 (25.20)
Disagreed	77 (20.40)

Table I: Response of awareness of farmer

Similarly, majority 205(54.40%) of them were unaware of chronic disease, however long-term health effects due to pesticide exposure according to them includes respiratory diseases 206(54.60%) followed by cancer 119(31.60%) and infertility 52(13.80%). Pesticides are mainly used for killing pests 181(48%) in agriculture followed by increasing rainfall 144(38.20%) and increasing soil fertility 52(13.80%). Pesticide could be harmful to only insects 190(50.40%), humans and animals 135(35.80%) and only plants 52(13.80%). The mixing of pesticides with bare hands are harmful as 152(40.30%) agreed and 173(45.90%) were unaware and 52(13.80%) disagreed. Similarly,181(48%) farmer's believed spraying pesticides without protective equipment are risky however,144(38.20%) are unaware while 52(13.80%) disagreed. Although higher proportion 168(44.60%) farmer's reported re-entering the field immediately after spraying increase health risk, still 157(41.60%) were unaware and few 52(13.80%) disagreed. Likewise, 159(42.20%) of farmer's believed wind direction should be considered while spraying pesticides followed by 144(38.20%) who were unaware and 74(19.60%) disagreed. Similarly, 174(46.20%) responded storing pesticides inside the house pose health risks to family members, still 135(35.80%) were unaware and 68(18%) believed it does not pose risk if kept carefully. Personal protective equipment (PPE) used while spraying pesticides gloves 128(34%), boot 128(34%), goggles 69(18.30%) and mask/respirator 52(13.80%). According to respondent washing hands and bathing after spraying is necessary as 213(56.50%) agreed to the statement and 111(29.40%) were unaware and 53(14.10%) disagreed however; 88(23.34%) correctly identify the exact route of entry into the human body during spraying and 289(76.66%) were not sure. Likewise, farmer's agreed pesticide labels should be read before use as 168(44.60%), 112(29.70%) were unaware and 97(25.70%) disagreed. Similarly, 135(35.80%) don't check for expiry date before purchasing pesticides, 129(34.20%) check sometimes but 113(30%) do check expiry date always.

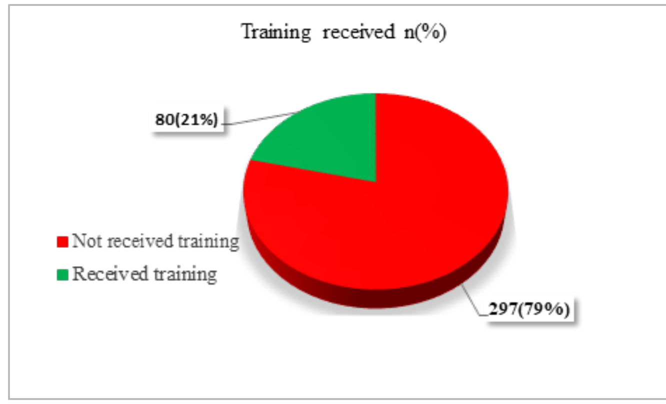

Figure 2: Farmer received training on safe pesticide handling

Regarding safety precaution	n (%)
Wearing gloves and mask during spraying prevents	
Skin exposure	144 (38.20)
Inhalation of pesticide droplets	121 (32.10)
Eye irritation	112 (29.70)
Protective clothing helps	
Reduce pesticide contact with skin	142 (37.70)
Decrease pesticides toxicity	112 (29.70)
Increase spraying speed	100 (26.50)
Unaware	23 (6.10)
Reading pesticide labels before use helps to know	
Dosage	152 (40.32)
Toxicity level	112 (29.71)
Safety precautions, Dosage, toxicity level	113 (29.97)
Symptoms which indicates poisoning	
Vomiting, weakness and breathing difficulty	113 (30)
Dehydration	112 (29.70)

Fatigue	68 (18)
Unaware	84 (22.30)
Immediate action taken after pesticide poisoning	
Medical help	143 (37.93%)
Ignore symptoms and sleep than continue to work	234 (62.07%)

Table II: Awareness regarding safety precaution among farmer's

The farmer's agreed providing training to them on pesticides safety 134(35.50%) might improve

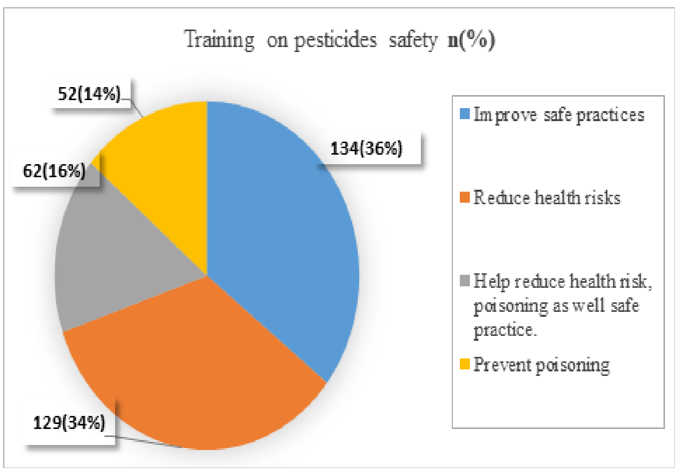

Figure 3: Response of providing training to farmer's on pesticides safety helps

Similarly, farmer's education on pesticide safety is important to promote safe farming 128(34%) followed by protection to their health 120(31.80%), reduce occupational hazards 52(13.80%), 77(20.40%)agreed to all of it. Likewise, they agreed pesticides can contaminate surface and groundwater as 167(44.30%) agreed, 135(35.80%) unaware and 75(19.90%) disagreed. Similarly, 158(41.90%) agreed pesticides affect non-target organism (eg. Bees, animals etc) however, 151(40.10%) unaware and 68(18%) disagreed. Similarly, 174(46.20%) believed pesticides residues remain on vegetables and affect consumers followed by 151(40.1%) unaware, 52(13.80%) disagreed. Likewise, 287(76.10%) believed reducing pesticide use can improve their health and environmental safety followed by 64(17%) unaware and 26(6.90%) disagreed. According to them pesticides remains on land for 5-10 years 295(78.20%) followed by 21-30 years 56(14.90%) and 11-20 years 26(6.90%). Alternative fertilizer instead of pesticides for more production could be 182(48.27%) Ashes and 195(51.72%) cow-dung for organic farming. The overall result based on scoring for knowledge, attitude and practice considering mean value the farmer's had poor knowledge regarding pesticides as well as poor practice however, good attitude towards its disuse.

DISCUSSION

The present study evaluated the knowledge, attitude, and practices (KAP) of farmer's regarding pesticide use and associated health risks, revealing substantial gaps in awareness and safety behaviors. The demographic profile of respondents showed that the majority (45.40%) were in the economically productive age group (41–55 years), which is consistent with findings from Nepal and other South Asian countries, where middle-aged individuals are primarily engaged in agriculture.[6,7] The slightly higher proportion of female respondents reflects the feminization of agriculture, particularly in rural areas due to male migration as also reported in Nepalese studies.[4,8] A major proportion of respondents in this study were illiterate (44.6%), which strongly influences knowledge and safe pesticide practices. Education has been consistently identified as a key determinant of pesticide safety awareness. Studies conducted in Pakistan and Greece have shown that farmer's with lower educational levels are more likely to misuse pesticides and have inadequate knowledge of associated risks.[1,3,9] This aligns with the present study, where misconceptions about pesticide use and exposure were common. Knowledge regarding pesticide exposure routes was poor, with only (23.30%) correctly identifying entry into the human body during spraying. Similar findings have been reported in studies from Bolivia and India, where farmer's lacked awareness of inhalation, dermal, and ingestion pathways.[2,10] Despite inhalation being the most commonly recognized route in this study (43.2%), a large proportion of respondents remained unaware, highlighting the need for targeted educational interventions. Awareness of health effects was also limited. Only one-third of respondents recognized acute pesticide toxicity and more than half were unaware of chronic health effects. This is comparable to findings from studies conducted in Nepal and Ethiopia, where knowledge of long-term effects such as cancer, neurological disorders, and reproductive issues was significantly low.[6,11] The partial recognition of symptoms such as headache and nausea suggests experiential knowledge rather than formal education, which is often insufficient for prevention. Misconceptions regarding the purpose of pesticides were notable, with a substantial proportion of farmer's believing that pesticides increase rainfall or soil fertility. This reflects a lack of basic agricultural knowledge and has also been observed in studies from developing agricultural communities.[3,9] Such misunderstandings can lead to overuse and misuse of pesticides, increasing health and environmental risks. Attitudinal findings indicated moderate awareness of pesticide-related risks. While nearly half of the respondents acknowledged the dangers of spraying without protective equipment and immediate re-entry into sprayed fields, a considerable proportion remained unaware. This gap between knowledge and perception has been widely documented, where awareness does not necessarily translate into safe practices.[4,12] In terms of practices, the use of personal protective equipment (PPE) was suboptimal. Only about one-third of respondents reported using gloves or boots and even fewer used masks or goggles. Similarly, low levels of PPE usage have been reported globally, particularly in low- and middle-income countries, due to factors such as cost, discomfort, and lack of awareness.[5,13] According to the World Health

Organization, inadequate PPE use significantly increases the risk of occupational pesticide exposure and associated health outcomes.[5] Encouragingly, more than half of the respondents recognized the importance of personal hygiene practices such as washing hands and bathing after spraying. However, other safe practices, including reading pesticide labels and checking expiry dates, were inconsistently followed. This may be attributed to low literacy levels, as also observed in studies from India and Nepal.[10,11] A critical finding of this study is the lack of training, with nearly (79%) of respondents reporting no formal education on pesticide safety. Training has been shown to be a key determinant of safe pesticide handling practices. Studies have demonstrated that trained farmer's are significantly more likely to use PPE follow safety guidelines and adopt safer alternatives.[1,4,14] Environmental awareness among respondents was moderate but incomplete. While some farmer's recognized the impact of pesticides on water contamination and non-target organisms, a large proportion remained unaware. Similar findings have been reported in environmental health studies, where farmer's often underestimate ecological risks.[13,15] However, the majority belief that reducing pesticide use could improve health and environmental safety is a positive indicator for future intervention programs. The study has been conducted at selected areas with limited sample size therefore, the result cannot be generalized.

CONCLUSION

The overall knowledge level can be categorized as poor because a majority of respondents lacked awareness of exposure routes, chronic effects and correct pesticide use. Attitude was also good as some respondents recognized risks but not consistently. Practices were generally poor particularly regarding personal protective equipment usage and safe handling behaviors. Therefore, we recommend there is urgent need for structured training programs on pesticide safety, promotion of personal protective equipment usage, health education campaigns targeting low-literacy populations and encouragement of alternative pest control methods such as organic farming.

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