# Pesticide Poisoning Among Commercial Vegetable Farmers of Chitwan, Nepal

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**ABSTRACT:** Pesticide use in Nepal has increased by 10%–20% annually, and the proportion of vegetable growers using pesticides in Nepal has also increased from 7.1% (1991/1992) to 16.1% (2001/2002), thereby increasing the chances of pesticide poisoning among farmers. A cross-sectional study was conducted in four Village Development Committees of Chitwan to determine the adverse health effects of pesticide among 125 commercial vegetable farmers. It was observed that 71% of them were found to be affected after spraying. Farmers experienced 3 poisoning symptoms out of 12. The most common symptoms experienced were skin irritation (62%) and headache (55%). In spite of poisoning, 82% stayed idle, whereas 18% either took self-medication or sought medical attention. Although a majority of the farmers suffered from pesticide poisoning, most of them did not seek medical assistance. Hence, there is an immediate need for promoting education for the farmers about the identification and treatment of poisoning along with its possible prevention.

**KEYWORDS:** pesticide, knowledge, poisoning, healthcare workers, farmers, adverse health effects

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## Introduction

Chemical pesticides are known to have deleterious effects on human health and the environment. Pesticide poisoning (PP) has been a major problem worldwide, but the estimates vary among the reports.[1,2] Developing countries are known to consume nearly 20% of the world production of agrochemicals, which are responsible for as much as 1.1 million (70%) of the total cases of acute poisoning in the working population.[3] Pesticide use in Nepal for the year 2008 was 151.2 g of active ingredient per hectare of arable land.[4] The trend of pesticide use is increasing in Nepal by about 10%–20% per year.[5] In 1997/1998, the pesticide imported and formulated in Nepal was about 50,000 kg, which has soared to about 350,000 kg in 2011/2012, which is more than sixfold increase.[6] The proportion of vegetable growers using pesticides has increased from 7.1% in 1991/1992 to 16.1% in 2001/2002 and the chances of PP are higher, especially among the less aware and uneducated farmers.[7] Majority of the farmers in Nepal have never received training in handling of pesticides, leading to unawareness of types of pesticides, level of poisoning, safety precautions, and potential hazards on health and environment.[8,9] Farmers also apply pesticides into rivers and streams in order to catch fish.[10] These pesticides easily find their way into the blood of human beings through the mouth, nose, skin, and eyes. Hence, there are high chances of pesticide exposure, further leading to adverse acute and chronic health effects.[3] Thus, this study was conducted to identify the adverse health effects of pesticides among the commercial farmers.

## Materials and Methods

**Study site.** Chitwan district is purposively selected for this study because of the commercial and intensive vegetable cultivation and the high volume of pesticide use. It is one of the highest commercial vegetables growing districts of Nepal.

**Study design and selection of participants.** A cross-sectional study was conducted from December 2012 to June 2013. Multistage random sampling method was applied to select the participants. In the first stage of the 39 Village Development Committees (VDCs) of Chitwan, four VDCs were randomly selected by using lottery method. For the lottery method, names of all 39 VDCs were written in a separate, uniform-sized paper, which was folded and put into a bowl. The papers were thoroughly mixed in the bowl. Four papers were taken out one by one. The bowl with papers was thoroughly shaken every time a paper was taken out.

Almost all commercial farmers in Chitwan are registered with the District Agriculture Development Office (DADO). Hence, in the second stage, the total list of commercial farmers of selected VDCs was obtained from the DADO. Of the 570 farmers in the list, 125 farmers were randomly selected by systematic sampling technique. The first farmer was selected by using the lottery method, and then using an

interval ratio (4.56), one in every five farmers was selected. Only those farmers who were using pesticides within a year of this study and were engaged in commercial farming were included in this study.

**Data collection and statistical analysis.** The data collection tool was semistructured interview schedule, and the data collection method was face-to-face interview. The semistructured interview schedule (Annexure) was first developed in English and then translated to Nepali language. Data collection was done by the researcher herself. The data were collected for information on demography, knowledge on pesticide coding, training received on safe handling of pesticides, self-reported experience of acute and chronic symptoms, types and frequency of self-reported symptoms experienced, and management sought by farmers after facing poisoning symptoms and personal protective equipments (PPE) worn by farmers during mixing and spraying of the pesticides.

The use of a long-sleeve shirt, hat, face mask, hand gloves, goggles, long pant/trousers, boots, and gown was considered as the use of PPE in this study. The person who was predominantly involved in farming was selected as a respondent. Those farmers who were not available in three subsequent visits and/or did not give informed consent were not included in the study, and subsequent farmers were selected from the list using random selection method.

Regarding self-reported symptoms, we asked "Did you suffer from any of the following symptoms in the last month immediately after handling pesticides?" To identify chronic symptoms, we asked "Did you suffer from any of the following symptoms in your lifetime of pesticide handling?"

Chitwan is an agricultural land. It is important to save the crops from pests and fungi using chemical compounds. Hence, there is a large market for organophosphate and carbamate products, which are very easily available, highly potent, and lethal to insects as well as humans.[11,12] The symptoms of organophosphate and carbamate poisoning explored in this study were taken from two studies.[13,14] The symptoms explored were skin irritation, headache, respiratory difficulties, blurred vision, salivation, dizziness, extreme tiredness, muscular weakness, nausea, trembling hands, vomiting, and abdominal pain.

Pilot testing was done prior to the study among 15 farmers. Data were entered in Epi-data 3.1 and analyzed using SPSS 16. Statistical analysis was carried out by chi-square test and descriptive analysis.

**Ethical issues.** Ethical approval for this study was provided by the Institutional Research Committee of Chitwan Medical College on December 2, 2012. Only those farmers who acknowledged and gave informed consent were included in the study.

**Operational definitions.**

*Acute symptoms:* Acute symptoms were considered if respondents experienced skin irritation, headache, respiratory difficulties, blurred vision, salivation, dizziness, extreme tiredness, muscular weakness, nausea, trembling hands, vomiting, and abdominal pain immediately after spraying and lasted for less than one month.

*Chronic symptoms:* Respondents experiencing any of the following symptoms in their lifetime for a period of more than a month of pesticide handling were considered as having chronic symptoms: lack of sensation, ataxia, paresthesia of the extremities, dementia, urticaria, and skin hypopigmentation.

*Mixed symptoms:* If farmers experienced both acute and chronic symptoms, they were considered as having mixed symptoms.

*Hours:* If respondents experienced symptoms up to 1–24 hours after spraying.

*Days:* If respondents experienced symptoms up to one to seven days after spraying.

*Weeks:* If respondents experienced symptoms more than seven days after spraying.

*Self-medication:* If farmers took medication for symptoms experienced after spraying without consultation of health workers.

*Went to health center:* If farmers went to a health center after experiencing symptoms.

*Took rest:* If farmers took rest in the home after experiencing symptoms without taking medication and visiting the health center.

*Did nothing:* If farmers ignored the symptoms experienced and continued their routine work.

*Properly school educated:* Attended education in school and received academic certificate.

*Formally educated:* Those who could read and write but did not attend school.

## Results

**Age and education.** Of the 125 farmers, 105 were aged 25–54 years. Male-to-female ratio was 1.23. A total of 50% of Nepali farmers owned less than 12 katta (1 katta = 67 $m^2$) of land, which was used for farming. A total of 74 farmers were properly school educated, 47 farmers were formally educated, and the remaining farmers were neither able to read nor able to write. Most of the farmers (90%) were married. The average duration of pesticide use by the farmers was 13 years.

**Knowledge on pesticides.** Of the 125 farmers, 43 had received a formal training on the handling of pesticides. Of them, 34 farmers had attended multiple training sessions. A total of 51 farmers were aware of the color-coding mark pertaining to the pesticide level. Of them, 46 farmers and 27 farmers were aware of red color code and green color code denoting the most and least dangerous labels of pesticides, respectively.

**Acute symptoms of PP.** There were 12 categories of PP symptoms. Of the 125 farmers, 89 were found to be affected after spraying pesticides. On an average, farmers experienced three (2.56) symptoms of PP. The most common symptoms reported were skin irritation (62%) and headache (55%).

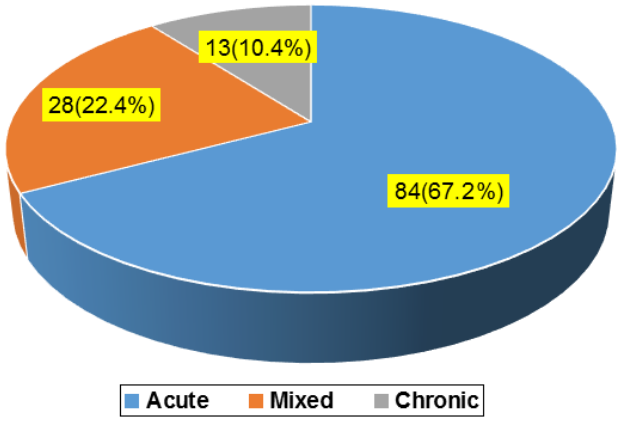


**Figure 1.** Pattern of pesticide poisoning ($n$ = 125).

A total of 34 farmers experienced skin irritation more than ten times a month. A total of 14 farmers also experienced headache more than seven times a month.

Figure 1 shows that 84 of the 125 farmers had suffered from an acute PP, but there were cases of chronic (13) and mixed (28) pattern. Table 1 shows that almost all farmers (98%) reported an immediate intoxication lasting for hours to days, whereas very few farmers (2%) experienced up to weeks after spraying. Symptoms such as vomiting and abdominal pain lasted only for few hours. Nausea, dizziness, salivation, respiratory difficulties, and skin irritation remained for hours to few days, and other symptoms such as trembling hands, muscular weakness, extreme tiredness, blurred vision, and headache lasted for hours to weeks.

Table 2 shows that majority of the farmers (82%) stayed idle or took rest in spite of intoxication. Very few of them (18%) either took self-medication or sought medical attention. For the top two commonest symptoms experienced by more than half of the farmers, 84% (123/147) of the farmers did not seek any sort of treatment. The remaining either got self-medicated (79%) or visited the nearby health center (21%).

**Table 1.** Frequency and duration of pesticide poisoning ($n$ = 125).

| SIGNS & SYMPTOMS | FREQUENCY (%)* | | | TOTAL | |
|---|---|---|---|---|---|
| DURATION | 1 | 2 | 3 | NO | % |
| Skin irritation | 74.4 | 25.6 | 0 | 78 | 62.4 |
| Headache | 58 | 40.6 | 1.4 | 69 | 55.2 |
| Respiratory difficulties | 70.3 | 29.7 | 0 | 37 | 29.6 |
| Blurred vision | 77.4 | 19.4 | 3.2 | 31 | 24.8 |
| Salivation | 60 | 40 | 0 | 30 | 24 |
| Dizziness | 86.2 | 13.8 | 0 | 29 | 23.2 |
| Extreme tiredness | 63.6 | 31.8 | 4.6 | 22 | 17.6 |
| Muscular weakness | 52.6 | 26.3 | 21.1 | 19 | 15.2 |
| Nausea | 64.7 | 35.3 | 0 | 17 | 13.5 |
| Trembling hands | 66.6 | 16.7 | 16.7 | 6 | 4.8 |
| Vomiting | 100 | 0 | 0 | 4 | 3.2 |
| Abdominal pain | 100 | 0 | 0 | 3 | 2.4 |
| Total | 237 | 100 | 8 | 345 | 100 |

**Notes:** *Number exceeds due to multiple response; duration: 1, hours (1–24 hours); 2, days (one to seven days); 3, weeks (more than seven days).

**Table 2.** Frequency of poisoning and management practices ($n$ = 125).

| SIGNS & SYMPTOMS | FREQUENCY (%)* | | | | TOTAL | |
|---|---|---|---|---|---|---|
| MANAGEMENT PRACTICE | 1 | 2 | 3 | 4 | NO | % |
| Skin irritation | 9 | 2.6 | 7.6 | 80.8 | 78 | 62.4 |
| Headache | 17.4 | 4.3 | 46.4 | 31.9 | 69 | 55.2 |
| Respiratory difficulties | 0 | 2.8 | 48.6 | 48.6 | 37 | 29.6 |
| Blurred vision | 0 | 22.6 | 19.4 | 58 | 31 | 24.8 |
| Salivation | 6.7 | 13.3 | 20 | 60 | 30 | 24 |
| Dizziness | 3.4 | 13.8 | 13.8 | 69 | 29 | 23.2 |
| Extreme tiredness | 9.1 | 9.1 | 50 | 31.8 | 22 | 17.6 |
| Muscular weakness | 26.3 | 0 | 47.4 | 26.3 | 19 | 15.2 |
| Nausea | 11.8 | 17.6 | 5.9 | 64.7 | 17 | 13.5 |
| Trembling hands | 0 | 33.3 | 16.7 | 50 | 6 | 4.8 |
| Vomiting | 0 | 50 | 0 | 50 | 4 | 3.2 |
| Abdominal pain | 0 | 66.7 | 0 | 33.3 | 3 | 2.4 |
| Total | 31 | 32 | 94 | 188 | 345 | 100 |

**Notes:** *Number exceeds due to multiple response; management: 1, self-medication; 2, went to health center; 3, take rest; 4, do nothing.

**Protective gadgets worn.** A total of 52 (41.6%), 43 (34.4%), and 36 (28.8%) farmers used face mask, long-sleeve shirt, and hand gloves for personal protection, respectively. Few farmers (15%) also covered other body parts using gowns, long trousers, hats, and boots while spraying. There was no significant association between training received and signs/symptoms experienced by the farmers ($\chi^2 = 0.331$, $P = 0.563$). Similarly, no significant association was found between the knowledge of pesticide color coding and the signs/symptoms experienced by the farmers ($\chi^2 = 0.278$, $P = 0.598$).

## Discussion

Exposure to pesticides and intoxications are an important public health problem among farmers in developing countries. Hence, this study was conducted to identify the adverse health impacts of pesticide among farmers handling pesticides.

In this study, one-third of the farmers (33%) had received proper training on the handling of pesticides, which was higher than those reported in Jors et al study (25%) and Oesterlund et al's study (31%).[13,14] In this study, 40% of the farmers were unaware of the color-coding mark pertaining to pesticide level, which was exactly similar to the study result of Oesterlund et al[14] (40%). On the contrary, Jors et al[13] reported a higher number of farmers (71%) being unaware of the color codes. This showed that farmers lack knowledge regarding pesticide in this study. Training for the farmers is one of the

strongest means of preventing or reducing pesticide hazards. This training can be inbuilt in integrated pesticide management training. A simple intervention such as training, including possible risk of pesticide handling, importance of PPE, management of possible pesticide intoxication, and awareness by using mass media, may have a high impact in Nepal for effective prevention and management of PP.

The most common form of PP was acute type and affected two-thirds of our farmers, and the remaining farmers had mixed or chronic symptoms. Hence, it is clear from this study that acute poisoning of farmers requires immediate attention in our context.

In this study, of the 12 possible symptoms, around 3 symptoms were reported by the farmers. However, a study done in Nepal by Neupane et al[15] reported a higher number of possible symptoms (4.78) of acute intoxication. Another study done in Indonesia by Kishi et al[16] reported that farmers had four signs/symptoms on an average, which is a very high level of intoxication and thereby creates an urgent need of increasing awareness among the commercial farmers.[15] To tackle the above issues, the government of Nepal should develop the strategy of free distribution of PPE and guidelines on the use of PPE along with guidelines on pesticide handling and regular and compulsory training sessions for commercial farmers. Rules and regulations can also be established for compulsory distribution of PPE by retailers who sell pesticides as well as compulsory explanation by retailers of accurate dosage of pesticides. Nearly three-fourth (71%) of our farmers who sprayed had experienced some sort of acute poisoning symptoms, which were similarly supported by Jors et al's[13] study (70%). A study by Mancini et al[17] reported much higher number of farmers (83%) suffering from different grades of acute PP (APP).

The commonest complaints of APP were skin irritation (62%) and headache (55%). Neupane et al[15] reported blurred vision (50%) and extreme tiredness (47%), and Jors et al[13] reported headache (80%) and dizziness (69%) as the top two most common symptoms. A study by Oesterlund et al reported multiple common symptoms of poisoning including skin irritation, headache, extreme tiredness, excessive sweating, blurred vision, and dizziness.[14,18] A study in India by Rastogi et al[19] reported that burning sensation in the eyes/faces, itching and skin irritation/rash, and dizziness were the most prevalent symptoms among farmers.

The study by Sivayoganathan el al[20] in Sri Lanka showed that most common symptoms were headache (23%) and dizziness (17%). A study from Oman among south Asian farmers reported burning sensation (39.2%), headache (33.8%), and skin irritation (70.3%) as the most commonly reported symptoms.[21] A study conducted in Vietnam showed that the most commonly reported symptoms were skin irritation (66%), headache (61%), and eye irritation (56%).[22] The signs and symptoms reported in this study are somewhat similar to those reported in studies conducted in many developing countries, and also it was clear that there were various subjective observations seen among different studies regarding the commonest complaints reported by the farmers. This might be due to the difference in the crop cultivated, pest density, and spraying intensities among the studies. It is also important to consider that the self-reported symptoms largely depend on farmers' perception of symptoms, duration of recall period, and duration of exposure.

In this study, 34 farmers experienced skin irritation more than ten times in a month. A total of 14 farmers also experienced headache more than seven times a month. Farmers experiencing APP symptoms were exceptionally high. It may be due to the fact that farmers had the habit of irrational spraying of pesticides.[9]

Almost all farmers (98%) experienced the poisoning symptoms for hours to days, and a few farmers (2%) were affected even up to weeks after spraying. It all depended on the use of variety of pesticides, duration of spraying, and different weather and health conditions of the farmers. Majority of the farmers (82%) did not seek treatment. The trend of staying idle or taking rest even after pesticide intoxication was exceptionally high among the farmers. Very few farmers (18%) had sought treatment, and among them, nearly equal farmers had either self-medicated or visited nearby health centers. This could be because of the fact that farmers were not aware and conscious about the harmful pesticide effects to human body as well as because of fear of high cost of treatment. Those who visited in the health center also did not get satisfactory result because the healthcare workers have lack of knowledge on managing poisoning symptoms.[23] Hence, there is an urgent need for specific training of the health professionals regarding pesticide intoxication.

Our study found that farmers had not been using adequate PPE during pesticide application and none of the farmers used a complete set of PPE. A study conducted in Nepal by Shrestha et al[24] reported that 66.6% of the farmers did not wear any form of PPE due to lack of knowledge and poor affordability. Atreya[25] revealed that very few Nepali farmers used safety gear during the handling of pesticides. Another study by Atreya et al[26] reported that only 10% of farmers used a facemask. The cloth face mask commonly worn by our farmers was for the purpose of getting rid of bad odors rather than preventing pesticide exposure. This mask in reality does not protect against vaporized pesticide.[27,28]

## Conclusion

None of the farmers used a complete set of PPE. Majority of the farmers, being unaware of the possible side effects of PP, did not bother to seek treatment. They either stayed idle or took rest at home for days to weeks in hope of self-recovery. Hence, there is an immediate need for educating our farmers and health workers for identifying, treating, and also preventing the possible side effects of PP. Rules and regulations on the use of PPE should be made stringent in the country.

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## Author Contributions

Involved in conceptualizing the study, reviewing the literature, designing the protocol, developing the questionnaire, data collection, analysis, and preparing the article: KG. Guided and supervised KG throughout the study: SA. Involved in data coding, entry, and analysis: DG. All authors reviewed and approved the final article.

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## Annexure

**Questionnaire for farmers**

| | | |
|---|---|---|
| **A. Identification** | | |
| A1. Date of interview _____<br>A2. VDC: _____<br>A3. Ward _____<br>A4. Name of household head _____ | | |
| **B. Demography** | | |
| B1. Full name of respondent: _____<br>B2. Age (completed years): _____<br>B3. Sex: _____<br>(1 = Male, 2 = Female)<br>B4. Ethnicity: _____<br>(see coding below)<br>B5. Marital Status _____<br>(1 = Married, 2 = Unmarried, 3 = Separated/divorced, 4 = Widowed)<br>B6. What is your education level? _____<br>(0 = Illiterate, 1 = Formal, 2 = Primary, 3 = Secondary, 4 = Higher than secondary)<br>B7. Agriculture land using (in katta or biga)<br>B8. Involved year in handling pesticides _____ Years | | |
| (Code: 1 = Upper Caste Groups, 2 = Relatively Advantaged Janajatis, 3 = Disadvantage Janajatis, 4 = Disadvantaged non-dalit Terai, 5 = Dalit, 6 = Religious minorities) | | |
| **C. Awareness/Training** | **Yes** | **No** |
| Have you ever had any training on how to use and handle pesticides? | 1 | 0 |
| If yes, how many times have you participated in such training? | | |
| Once | 1 | 0 |
| 2–5 times | 1 | 0 |
| More than 10 times | 1 | 0 |
| Do you know the meaning of Red, Yellow, Blue and Green colour shown in pesticide bottle/ container/packet? | Yes<br>1 | No<br>0 |
| If yes Which colour code indicates the most dangerous pesticide?<br>a. Green b. Yellow c. Red d. Blue | | |
| Which colour code indicates the least dangerous pesticide?<br>a. Green b. Yellow c. Red d. Blue | | |
| Do you use any of the following protective equipment while mixing loading & spraying? | Yes | No |
| Gloves _____ | 1 | 0 |
| Boots _____ | 1 | 0 |
| Mask _____ | 1 | 0 |
| Hat _____ | 1 | 0 |
| Goggles _____ | 1 | 0 |
| Long sleeved shirt _____ | 1 | 0 |
| Long pant/sari _____ | 1 | 0 |
| Gown _____ | 1 | 0 |
| Others (Specify) _____ | 1 | 0 |

| **D. Health related details** | | | | | | |
|---|---|---|---|---|---|---|
| Did you ever experienced any of these symptoms in your entire life? (lack of sensation, ataxia, and paresthesia's of the extremities, dementia, urticarial and skin hypopigmentation) | | | | | 1 | 0 |
| Did you ever feel ill immediately after handling pesticides in last month? | | | | | 1 | 0 |
| If yes, what symptoms did you suffer (do not prompt) | Yes | No | If yes, How many times? | Duration of symptoms | What did you do for management? | |
| Nausea | 1 | 0 | | | | |
| Blurred vision | 1 | 0 | | | | |
| Dizziness | 1 | 0 | | | | |
| Salivation | 1 | 0 | | | | |
| Skin irritation | 1 | 0 | | | | |
| Muscular weakness | 1 | 0 | | | | |
| Headache | 1 | 0 | | | | |
| Trembling hands | 1 | 0 | | | | |
| Respiratory difficulties | 1 | 0 | | | | |
| Extreme tiredness | 1 | 0 | | | | |
| Vomiting | 1 | 0 | | | | |
| Abdominal pain | 1 | 0 | | | | |
| 1 = Hours, 2 = Days, 3 = Weeks/1 = Used self-medication, 2 = went to health centre, 3 = take rest, 4 = do nothing | | | | | | |