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Research Article

Pesticides handling practices among potato growers in Kavrepalanchok, Nepal

[1]Kashi Ram Sapkota*, [2]Sundar Sapkota, [3]Sanjib Sapkota and [4]Krishna Katuwal

[1]Department of Agriculture, Agriculture and Forestry University, Rampur, Nepal
[2]Department of Biology, Eastern New Mexico University, Portales, NM 88130, USA
[3]Department of Biological Sciences, Simon Fraser University, Burnaby, V5A 1S6, Canada
[4]Department of Crop and Soil Sciences, University of Georgia, Athens, GA 30602, USA

*Correspondence: sapkotakashi290@gmail.com; ORCID: https://orcid.org/0000-0001-6310-2344
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ABSTRACT

The rate of pesticide application in the agricultural field is surging. Farmers are getting exposed to pesticide hazards from the misuse and unsafe handling of pesticides. The study was conducted among 101 potato growers in Kaverpalanchok district of Nepal in 2018. The objective of the study was to assess the knowledge, status, and pesticide handling practices among potato growers. Around 94% farmers applied pesticides against early and late blight. Only 5% growers treated seed before potato sowing. About 93 and 73% farmers sprayed pesticides 2-10 times/season into the field and spent 2-6 hours/pesticide spray respectively. More than 2/3rd growers did not read the pesticide labels, and nearly 95% growers received information on pesticide applications from agrovet rather than authorized government bodies. Only 13% farmers had received Integrated Pest Management (IPM) training. However, 1/4th of them had practiced IPM techniques. The majority of the growers used masks, rubber boots, and long-sleeved clothes during pesticide handling. Nearly 2/3rd growers threw pesticide containers anywhere in the environment. Concerned authorities should provide IPM training, skill-building programs on pesticide handling and awareness on waiting period and environmental hazards to avoid pesticide risk.

Keywords: Environment, Farmers, Health, IPM, Pesticides

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INTRODUCTION

Pesticides are toxic chemicals used to kill pests (insects, weeds) and plant diseases, which have a long-term impact on the environment and human life (Pimental, 2005; Sharma et al., 2012). Pesticides misuse is a serious concern in commercial agriculture. Pesticide spraying in an unsafe manner creates acute and chronic health problems. Health problems such as cancer, skin irritation and respiratory diseases are increasing because of incidental and occupational exposure to the pesticides (Konradsen et al., 2003). Globally, around 2 million tons of pesticides are sprayed each year in agricultural land (Sharma et al., 2012; Dhital et al., 2015). A majority (45%) of the pesticides are consumed in Europe followed by the USA (24%). Pesticides use in Nepal is very low (0.142 a.i. kg/ha) compared to UK (5), USA (7), Netherlands (9.4), Japan (12), China (14) and Taiwan (17) (Sharma et al., 2012; Dhital et al., 2015). The use of pesticides in Nepal started with DDT in the early 1950s to eradicate malaria. Different categories of pesticides such as Organochlorines (BHC, Dieldrin), organophosphate (Ethyl parathion, Malathion), carbamates and synthetic pyrethroids were entered in Nepal after 1950s (Atreya, 2008; Shrestha et al., 2010; Kafle et al., 2015).

In Nepal, five hundred different pesticide brands are available (Khanal and Singh, 2016). Farmers are using pesticides to control insects such as brown planthopper and fruit flies. In addition, chemical pesticides have been used to control plant diseases such as late blight of potato and tomato (Atreya, 2008). The pesticide application rate is rising by 10-20% per year (Khanal and Singh, 2016). However, a greater proportion of farmers are unaware of pesticide types, poison level, safety precautions, and pesticide effects on health and environment (Yassin et al., 2002).

Earlier studies have reported Nepalese potato farmers are using several types of pesticides such as organophosphates, pyrethroids and organochlorines. Notably, Endosulfan, Malathion and Mancozeb are still very common among potato farmers of Nepal (Giri et al., 2009). Sharma et al. (2012) reported that pesticide used in potato was very low in Nepal during 1980's. Less than one percent of potato farmers used to spray pesticides during that period. However, a study conducted by Atreya (2005) in central mid-hills of Nepal showed farmers were extensively applying pesticides on potato crops for more than a decade.

Despite the higher use of pesticides, research reports are inconclusive about pesticide handling practices in Panchkhal and Banepa municipalities of Kavrepalanchowk district. Thus, this study aimed to assess knowledge, status, and pesticide handling practices among potato growers in Kavrepalanchok district, Nepal.

METHODOLOGY

Study Site

A household survey was conducted in Kavrepalanchok district of Nepal in 2018. The study site is situated at longitude: 85° 33' 40.32" E, latitude: 27° 31' 33.24" N and an elevation: 280-3018. Two municipalities, Panchkhal and Banepa were selected purposively as these areas were noted for maximum use of pesticides. Banepa (27.6332° N, 85.5277° E) is a mid-hilly region located approximately 25 km east of the capital city of Nepal, Kathmandu. The area experiences a subtropical climate. Moreover, Panchkhal (27.6564° N, 85.6126° E) is a valley

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located approximately 47 km east of the capital city of Nepal, Kathmandu and experiences subtropical climate.

Selection of respondents

The total sampling population size was 1,010. The information about population size was obtained from Potato Super Zone, Kavrepalanchok. From sampling population, 101 respondents were randomly selected. For that, we selected 50 farmers from Banepa (25 each from Shumara and Chunatal), and 51 farmers from Panchkhal (13 each from Shrirampati, Rampur, and Anekot; 6 each from Pipaltar and Tamaghat) municipaliity.

Data collection and analysis

Primary data were collected from potato growers through personal interviews using questionnaire. The data were analyzed using MS-Excel 2016 and SPSS 2009 (SPSS, 2009).

RESULTS AND DISCUSSION

Socio-demographic characteristics

The data analysis indicated that there were 56.4% males and 43.6% females involved in potato farming (Fig. 1). The potato farmers had an average age of 37.31 years with average years of schooling of 6.89. The average family size of the respondents was about 5 members per family. The respondents had cultivated potato in a medium scale (0.445 ha) (Table 1).

Table 1. Socio-demographic characteristics of the respondents in Panchkhal and Banepa, Kavrepalanchowk (N =101).

Parameters	Mean	SD	SE
Age (years)	37.31	11.54	1.149
Education (schooling years)	6.89	4.67	0.464
Family size (number)	5.435	2.325	0.040
Potato cultivated land (ha)	0.445	0.305	0.0304

Source: Field Survey, 2018

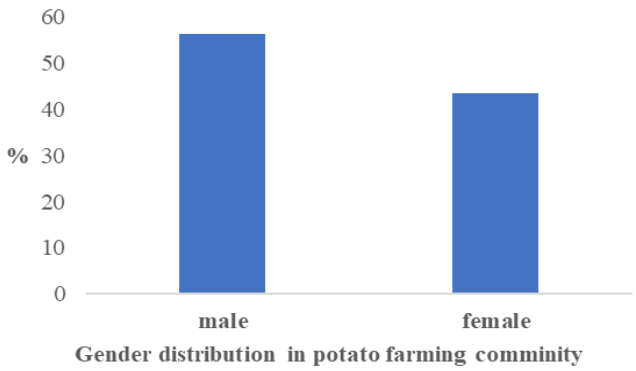

Fig. 1. Gender distribution in potato farming community in Panchkhal and Banepa, Kavrepalanchowk

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Pesticides handling practices

Pesticides handling practices in Kavrepalanchok is shown in Table 2. Majority (57.4%) of the pesticide applicators were males. Nearly 61% of the farmers used power sprayer, whereas 39% used Knapsack sprayer. The probable reason could be associated with easy handling, low cost, and high efficiency of the power sprayer. Almost 94% of the farmers sprayed pesticides against early and late blight diseases, and only 6% respondents applied pesticides against insects and weeds. This infers that the fungal infestations are higher compared to other pests in the potato field. More than half of the farmers had applied pesticides before disease and pest infestation. Almost 38% of the farmers had applied pesticides after pest appeared in the field. Nearly 11% of the farmers sprayed pesticides after pests damage their crops. A study conducted by Rijal et al. (2018) in Chitwan district reported that about 54% of the farmers sprayed pesticides right after the appearance of pests. Two-fifths of the potato growers did not account for windy days for pesticide spraying. Wind may divert pesticides from targeted crops leading to pesticide wastage as well as human health problems. Khanal and Singh (2016) reported 90% farmers in Chitwan district considered wind direction during pesticide application. In the study area, a total of 95% farmers had not treated seed before potato sowing. Almost three-fifths of the potato growers had not applied any chemicals during potato seed storage at home. Nearly 21, 12, and 5% farmers used Malathion, Novan and Metacid respectively to control Potato Tuber Moth (PTM) during potato seed storage.

Table 2. Pesticide handling practices in Panchkhal and Banepa, Kavrepalanchowk (N =101).

Parameters	Frequency	Percent
Pesticide applicator		
Male	58	57.4
Female	43	42.6
Equipment used for spraying		
Power sprayer	62	61.4
Knapsack sprayer	39	38.6
Pesticide used against		
Insects and weeds	6	5.9
Early and late blight (fungus)	95	94.1
Situation of pesticide use		
Before infestation of disease and appearance of pests	52	51.5
After appearance of pests	38	37.6
After damage seen in crops	11	10.9
Pesticide application during windy days		
Yes	40	39.6
No	61	60.4
Seed treatment before potato sowing		
No	96	95
Yes	5	5
Pesticide used during potato seed storage at home		
No chemical used	63	62.4
Malathion powder (For PTM)	21	20.8
Novan (For PTM)	12	11.9
Metacid (For PTM)	5	5

Source: Field Survey, 2018, PTM = Potato Tuber Moth

More than half of the farmers stored pesticides in a storeroom whereas only 4% used kitchen to store pesticides (Fig. 2). A similar report was mentioned by Shrestha et al. (2010) that

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majority of the farmers store pesticide in a storeroom in the Dhading district. Farmers should store chemical pesticides in a safe place to avoid adverse consequences. About 73% of potato farmers had spent 2 to 6 hours per pesticide spray. Nearly 10 and 17% of the farmers had spent <2 hours and >6 hours per pesticide spray (Fig. 3). The majority (83.2%) of the farmers reentered potato field at an interval of 5-17 days (Fig. 4). A slightly different result was reported by Shrestha et al. (2010) in Dhading district who found that farmers (76.6%) reentered crop field within 0-4 days of pesticide spray. An early entry in pesticides sprayed field results several health problems such as cancer, skin irritation, breathing, and eye problems due to pesticidal exposure. All potato farmers had applied pesticides >2 times/season. Ninety-three percent of the farmers had sprayed pesticides 2 to 6 times/season. Nearly 7% farmers had applied pesticides >10 times/season (Fig. 5). A similar result was observed in Chitwan district. Around 58% of Chitwan's farmers had sprayed pesticides >4 times/season whereas 38% farmers applied pesticides 1-3 times/season (Rijal et al., 2018). The study conducted by Khanal and Singh (2016) also showed an increasing trend of unrestricted use of pesticides by vegetable farmers in Chitwan district. Confusion among farmers to identify the specific cause of crop damage either due to biotic stress (insects, plant diseases and weeds) or abiotic stress particularly drought resulted false perception among farmers that increasing pesticide dose improve crop production. Integrated pesticide management strategies with minimal chemical pesticide dose along with growth stage-based irrigation would be a better fit for low input farming conditions (Katuwal et al., 2018).

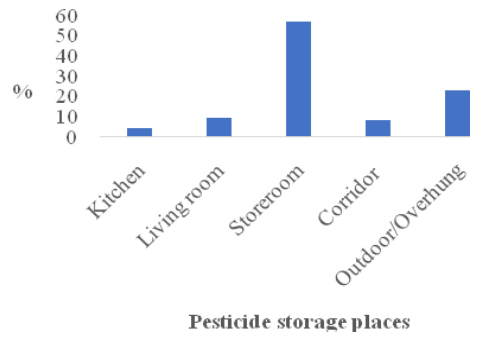

Fig. 2. Pesticides storage places in Panchkhal and Banepa, Kavrepalanchowk

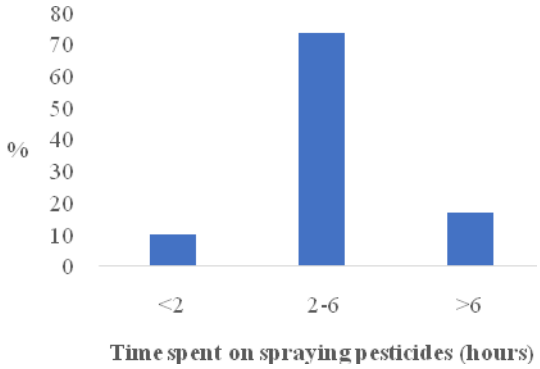

Fig. 3. Time spent on spraying pesticides in potato field in Panchkhal and Banepa, Kavrepalanchowk

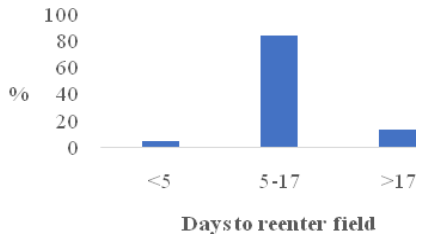

Fig. 4. Days to reenter in potato field in Panchkhal and Banepa, Kavrepalanchowk

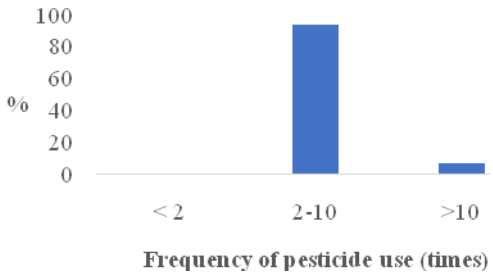

Fig. 5. Frequency of pesticide used/season in potato field in Panchkhal and Banepa,

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Knowledge about pesticides handling practices

Knowledge about pesticide handling practices among potato growers in Kavrepalanchok is shown in Table 3. The majority (71.3%) of the farmers did not read the icon of pesticide labels present on the containers. Low level of education, lack of awareness and use of international language probably reasoned carelessness among the potato farmers. Pesticides labels provide information about hazardous levels, waiting period, application procedures, and precautions. Khanal and Singh (2016) reported that illiterate farmers have difficulty in understanding the instructions and follow safety measures during pesticide application. Awareness and training programs about crop farming and pesticide handling strategies could help farmers to reduce the misuse of inputs and eventually to enhance crop production (Sapkota and Sapkota, 2019). In the study area, 95% of the farmers had received suggestions from agrovets. Previous studies also demonstrated the role of agrovets in information dissemination. For example, Rijal et al. (2018) in Chitwan district reported that a major portion of the farmers (55%) entirely rely on agrovets for technical help. This implies that the Nepalese government is almost passive in disseminating information about pesticide to farmers. Our result indicated that a small portion of potato growers were Integrated Pest Management (IPM) trained (12.9%) and practitioners (24.8%). Similarly, Shrestha et al. (2010) and Atreya (2005) also reported that a very low number of Nepalese farmers have heard about IPM techniques. Provision of farmer training and extension services could solve pesticide problems along with enhanced farm production (Mahat et al., 2019). IPM techniques emphasize the physical and biological control of pests along with no or minimal use of chemical pesticides. (Konradsen et al., 2003). Training also contributes to higher potato production as it provides the farmers with information about safe handling, storage, application, and disposal of pesticides.

Furthermore, Shrestha and Subedi (2019) reported that the application of good agricultural practices enhances crop production without hampering the environment and climate.

Table 3. Knowledge on pesticide handling practices in Panchkhal and Banepa, Kavrepalanchowk (N =101).

Parameters	Frequency	Percent
Pesticide label readers		
No	72	71.3
Yes	29	28.7
Suggestions received from		
Super zone	4	4
Agrovets	96	95
Radio/Pamphlet	1	1
IPM training participants		
No	88	87.1
Yes	13	12.9
IPM practitioners		
No, I have no idea	76	75.2
Yes	25	24.8

Source: Field Survey, 2018

Status of pesticide use

Around 44% potato farmers reported the problem of new pests and diseases. Similarly, 9% respondents felt increment in frequent pests and disease. However, 28% respondents reported declining trend of regular potato pests and diseases (Fig. 6). This implies that major portion

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of farmers do not keep accurate records about crop pest incidence, pest's trend and pesticide application.

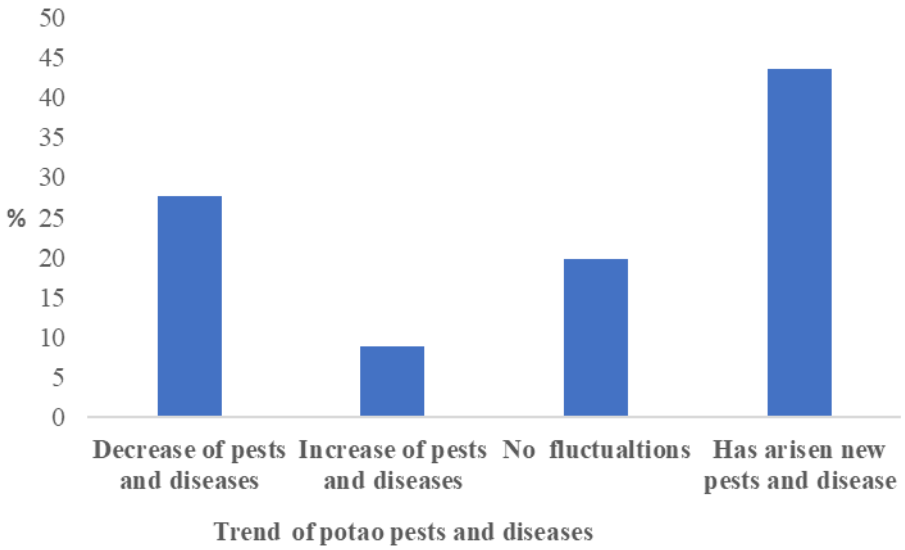

Fig. 6. Trend of potato pests and diseases in Pachkhal and Banepa, Kavrepalanchowk

The average fungicide and insecticide dose used by the potato farmers in the study area was 1.690 caps/tank. Similarly, the average weedicide dose used by the potato farmers was 2.054 caps/tank. The mean number of farmers applying more than one pesticide in a single day was 0.940.

Table 4. Status of pesticide used in Panchkhal and Banepa, Kavrepalanchowk (N=101).

Particulars	Mean	SD	SE
Fungicide and insecticide dose (caps/tank)	1.690	0.579	0.058
Weedicide applied dose (caps/tank)	2.054	0.740	0.122
More than one pesticide users in a single day (numbers)	0.940	0580	0.057

Source: Field Survey, 2018,1 tank = 16 liters

In the study area, pesticides have been used for a long time. Nearly 75 % of the respondents started to use pesticides since a decade ago (Fig. 7).

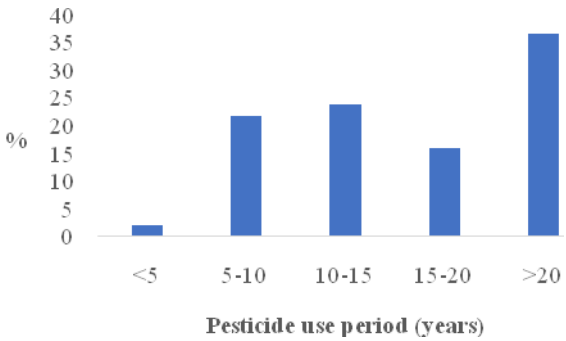

Fig. 7. Pesticide use period in Potato field in Panchkhal and Banepa, Kavrepalanchok

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Status of Personal Protection

The result indicated that no farmers used complete personal protective equipment (PPE) during pesticide application. The majority of the farmers used a face mask (70.3), rubber boots (54.5) and long sleeves clothes (69.1%) during pesticide application. Notably, the proportion of the farmers wearing gloves (31.7), google (11.9), hat (37.6), and apron (35.6%) were very less (Fig. 8). The probable reason could be a lack of awareness, high cost of personal protective apparel, carelessness and feeling of discomfort. A similar result was reported in Chitwan (Rijal et al., 2018) that majority of the farmers wore facemask along with gloves and long-sleeved clothes during pesticide spray. The result was further supported by Koirala et al. (2010) who reported that 70% of Nepalese farmers use PPE. In contrast, a study in Kavrepalanchok (Atreya et al., 2008) found that only 10% farmers wear face masks during pesticide application. A total of 85% farmers have had the whole body shower after pesticide spraying, whereas 15% farmers only washed their feet but had not taken (Fig. 9). Khanal and Singh (2016) also reported that the majority (72%) of the commercial vegetable farmers in Chitwan district have had whole body shower after pesticide spray but 14% farmers washed their hands and feet but had not taken a shower. Furthermore, Koirala et al. (200) mentioned that nearly 52% farmers had taken whole body shower after pesticide application. A good proportion of farmers (94.1%) washed personal protective equipment after pesticide spray (Fig. 9). Our result indicated that the majority (65.3%) of the potato farmers in Kavrepalanchowk threw pesticide containers inappropriately in an environment (Fig. 10). This may be due to either carelessness or low education of the farmers. A previous study in Chitwan (Khanal and Singh, 2016) also reported that 74% of the commercial vegetable farmers had thrown pesticide containers in a nearby water source. A very similar finding was observed by Shrestha et al. (2010) among vegetable growers in the Dhading district. Farmers should properly dispose pesticide containers in order to minimize risks to humans and the environment.

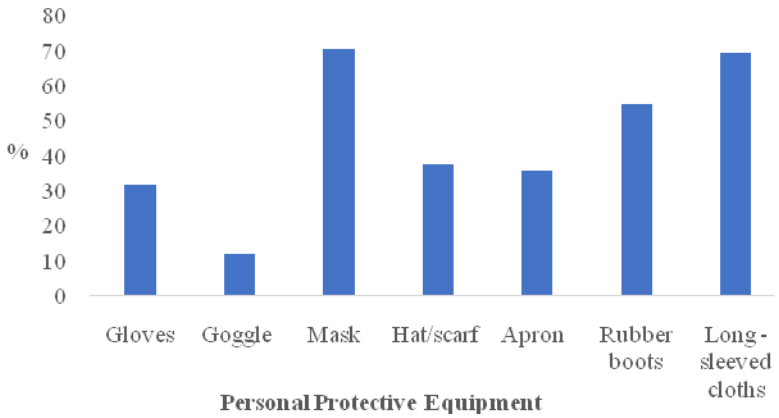

Fig. 8. Personal protective equipment used by potato growers in Panchkhal and Banepa, Kavrepalanchok

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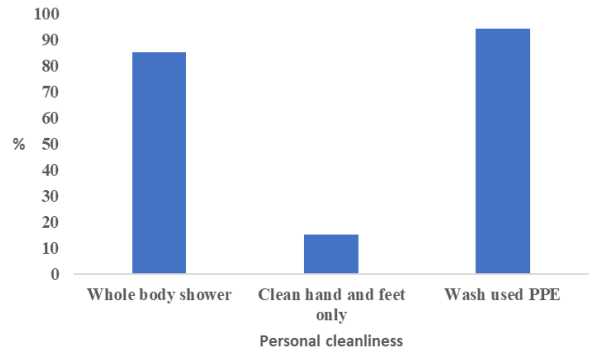

Fig. 9. Personal cleanliness methods adopted by potato growers in Panchkhal and Banepa, Kavrepalanchok

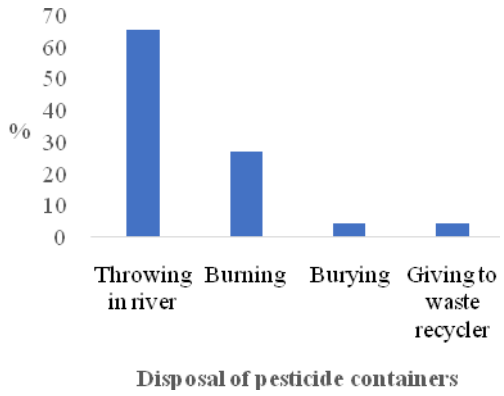

Fig. 10. Disposal of pesticide containers in Panchkhal and Banepa, Kavrepalanchok

CONCLUSION

In summary, farmers' age, education, training (IPM and pesticide) and use of personal protective equipment are the primary factors in safe pesticide handling practices in Kavrepalanchok. Inappropriate handling and application of pesticides could increase health and environmental risks along with increment in crop production cost. In Kavrepalanchowk, farmers are using pesticides haphazardly, ignoring pesticide labels, PPE, and its impacts on non-target pests and the environment as well. The implications of Nepalese agricultural extension and stakeholders are very low in providing pesticide information and IPM training. Concerned bodies should pay attention to provide farmers training on pesticide handling practices and Integrated Pest Management. The awareness should be disseminated on pesticide misuse and the importance of personal protective equipment. Furthermore, pesticide analysis facilities should be established in different parts of Nepal.

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AUTHOR CONTRIBUTIONS

Conceptualization, K.R.S. (Kashi Ram Sapkota) and S.S. (Sundar Sapkota); methodology, K.R.S. (Kashi Ram Sapkota); data collection, K.R.S. (Kashi Ram Sapkota); data analysis, K.R.S. (Kashi Ram Sapkota) and S.S. (Sundar Sapkota); original draft, K.R.S. (Kashi Ram Sapkota); S.S. (Sundar Sapkota); and S.S. (Sanjib Sapkota); Writing- review and editing, S.S. (Sundar Sapkota); S.S. (Sanjib Sapkota); and K.K (Krishna Katuwal).

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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