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Assessment of pesticide use on vegetables in the context of climate change in Dhading and Chitwan district of Nepal

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ABSTRACT

A farmer's field survey was carried out to assess pesticide use status of major vegetables as well as farmers' perception and knowledge of climate change in Dhunibesi municipality of Dhading district and Bharatpur metropolitan city of Chitwan district of Nepal in 2022. A total of 133 farmers were interviewed using semi-structure questionnaire. To analyze the data Microsoft-Excel and Statistical Package for Social Sciences (SPSS) softwares were used. Out of the total land holding, land allocated for vegetable production was 84.4% and 86.4% in Dhunibesi and Bharatpur, respectively. Majority of respondents (73%) were aware of environmental impact of pesticides and 56% experienced human health related problems due to the pesticide application. Moreover, 68.4% used symptoms-based pesticide spray, followed by routine (27.1%) and weather-based (4.5%). Of the total, 88, 85.7, 75.9 and 73.7% of farmers were found to consider expiry date, recommended dose, waiting periods and tag level, respectively, while purchasing pesticides. The majority (52.63%) of the farmers rely on agro-vet recommendations to buy right pesticides followed by their own decision (27.07%) and neighbor recommendation (13.53%), whereas only 6.67% were based on agriculture technician recommendations. Majority of the farmers (82.71%) were using only chemical pesticides. Furthermore, more than half of respondents (56.39%) were somewhat aware of climate change, while only 1.50% had a clearer awareness of it. Of the total, 45.1, 24.3, 18.6, 7.5 and 4.5% of the respondents had experienced excessive rainfall, frost, hailstorm, drought and cold wave, respectively, as a major weather event affecting vegetable production. Awareness, training on pesticide using procedures, safety and precaution measures, Integrated Pest Management (IPM) knowledge and encouragement to use botanical and biological pesticides could be effective ways to combat pest risks. Furthermore, timely weather and climate information helps farmers minimize agricultural risks and human health hazards.

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I. Introduction

Nepal is an agrarian country and agriculture contributes to 23.95% of the national gross domestic product (NRB, 2022). Vegetable farming is an important agricultural sub-sector and significantly contributes to farm economy and farmer's diets. Chemical pesticides are heavily used for commercial vegetable production in Nepal (Rijal et al., 2006). More than 90% of imported pesticides in the country are used in vegetable farming (Ghimire and Arun, 2018). Pesticides are easy to use and give immediate results (Aktar et al., 2009) however, their misuse poses serious problems in agricultural sustainability (Enserink et al., 2013). Specifically, unscientific use of chemical pesticides is a major concern to the farmers of developing countries and Nepal could not be the exception. Farmers have experienced headaches, skin irritation, weakness and some other discomfort by using pesticides (Atreya et al., 2012). Moreover, several chemical pesticides cause human health and livestock problem and adversely impacts plant diversity and environment (Atreya, 2007; Stern et al., 1959; Pimentel et al., 1993).

In Nepal, average consumption of active ingredients (a.i.) of used pesticides is 396 g/ha (Ghimire and Arun, 2018), which is lower than in neighboring countries (e.g., India 0.5 kg/ha and China 14 kg/ha) (Dhital et al., 2015). However, pesticide consumption in the country is increasing by more than 10% per year (Khanal and Singh, 2016) to meet the food demand of growing population. To date, 21 most hazardous pesticides have been banned in the country (Krishi Diary, 2019). Almost 65% of area under Nepalese agriculture is rain-fed (MoPE, 2000), which makes agriculture production highly impactful from uncertain and erratic rainfall. The onset of monsoon rainfall is more unpredictable compared to past (Timilsina et al., 2019a). Based on the report published by Department of Hydrology and Meteorology (DHM), Nepal temperature increment of the country is 0.056°C per annum. Increasing temperature impacts on pest and disease related problems in agriculture (Timilsina et al., 2019a).

Nepal ranked fourth most vulnerable country to climate change. Climate change increased natural hazards and extreme events such as droughts, floods, landslides, soil erosion, avalanches, etc., which are the major threats to agriculture as well as public health. Dhading and Chitwan districts are the major suppliers of vegetables to the Kathmandu valley. Farmers often misuse pesticides (Schreinemachers et al., 2020), which is further enhanced by the impact of climate change. Therefore, the present study was conducted to assess knowledge, perception, and practice of farmers regarding the uses of pesticides and climate change in these districts.

II. Materials and Methods

This study was carried out in Chitwan and Dhading districts of Nepal during 2022. The study locations were Dhunibesi Municipality of Dhading district and Bharatpur Metropolitan City of Chitwan district. These sites were selected because these areas are pockets for commercial vegetable production and farmers are using high volume of pesticides.

Household survey was conducted with 133 farmers using the semi-structured questionnaire considering time and resource availability. Among 133 vegetable growers, 38 were from Dhunibesi Municipality and 95 from Bharatpur Metropolitan City. Sampling was done using a simple random sampling technique having minimum of 0.033 ha (1 kattha) of land under vegetable cultivation. Primary data were collected using household surveys and secondary data were collected using literature and various authentic publications. The data were analyzed using MS-excel and Statistical Package for Social Sciences (SPSS).

III. Results and Discussion

Demographic features

Demographic features include household and farm characteristics of the respondents. These characteristics are discussed briefly here.

Sex of respondents: Proportion of male respondents was higher than female respondents. Male respondents constituted 63.9%, whereas females were only 36.1%. Female respondents were higher in Dhunibesi (Table 01).

Table 01. Sex ratio of respondents at two locations

	Dhunibesi	Bharatpur	Total
Male	18	67	85 (63.9)
Female	20	28	48 (36.1)
Total	38	95	133

Parenthesis indicates percentage

Education of respondents: It is evident that 5.3% of the respondents have university degree, 29.3% have higher secondary level degree, 49.6% of respondents were literate and remaining 15.8% were illiterate (Table 02). Majority of the farmers were literate in both sites. However, none of the respondents had university level education in Dhunibesi.

Table 02. Education status of sample population

	Illiterate	Literate	High school	University degree	Sub-total
Dhunibesi	3	23	12	0	38
Bharatpur	18	43	27	7	95
Total	21 (15.8)	66 (49.6)	39 (29.3)	7 (5.3)	133

Parenthesis indicates percentage

Land holding and income: Average land holding of the respondents in Dhunibesi was 0.45 ha and area under vegetable cultivation was 0.38 ha. However, average land holding of respondents of Bharatpur was 2.20 ha and area under vegetable cultivation was 1.90 ha. Average annual household income of the respondents from vegetable production was NRs 2.36 lakh for Dhunibesi and 8.67 lakh for Bharatpur.

Vegetable crops grown and support received in study sites

Study sites were the pockets of vegetable production. Major vegetables grown in the study area were solanaceous (tomato, brinjal), cole (cauliflower, cabbage), cucurbitaceous (cucumber, pumpkin, gourd) and leguminous (bean, cowpea), etc. Thirty four percent of the farmers had received government support in vegetable production. They had received support mainly in tractors, plastic tunnels and water pumps.

Types of pesticide use

Majority of the farmers (82.7%) were using only chemical pesticides. Out of the total, 15% of farmers were using both pesticides, whereas 2.3% of farmers were using only bio-pesticides in the study site. (Table 03). Mainly farmers purchased chemical pesticides through the agro-vet and some were using home-made bio-pesticides too.

Table 03. Pesticide types used by farmers

	Dhunibesi	Bharatpur	Sub-total
Chemical pesticides	38	72	110 (82.7)
Bio-pesticide	0	3	3 (2.3)
Both	0	20	20 (15)
Sub-total	38	95	133

Parenthesis indicates percentage

Awareness and consideration for pesticide use

About seventy three percent of respondents were aware of environmental impact of pesticides. Similarly, 63% of the respondents were conscious about adverse effects of pesticides on beneficial insects too. Among the users of chemical pesticides, 56% experienced human health related problems due to pesticide use. These results are also to result of Sharma (2015), who reported overuse of pesticides in vegetable farming results in human health hazards and ecosystem degradation. Due to pesticide applications, major problems were skin allergy, respiratory problems, cancer, eye itching, headache and vomiting. Though they have awareness of negative effects of pesticide use in vegetables, farmers (57%) were compelled to use pesticides to minimize the pest risk and potential loss.

Among the respondents, 74.4% considered weather as major factor in deciding time of pesticide application. Rainfall, wind, temperature, frost and dew were the major weather parameters they have been considering. Among respondents, 68.4% used symptoms-based spray, followed by routine-based (27.1%) and weather-based (4.5%). This result is also similar to the result of PRMD (2014), in which >50% of the farmers used pesticides only after the incidence of disease pests.

Of the total, 88, 73.7, 85.7 and 75.9% of survey farmers considered pesticides' expiry date, tag level, recommended dose and waiting periods, respectively, while purchasing the pesticides. In most cases, required pesticides were available timely and adequately. About half of the respondents (52.6%) purchased pesticides based on agro-vet recommendations followed by their own decision (27.1%), neighbor recommendation (13.5%) and technician recommendations (6.8%) (Figure 01).

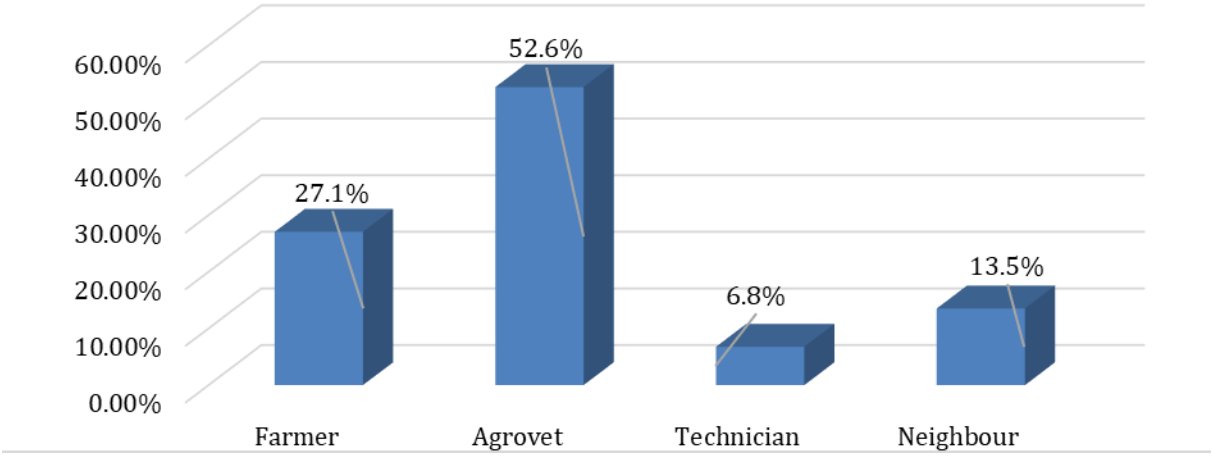

Figure 01. Typical pesticide purchase decision

Climate change awareness and weather hazards

During the study, respondents were asked about climate change. Most of them (56.4%) were aware a little bit of climate change. However, 23.3% were not known about it. The remaining respondents were aware of climate change (Figure 02).

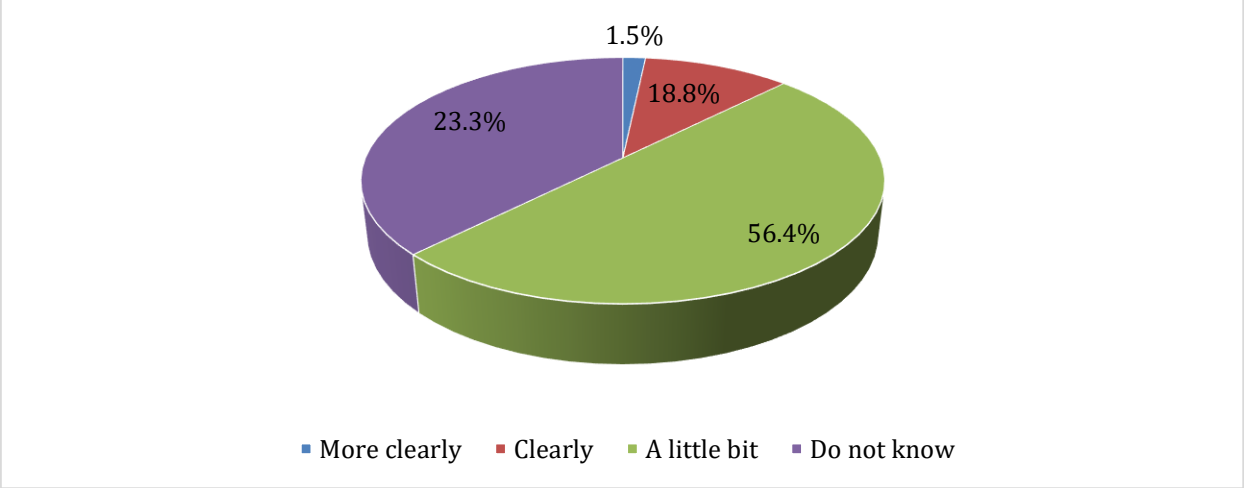

Figure 02. Awareness about climate change

Our findings indicate that most farmers in the study area were potentially vulnerable to increasing hydro-climatic variability. Major weather hazards in the study sites were excessive rainfall, frost, hailstorm, drought and cold waves. Of the total, 45.1, 24.3, 18.6, 7.5 and 4.5% of the respondents had experienced excessive rainfall, frost, hailstorm, drought and cold wave, respectively, as the major weather events affecting vegetable production.

Occurrences of erratic weather are beyond human control. It is possible, however, to adapt to the adverse effects of weather events if expected weather forecast can be obtained in time. In this regard, farmers should be better trained through capacity building programs and activities such as training,

seminar and interaction workshops to utilise the available weather information in agriculture. So that they can better use the available weather information in their farming to combat weather-based risk. Some countries are using agro-met advisory service which helps farmers (Timilsina et al., 2019b) to minimize weather-based risk.

IV. Conclusion

Haphazard use of pesticides in vegetable production adversely impacts human health and environmental problem. Due to lack of the best alternative to chemical pesticides, farmers are compelled to use chemical pesticides to overcome pest damage. Easy and adequate access to biological and botanical pesticides to the farmers and awareness helps minimize the use of chemical pesticides. Training on judicious use of pesticides and knowledge dissemination to adopt IPM could be effective in this regard. There are adequate rules and regulations about pesticide use; however, the effective implementations are mostly questionable, so implementing plans, policy and programs related to pesticide use are inevitable. In the same way, weather and climate-related risks in agriculture are numerous and diverse. So, easy access to weather forecasts, climate related information and agricultural advisory services help to minimize weather-based agricultural risks.

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