P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 7; Issue 4; April 2024; Page No. 90-95

Received: 07-01-2024
Accepted: 10-02-2024

Indexed Journal
Peer Reviewed Journal

# Farmer's knowledge about safe plant protection measures in vegetable crops in Bundelkhand

**[1]Deepak Kumar Pathak, [2]Dheeraj Mishra, [3]Gaurav Shukla, [4]BP Mishra, [5]PK Ojha, [6]Abhishek Kalia and [7]Rakesh Pandey**

[1]Research Scholar, Department of Agricultural Extension, BUAT, Banda, Uttar Pradesh, India

[2, 5]Assistant Professor and Department of Agricultural Extension, BUAT, Banda, Uttar Pradesh, India

[3]Assistant Professor, Department of Statistics and Computer Science, BUAT, Banda, Uttar Pradesh, India

[4]Professor, Department of Agricultural Extension, BUAT, Banda, Uttar Pradesh, India

[6]Assistant Professor, Department of Basic and Social Sciences, BUAT, Banda, Uttar Pradesh, India

[7]Professor, Department of Entomology, BUAT, Banda, Uttar Pradesh, India

**DOI:** https://doi.org/10.33545/26180723.2024.v7.i4b.503

**Corresponding Author:** Dheeraj Mishra

**Abstract**

Farmers' knowledge on pesticides and their safe use of pesticides in the Bundelkhand region of Uttar Pradesh. The research was framed with Ex-post facto design. The study was carried out in 6 villages randomly selected from two blocks of Banda district where vegetable was the major crop. A sample of 90 vegetable growers was randomly selected from selected villages. It was observed that the majority were male, middle aged, possessed medium level of education and having nuclear and large family, social participation very low and annual income upto Rs. 50,000/. While, extension contact and mass media exposures was found on an average level. Research findings show that the majority of vegetable farmers having medium level of knowledge about use of pesticides in vegetable cultivation have (73.33%) vegetable growers. Age, education, mass media and farming experience in vegetable cultivation had positive and highly significant correlation with knowledge while, landholding, social participation and extension contact had a positive and highly significant correlation with knowledge. Appropriate safety precautions must be taken to avoid pesticide-related harms.

**Keywords:** Knowledge, pesticides, safety, vegetable growers, social participation

## Introduction

Growing vegetables provides both income and nutritional security to farm families. Vegetables are a crucial component of our diet since they are so nutrient-dense. According to Taha *et al.*, (2018) [34], vegetables are important sources of dietary fiber, minerals, and vitamins C, A, $B_6$, thiamine, niacin, and E. The world's total vegetable primary production was estimated at 1046 million MT in 2021 (World Data Atlas). India holds the second position, producing 200 million MT, which is about a third of China's output (World Population Review). Uttar Pradesh generated nearly 300.11 MT of vegetables (APEDA, 2023) [33].

Pesticide poisoning is a severe global health problem that is especially prevalent in countries like India. It has been demonstrated that exposure to insecticides can acutely and chronically poison people. Chemical substances known as pesticides are used to get rid of weeds, fungi, rodents, and insects. According to Zhan *et al.*, (2020) [24], Bhatt *et al.*, (2021a) [2], and Zhang *et al.*, (2021a) [26], insecticides, herbicides, nematicides, fungicides, molluscicides, rodenticides, and other substances are examples of pesticides.

The global pesticide consumption in 2019 was approximately 4.19 million MT, where China was by far the largest pesticide-consuming country (1.76 million MT), followed by the United States (408 thousand tons), Brazil (377 thousand tons), and Argentina (204 thousand tons) (Fernández, 2021) [4]. In India, the annual consumption of pesticides is approx. 58720 MT during 2021-22. In India, Maharashtra has 1st rank in consumption of pesticides with 13175MT while Uttar Pradesh has 2nd rank in consumption of pesticides with 11688 MT, (DPPQ&S, 2021-22).

India is a major Asian pesticide producer, manufacturing 90 thousand tons of organochlorine pesticides yearly, notably benzene hexachloride and DDT (Khan *et al.*, 2010; and Pozo *et al.*, 2011). Herbicides make up 47.5% of pesticide contributions, with insecticides accounting for 29.5%, fungicides accounting for 17.5%, and other types of insecticides accounting for 5.5% (Gill and Garg, 2014; Zhang, 2018; Sharma *et al.*, 2019) [5, 21, 25]. Most of the pesticides worldwide are used in vegetable crops. However, farmers are becoming more conscious of the significance of protecting themselves against pesticide-related dangers is still scarce, notably in Banda district. One of the biggest

issues facing man is food material pollution. The consumer faces the biggest exposure risk through tainted food and herbicides emphasis is placed by some on the careless use of pesticides. Farmers' use of excessive chemicals results in agriculture with a variety of repercussions i.e. development of pesticide resistance in the targeted population pest species, pest population growth, secondary pest epidemics, contaminants in feed or food, etc. (Gill *et al.*, 2020) [6]. Pesticides are widely regarded as the most appealing way of pest control because they require less labour and produce more per hectare of land than other methods. Still, the widespread use of these pesticides poses serious health and environmental risks. Pesticides are majorly poisonous and their arbitrary use and abuse can lead to sustainable dissimilarity (Paine, *et al*., 2018) [15]. The current study sought to analyze farmers' understanding of pesticide use and handling, as well as to evaluate their existing pest management strategies in commercial vegetable production.

## Materials and Methods

Uttar Pradesh ranks first in pesticide consumption and second in vegetable production, making it more likely that chemicals will be used to increase vegetable production. Uttar Pradesh state was purposively selected. The research was conducted in the Bundelkhand region of Uttar Pradesh. In Banda district, two blocks, Badokhar Khurd and Tindwari, were selected through simple random sampling. From each selected block, three villages were chosen randomly, thereby making a total of six villages for the study. Out of these villages, 15 vegetable growers were selected through simple random sampling. Thus, the total sample size for the study was 90. In collaboration with subject matter experts, appropriate interview schedules depending on the objectives of the study were created. The data were analyzed using frequency, percentage, mean, standard deviation, and correlation statistics.

## Result

### Socio-economic profile of the respondents

Data presented in table 1 revealed the Socio-demographic status of surveyed vegetable growers in the study area, a total of 13 variables were selected for assessing the socio-economic status of vegetable growers, and data were analyzed which indicates (94.40%) are male and the remaining (5.60%) share female, the majority of aged between 29-53 (66.66%). Most vegetable growers (21.10%) completed high school and (20.00%) were illiterate. Respondents with a higher level of education accounted for only (12.20%). These results are in accordance with (Mubushar *et al.*, 2019 and Yassin *et al.*, 2002) [11, 23], who reported that a higher level of education accounted for only (14.40%) and (13.20%) respectively. The findings of Rios-Gonzalez *et al.*, (2013) [19] are in close conformity with that literate farmers comprehend the impacts of pesticides on health and the environment better than illiterate farmers. The majority of vegetable growers (88.88%) belonged to the OBC caste, followed by the SC caste (11.12%), and families were found nuclear (62.22%) while the majority of vegetable growers had a large family size 51.11% (more than 5 members). The majority of vegetable growers 68.88% fall into the marginal landholding category, while, 24.44% fall into the small landholding category, and the majority of farmers (45.60%) were solely dependent on farming. The majority of vegetable growers (66.66%) were in the low-income category (Annual income up to 50,000), followed by 22.22% in the medium-income category (annual income 50,001/- to 1,00,000/-) and (45.60%) were not a member of any organization, while 54.40% members were associated with various organizations. 76.66% of respondents had a medium level of farming experience, followed by a high level (13.33%). 83.30% of vegetable growers are attached to the input agency.

### Distribution of frequency and percentage based on knowledge of the respondents

The study revealed that none of the respondent vegetable growers had received any training on the judicious use of pesticides. Lack of farmers' training affects their knowledge and practices of pesticide safety use (Damalas and Koutroubas, 2017) [3]. It was found that the majority of the vegetable growers (82.20%) were able to identify two major insect pests, 64.40 percent of vegetable growers were able to identify two major diseases of vegetable crops and 61.10 percent of vegetable growers could identify two weeds of vegetable crops. We found most of the respondents said empty pesticide containers crush and burry in the soil after the use of pesticides. Nguyen *et al.*, (2018) [14] reported that many of the vegetable growers surveyed stated that they gathered and stored empty pesticide containers outside their homes in secure locations before transporting them to designated locations where pesticide companies would collect and handle them. According to Yassin *et al.*, (2002) [23], a total of 185 farm workers (97.9%) were cognizant of the detrimental effects of pesticides on human health. A total of 155 (83.8%) of those agricultural workers knew that not all pesticides had the same negative impacts on health when asked additional questions concerning the extent of the health impact of pesticides. 183 people (96.8%) were also found to be familiar with the names of the pesticides they were employing. The percentages of people who were aware of biological and natural control as substitutes to pesticides were 23 (12.2%) and 36 (19.0%), respectively.

Only 17.80 percent of vegetable growers knew the appropriate chemicals/pesticides for pest control in vegetable crops. Only 7.80 percent of vegetable growers were able to identify the color labels/toxicity labels given on pesticide packets/bottles. More than 70 percent of respondents did not agree that pesticide bottles are admissible to wash them in the pond/canal/river.

**Table 1:** Socio-economic profile of the respondents

| Category | | Frequency | % |
|---|---|---|---|
| Age in years | Young (Below 29) | 15 | 16.66 |
| | Middle Age (29 to 53) | 60 | 66.66 |
| | Old Age (Above 53) | 15 | 16.66 |
| Sex | Male | 85 | 94.40 |
| | Female | 5 | 5.60 |
| Education | Illiterate | 18 | 20.00 |
| | Primary School | 14 | 15.60 |
| | Middle School | 18 | 20.00 |
| | High School | 19 | 21.10 |
| | Intermediate | 10 | 11.10 |
| | College Education | 11 | 12.20 |
| Family Type | Nuclear | 56 | 62.22 |
| | Joint | 34 | 37.78 |
| Family Size | Small (< 5 Members) | 44 | 48.89 |
| | Large (> 5 members) | 46 | 51.11 |
| Occupation | Farming and caste-based occupation | 12 | 13.30 |
| | Farming and wage | 34 | 37.80 |
| | Farming | 41 | 45.60 |
| | Farming & Service | 3 | 3.30 |
| Housing Pattern | Kachcha | 51 | 56.0 |
| | Mixed | 35 | 38.90 |
| | Pucca | 4 | 4.40 |
| Land Holding | Marginal (below 1 ha.) | 62 | 68.88 |
| | Small (1.0 to 2.0 ha.) | 22 | 24.44 |
| | Semi-Medium (2.0 to 4.0 ha.) | 4 | 4.44 |
| | Medium (4.0 ha to 10.0 ha) | 2 | 2.22 |
| | Large (>10ha.) | 0 | 0.00 |
| Annual Income | Upto Rs. 50,000/- | 60 | 66.66 |
| | 50,001/- to 1,00,000/- | 20 | 22.22 |
| | More than 100,000/- | 10 | 11.11 |
| Social Participation | Not a member of any organization | 41 | 45.60 |
| | Members of one organization | 28 | 31.10 |
| | Member of two organizations | 21 | 23.30 |
| Farming Experience | Low (Below 12 years) | 9 | 10.00 |
| | Medium (12 to 30 years) | 69 | 76.66 |
| | High (Above 30 years) | 12 | 13.33 |
| Extension Contact | **Frequency Contact** | | |
| Organization | **Often** | **Sometimes** | **Never** |
| | **f (%)** | **f (%)** | **f (%)** |
| University Scientist | 9 (10.00) | 5 (5.60) | 76 (84.40) |
| KVK | 7 (7.80) | 4 (4.40) | 79 (87.80) |
| DAO/DHO | 1 (1.10) | 00 | 89 (98.90) |
| DEO | 00 | 00 | 90 (100.00) |
| NGOs | 2 (2.20) | 00 | 88 (97.80) |
| Input Agencies | 75 (83.30) | 13 (14.40) | 2 (2.20) |
| Others | 00 | 00 | 90 (100.00) |
| **Mass Media Exposures** | **Regularly** | **Occasionally** | **Never** |
| | **f (%)** | **f (%)** | **f (%)** |
| Listening to radio | 00 (00) | 00 (00) | 90 (100.00) |
| Viewing TV | 12 (13.30) | 8 (8.90) | 70 (77.80) |
| Reading newspaper | 6 (6.70) | 17 (18.90) | 67 (74.40) |
| Reading farm magazines | 00 (00) | 00 (00) | 90 (100.00) |

The inability of farmers to read and understand the toxicity label was also reported by Jallow *et al.*, (2017) [7] and Mishra and Ghadei (2015) [10]. According to Rijal *et al.*, (2018) [18], reading the pesticide label and according to the application directions are crucial for safe handling. Only 12% of farmers were uninformed of the hazards and ill effects associated with pesticides, while the majority of farmers (88%) were. Similar findings were seen in a prior study, where 12.3% of the producers polled in Pakistan said that pesticides posed no risk at all. Farmers read the label before using pesticides in about 34% of cases. 56 percent of them are aware of it, and 31% are aware of the importance and mode of action of pesticides but are unaware of how to use them safely. In their survey, just 16% of farmers accurately identified the herbicide toxicity colour codes printed on the Label. However, Nguyen *et al.*, (2018) [14] observed that after appropriate training, 97 percent of the respondents were able to read the labels and instructions provided with the pesticide containers. While 72.20 percent of vegetable growers were aware about the types of personal

protective equipment to be used at the time of pesticide application. Only 10 percent of vegetable growers had knowledge about first aid to be given in case of pesticide poisoning. Rahaman *et al.*, (2018) [17] stated that practically all of the users claimed to have read the pesticide containers' printed instructions, understood their danger, and kept the pesticides out of children's reach. Most farmers who used pesticides in the field washed their hands with soap (90.83%); a small number did so with soil, ash, and water; 86.66% washed their bodies after spraying; 66.66% disposed of empty pesticide containers; 68.33% prevented domestic animals from entering sprayed rice fields; and 32.5% took no safety precautions at all. Mostly farmers applied pesticides in the morning (78.89 percent) and in spot-specific areas (72.22 percent). However, Nguyen *et al.*, (2018) [14] were revealed that the majority of pesticides were used in the afternoon (52 percent) and 41 percent of pesticides applied directly on targeted plants.

The majority of vegetable growers' pesticide spraying practices should be done when the weather is windy which was reported similarly by Nguyen *et al.*, (2018) [14]. A total of 72.20 percent of the respondents were aware about the personal protective equipment at the time of pesticidal spraying while, 6.70 percent of respondents were not aware. More or less present findings in accordance with the report of Yassin *et al.*, (2002) [23] who found that burning sensation in the eyes/face was the commonest symptom (64.3%).

**Table 2:** Knowledge of respondents about the use of pesticides in vegetable crops

| Statements | No answer | One answer | Two answers |
|---|---|---|---|
| Name of two major insect pests of the vegetables you cultivate | 00 (00) | 16 (17.80) | 74 (82.20) |
| Name of two major diseases of the vegetables you cultivate | 00 (00) | 32 (35.60) | 58 (64.40) |
| Name two major weeds of the vegetables you cultivate | 8 (8.90) | 27 (30.00) | 55 (61.10) |
| Name two chemicals for Insects & Pest control in vegetables | 39 (43.30) | 35 (38.90) | 16 (17.80) |
| What personal protective equipment should be used at the time of pesticide spraying? | 6 (6.70) | 19 (21.10) | 65 (72.20) |
| What are the harmful effects of insecticides? | 42 (46.70) | 38 (42.20) | 10 (11.10) |
| What are the different symptoms of insecticide poisoning? | 25 (27.80) | 21 (23.30) | 44 (48.90) |
| What first aid should be followed in case of insecticide poisoning? | 52 (57.80) | 29 (32.20) | 9 (10.00) |

| Statements | Answer | No answer |
|---|---|---|
| Name of any chemical recommended for seed treatment in vegetables | 9 (10.00) | 81 (90.00) |
| Give the dosage of seed-treating chemical per kg of seed | 4 (4.40) | 86 (95.60) |
| Give one advantage of seed treatment | 6 (6.70) | 84 (93.30) |
| After how many days of spraying pesticides the crop can be harvested? | 12 (13.30) | 78 (86.70) |
| Why shouldn't crops be harvested immediately after the spraying of pesticides? | 77 (85.60) | 13 (14.40) |
| What are the don'ts while spraying pesticides? (Eating/Smoking/Drinking/All of the above) | 71 (78.90) | 19 (21.10) |
| Name any banned pesticide. | 10 (11.10) | 80 (88.90) |
| It is necessary to inspect pesticide containers for leaks before handling them (true /false) | 36 (40.00) | 54 (60.00) |
| Changing clothes is necessary after spraying (true /false) | 28 (31.11) | 62 (68.89) |
| The sprayer should be washed after the application of herbicide for the next spray (true /false) | 75 (83.33) | 15 (16.67) |
| It is admissible to wash the used pesticide bottle in the pond/canal/river (true /false) | 64 (71.10) | 26 (28.90) |
| Where should empty pesticide containers be disposed of after use? | F | % |
| i) Throw in the field | 20 | 22.22 |
| ii) Crush and bury in the soil | 50 | 55.55 |
| iii) Reuse | 18 | 20.00 |
| iv) None of the above | 2 | 2.23 |

| Statements | Responses F (%) | |
|---|---|---|
| Insecticide application should be | Spot specific 65 (72.22) | Whole area 25 (27.78) |
| Right time for spraying pesticide? | Morning 71 (78.89) | Afternoon 19 (21.11) |
| Pesticide spraying should be done when the weather is | Windy 78 (86.67) | Rainy 12 (13.33) |

**Knowledge of the safe use of pesticides**

The knowledge level of vegetable growers refers to their awareness and skills to efficiently utilize or apply pesticides which was measured through a knowledge test. After obtaining the responses a knowledge index was developed. The findings of the study are shown in Table 3 & Figure 1 clearly show that the majority of respondents (73.33%) had a medium level of knowledge about the use of pesticides, followed by a low level of knowledge (14.45%). Only 12.22 percent of vegetable growers had a high level of knowledge about the safe usage of pesticides. The mean value of the knowledge test was found 21.66 and the value of the standard deviation was 3.92.

**Table 3:** Distribution of vegetable growers according to their knowledge of the safe use of pesticides n=90

| Sl. No. | Category | Frequency | % |
|---|---|---|---|
| 1. | Low-level knowledge | 13 | 14.45 |
| 2. | Medium level knowledge | 66 | 73.33 |
| 3. | High-level knowledge | 11 | 12.22 |
| | Total | 90 | 100.00 |

Mean = 21.66; SD=3.92

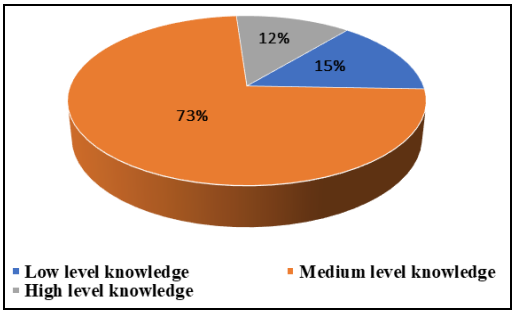


**Fig 1:** Distribution of vegetable growers according to their knowledge of the safe use of pesticides.

**Association between selected independent variables and knowledge of respondents about the use of pesticides**

In order to study the relationship between selected independent variables and the Knowledge of respondents about the use of pesticides, the correlation coefficient (r) was computed and the value is presented in Table 4.

**Table 4:** Relationship between selected independent factors and respondents' pesticide Knowledge

| S. No. | Variables | Independent Variable | Correlation Coefficient ('r' value) |
|---|---|---|---|
| 1. | $X_1$ | Age | 0.391** |
| 2. | $X_2$ | Education | 0.394** |
| 3. | $X_3$ | Caste Category | -0.084 |
| 4. | $X_4$ | Family Size | -0.190 |
| 5. | $X_5$ | Family Type | -0.148 |
| 6. | $X_6$ | Housing Pattern | -0.150 |
| 7. | $X_7$ | Land Holding | 0.482** |
| 8. | $X_8$ | Occupation | 0.131 |
| 9. | $X_9$ | Annual Income | 0.114 |
| 10. | $X_{10}$ | Social Participation | 0.461** |
| 11. | $X_{11}$ | Farming experiences | 0.436** |
| 12. | $X_{12}$ | Extension contacts | 0.579** |
| 13. | $X_{13}$ | Mass media exposure | 0.242* |

** Significant at the 0.01 level of significance
* Significant at the 0.05 level of significance

Table 4 depicted that the age, education, land holding, social participation, farming experiences, and extension contacts were found positive and highly significantly related to the knowledge of the respondents with the calculated value of the coefficient of correlation ('r' =0.391, 0.394, 0.482, 0.461, 0.436, 0.579 respectively). It can be understood as the higher the age, education, land holding, social participation, and extension contacts of farmers, the higher their farming experience would be, which leads to better learning of pesticide application. The results are in close conformity with the findings of Neupane *et al.*, (2014) [13], Al-Zyoud (2014) [1], and Lekei (2014) [9]. Neupane *et al.*, (2014) [13] stated that illiterate farmers lacked pesticide knowledge, whereas Shafiee *et al.*, (2012) [20] observed that farmers who participated in extension and education courses had a greater understanding of pesticide-specific difficulties. Nazarian *et al.*, (2013) [12] also concluded that better access to information communication channels increased the knowledge of farmers.

Table 4 showed that caste, family size, family type, and housing pattern were negatively non-significantly correlated to the knowledge of the vegetable growers. The computed coefficient of correlation of value ('r' =-0.084, -0.190, -0.148, -0.150 respectively). Hence, it may be concluded that caste has no significant relationship with knowledge.

However, variables like occupation ('r'= 0.131) and annual income ('r'= 0.114) were depicted as non-significant but mass media exposure shows a positively significant (0.242) relation with the knowledge of vegetable growers on pesticides.

## Conclusion

It can be concluded that age, education, mass media exposure, and farming experience were shown to be strongly connected with knowledge. Farmers utilize chemical pesticides as an effective pest control method. a summary of the report, most farmers know very little about pesticides, including their use, types, characteristics, selection, and overall treatment. Inadequate pesticide management and indiscriminate pesticide use may cause health hazards and result in expenses for farmers and consumers alike. Label instructions should be written in clear language that the user can understand. According to the findings, one of the most essential aspects of imparting knowledge and developing awareness about safe pesticide use in vegetable growing. To change this situation, educational and training initiatives on pesticide handling and safety precautions are advised. Finally, because it includes efforts to alter farmer behaviour, the problem of unsafe farming practices, which has been documented in this study and many others, is complicated. Even though the solutions presented here aim to solve this issue, more qualitative research must be conducted to do so fully.

## Implications

Based on current research, it is advised that a grassroots awareness campaign is necessary to influence and inspire vegetable growers to reduce pesticide exposure. To educate farmers about personal safety, literature should be created and circulated. It may cover one or all areas of personal safety, such as exposure to pesticides, using chemicals safely, reading and understanding pesticide label directions, etc. Pieces of training and workshops should be planned by extension organizations specifically for the farmers who are most at risk. In addition to training, policies should be implemented to promote the safe use of pesticides.

## References

1. Al-Zyoud FA. Indiscriminate Use and Improper Application of Pesticides by Jordanian Vegetable and Fruit Farmers. Bulletin of Faculty of Agriculture, Cairo University. 2014;65(4):344-359.
2. Bhatt P, Joshi T, Bhatt K, Zhang W, Huang Y, Chen S. Binding interaction of glyphosate with glyphosate oxidoreductase and C–P lyase: Molecular docking and molecular dynamics simulation studies. Journal of Hazardous Materials. 2021 May 5;409:124927. DOI:10.1016/j.jhazmat.2020.124927.
3. Damalas CA, Koutroubas SD. Farmers' training on pesticide use is associated with elevated safety behavior. Toxics. 2017 Aug 22;5(3):19.
4. Fernández L. Global pesticide use by country | Statista 2021 [Internet]. [cited 2022 May 31]. Available from: https://www.statista.com/statistics/1263069/global-

pesticide-use-by-country/
5. Gill H, Garg H. Pesticides: Environmental Impacts and Management Strategies, Pesticides-Toxic Aspects. London: IntechOpen; 2014. DOI:10.5772/57399
6. Gill JS, Sharma A, Sharma S. Plant Protection Measures use Behaviour of Vegetable Growers in Punjab State. Indian Journal of Extension Education. 2020;56(4):111-114.
7. Jallow MF, Awadh DG, Albaho MS, Devi VY, Thomas BM. Pesticide Knowledge and Safety Practices Among Farm Workers in Kuwait: Results of A Survey. International Journal of Environmental Research and Public Health. 2017;14(4):1-15.
8. Khan MJ, Zia MS, Qasim M. Use of pesticides and their role in environmental pollution. World Acad Sci Eng Technol. 2010 Dec 25;72:122-8.
9. Lekei EE, Ngowi AV, London L. Farmers' Knowledge, Practices and Injuries Associated with Pesticide Exposure in Rural Farming Villages in Tanzania. BMC Public Health. 2014;14(1):1-13.
10. Mishra D, Ghadei K. Socio-Economic Profile of Vegetable Farmers in Eastern Uttar Pradesh. Indian Journal of Agriculture and Allied Sciences. 2015;1(2):25-28.
11. Mubushar M, Aldosari FO, Baig MB, Alotaibi BM, Khan AQ. Assessment of farmers on their knowledge regarding pesticide usage and biosafety. Saudi Journal of Biological Sciences. 2019;26(7):1903-1910.
12. Nazarian M, Ajili AA, Akbari M, Rostami F. Knowledge, Attitude and Environmental Safety Behaviors of Vegetable Growers in Use of Pesticides in South West of Iran. International Journal of Agronomy and Plant Production. 2013;4(8):1844-1854.
13. Neupane RRK, Wantamutte AS, Banjade B, Kushwaha N, Neupane R. Practice of Pesticides Use Among the Farmers of Kangrali Village in Belgaum – A Cross-sectional Study. International Journal of Interdisciplinary and Multidisciplinary Studies. 2014;1(5):202-207.
14. NguyeN TM, Le NTT, HaVukaiNe NJ, HaNNaway DB. Pesticide use in vegetable production: A survey of Vietnamese farmers' knowledge. Plant Protection Science. 2018;54(4):203-214.
15. Paine AK, Saha A, Tiwari PK, Dhakre DS, Gupta RK. Constraints perceived by the vegetable growers towards excessive use of chemicals in Bankura district of West Bengal. Indian Journal of Extension Education. 2021;57(3):45-47.
16. Pozo K, Harner T, Lee SC, Sinha RK, Sengupta B, Loewen M, Geethalakshmi V, Kannan K, Volpi V. Assessing seasonal and spatial trends of persistent organic pollutants (POPs) in Indian agricultural regions using PUF disk passive air samplers. Environmental Pollution. 2011 Feb 1;159(2):64653. DOI:10.1016/j.envpol.2010.09.025.
17. Rahaman MM, Islam KS, Jahan M. Rice farmers' knowledge of the risks of pesticide use in Bangladesh. Journal of Health and Pollution. 2018 Dec 1;8(20):181203.
18. 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. Agriculture. 2018 Jan 22;8(1):16.
19. Ríos-González A, Jansen K, Sánchez-Pérez HJ. Pesticide risk perceptions and the differences between farmers and extensionists: Towards a knowledge-in-context model. Environmental Research. 2013 Jul 1;124:43-53.
20. Shafiee F, Rezvanfar A, Hashemi F. Vegetable growers in southern Tehran, Iran: Pesticides types, poisoning symptoms, attitudes towards pesticide-specific issues and environmental safety. African Journal of Agricultural Research. 2012 Feb 5;7(5):790-6.
21. Sharma A, Kumar V, Shahzad B, Tanveer M, Sidhu GP, Handa N, Kohli SK, Yadav P, Bali AS, Parihar RD, Dar OI. Worldwide pesticide usage and its impacts on ecosystem. SN Applied Sciences. 2019 Nov;1:1-6.
22. Ülger TG, Songur AN, Çırak O, Çakıroğlu FP. Role of vegetables in human nutrition and disease prevention. In: Veg. Importance Qual. Veg. Hum. Health. London: IntechOpen; 2018. p. 7-32. DOI:10.5772/intechopen.77038.
23. Yassin MM, Mourad TA, Safi JM. Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. Occupational and Environmental Medicine. 2002;59(6):387-393.
24. Zhan H, Huang Y, Lin Z, Bhatt P, Chen S. New insights into the microbial degradation and catalytic mechanism of synthetic pyrethroids. Environmental Research. 2020 Mar 1;182:109138. DOI:10.1016/j.envres.2020.109138.
25. Zhang W. Global pesticide use: Profile, trend, cost/benefit and more. Proceedings of the International Academy of Ecology and Environmental Sciences. 2018 Mar 1;8(1):1.
26. Zhang W, Pang S, Lin Z, Mishra S, Bhatt P, Chen S. Biotransformation of perfluoroalkyl acid precursors from various environmental systems: advances and perspectives. Environmental Pollution. 2021 Mar 1;272:115908. DOI:10.1016/j.envpol.2020.115908
27. https://www.statista.com/statistics/621210/vegetable-production-in-india/
28. https://agricoop.nic.in/sites/default/files/2020-21%20(Final)%20Advance%20Estimates%202020-21%20(1).pdf
29. http://ppqs.gov.in/statistical-database
30. https://pib.gov.in/PressReleasePage.aspx?PRID=1841480#:~:text=2021%2D22%20(Second%20Advance%20Estimates,2020%2D21%20(Final).
31. https://knoema.com/atlas/topics/Agriculture/Crops-Production-Quantity-tonnes/Vegetables-primary-production#:~:text=The%20world's%20total%20vegetables%20primary,1%2C154%20million%20tonnes%20in%202021.
32. https://worldpopulationreview.com/country-rankings/vegetable-production-by-country
33. Chrome:extension://efaidnbmnnnibpcajpcglclefindmkaj/https://apeda.gov.in/milletportal/files/Uttar_Pradesh_Millet_Value_Added_Products_Catalogue.pdf
34. Alom MZ, Taha TM, Yakopcic C, Westberg S, Sidike P, Nasrin MS, *et al*. The history began from alexnet: A comprehensive survey on deep learning approaches. arXiv preprint arXiv:1803.01164; c2018.