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Addressing pesticide application challenges among vegetable growers: Insights from Jabalpur district, Madhya Pradesh

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Abstract

Pesticides are crucial in modern agriculture, providing essential protection against pests, diseases, and weeds. However, farmers in rural areas often face significant challenges in their application. This study explored the constraints encountered by farmers in the Shahpura block of Jabalpur district, Madhya Pradesh, regarding pesticide use, along with their suggested solutions. Data were collected from farmers in seven villages through structured interviews, employing proportionate random sampling. The major constraints identified included inadequate knowledge about selecting appropriate pesticides (72.50%) and their recommended dosages (60%), a lack of field demonstrations (39.16%), and the unavailability of plant protection equipment at the village level (30%). Additionally, high labor costs during the spraying season (32%) and insufficient knowledge of equipment maintenance (32.50%) were notable challenges. To address these issues, farmers recommended timely education on pesticide selection and dosage (65.84%) and increased awareness of Integrated Pest Management (IPM) and bio-pesticides (56.66%). They also emphasized the need for training on pesticide application (46.66%) and equipment maintenance (40.83%). The findings highlight the necessity for targeted agricultural extension services and policy interventions to support farmers in improving their pesticide application practices, thereby enhancing crop protection and ensuring sustainable farming.

Keywords: Constraints, pesticide application, farmers, knowledge, plant protection, agriculture, pest control

Introduction

Pesticides, a class of toxic substances, are deliberately introduced into the environment to control pests, including weeds, insects, fungi, and rodents. While the term often evokes images of insecticides, it encompasses herbicides, fungicides, and other substances used for pest management (Baweja *et al*., 2020) [2]. These chemicals are integral to modern farming practices, safeguarding crops from pests and diseases, and have significantly boosted economic potential by increasing food and fiber production (Bourguet & Guillemaud, 2016) [3]. However, their use has also raised serious concerns for human health and the environment (Hashimi, *et al*., 2020) [5]. The effectiveness of pesticides hinges on proper application, involving the selection of appropriate chemicals, accurate dosage, and suitable equipment. Many farmers, especially in rural areas, face challenges in these aspects, leading to suboptimal pest control, economic losses, and environmental harm, particularly among farmers growing vegetables (Kumar *et al*., 2020) [6].

According to APEDA (2023) [1], of the 341.63 million tons of horticulture produce in India, 200.45 million tons are vegetables, underscoring their importance in improving food security, income, and nutrition at both household and national levels (Chakroborty, Gupta, & Pal, 2022) [4]. As essential sources of nutrients, vegetables contribute significantly to human health. Moreover, the cultivation of vegetables provides employment opportunities for both rural and urban populations, fostering socio-economic development (Panwar *et al*., 2019) [8]. Vegetable farmers employ a diverse range of pesticides to minimize losses from pests and diseases. The growing demand for food, driven by population expansion, has necessitated the intensification of agriculture and horticulture, leading to increased reliance on synthetic pesticides (Rajan, Parween, & Raju, 2023) [9]. While pesticide use enhances farm productivity, the development of pest resistance to chemicals necessitates the application of higher quantities of new compounds, resulting in unintended side effects and escalating food production costs (Logesh *et al*., 2023) [7].

Moreover, the improper use and disposal of pesticides can lead to environmental pollution and human health risks. Exposure to pesticides has been linked to a range of health problems, including neurological disorders, reproductive issues, and cancer (Hashimi *et al*., 2020) [5]. Additionally, pesticides can persist in the environment, contaminating food, water, and air, harming beneficial insects and pollinators, and contributing to soil degradation (Sun *et al*., 2018) [10]. This can have adverse effects on ecosystems, biodiversity, and public health (Tudi *et al*., 2021) [11].

To address these challenges, sustainable and integrated pest management (IPM) practices have gained prominence. IPM

emphasizes a holistic approach to pest control, combining biological, cultural, and physical methods to minimize pesticide use while maintaining effective pest management (Kumar *et al*., 2020) [6]. This approach aims to reduce the negative impacts of pesticides on human health and the environment, ensuring the long-term sustainability of agricultural systems (Bourguet & Guillemaud, 2016) [3]. Thus, by understanding the potential impacts of pesticides and adopting sustainable pest management practices, we can mitigate these risks and ensure the continued viability of farming practices globally.

Materials and Methods

The study was conducted in the Jabalpur district of Madhya Pradesh, which comprises seven blocks: Jabalpur, Sihora, Patan, Shahapura, Panagar, Kundam, and Majholi. Among these, Shahpura block was selected purposively for the study due to its highest area and production of vegetables compared to the other blocks. Shahpura block consists of 225 villages, from which 7 villages were chosen based on the maximum number of farmers engaged in vegetable cultivation. The selected villages are Sihoda, Dighoda, Vita, Kheri, Kuran, Belkheda, and Dharampura. The study used an Ex Post Facto research design. The respondents were selected using the proportionate random sampling method. From the selected 7 villages, 10% of the farmers were chosen to participate in the study. Total of 120 respondents were selected for the study. A structured interview schedule was developed to collect data. Personalised interview was done to collect the data from the selected respondents. The data was analysed using statistical methods such as the mean, standard deviation, frequency, percentage.

Results and Discussion

As depicted in Table 1, the primary constraint identified by 72.5% of respondents was the lack of knowledge concerning the selection of suitable pesticides for specific pest or disease control. This observation challenges faced by farmers due to the extensive variety of pesticides available in the market and limited access to technical knowledge . In the absence of adequate guidance, farmers often struggle to choose the most effective pesticide for their needs, which can result in inefficient pest control and potential crop damage. The second most frequently cited constraint was a lack of knowledge about the recommended pesticide doses, with 60% of respondents pointing to this issue. Incorrect dosage—either too little or too much—can adversely impact crop health and the environment. The shortage of knowledge concerning recommended dosages is often linked to lower educational levels among farmers and insufficient extension services to provide appropriate training on pesticide use. A substantial portion of respondents (39.16%) identified the lack of field demonstrations on pesticide application as a hindrance to effective use. This is due to lack of hands-on training and demonstrations to enhance farmers' understanding of pesticide application techniques. The absence of such practical learning opportunities often leaves farmers uncertain about how to apply pesticides properly, potentially leading to inefficient or harmful practices.

High labor charges during the spraying season emerged as another significant constraint, affecting 32% of the respondents. This issue is particularly acute during peak seasons when labor demand surges, leading to increased costs and financial strain on farmers. This shortage of labor and high costs has hindered timely and effective pesticide application. Additionally, 32.50% of the farmers mentioned a lack of knowledge regarding the use, repair, and maintenance of plant protection equipment. Effective pesticide application relies heavily on well-maintained equipment, yet many farmers lack the necessary skills for maintenance. Proper training in equipment uses and upkeep is crucial to ensure optimal performance and longevity.

Finally, 30% of the respondents indicated that the non-availability of plant protection appliances at the village level was a significant constraint. Limited access to necessary agricultural tools and equipment in rural areas often forces farmers to travel long distances to procure them, increasing costs and delaying timely pesticide application. Overall, these findings underscore the need for targeted interventions, such as improved extension services, accessible training programs, and the availability of necessary resources at the local level, to address the challenges faced by farmers in pesticide application effectively.

Table 1: Constraints faced by the farmers in pesticides application (n=120)

Sr no	Constraints	Frequency	Percentage	Rank
1	Lack of knowledge about recommended dose of pesticides	72	60	II
2	Lack of knowledge about selection of proper pesticides for particular pests or disease control	87	72.50	I
3	Lack of field demonstration on pesticide application	47	39.16	III
4	Non-availability of plant protection appliances at the village	36	30	VI
5	Lack of knowledge about usage repair and maintenance of plant protection equipment	39	32.50	IV
6	High labour charges at the time of spraying	42	32	V

The study identified several key suggestions from farmers to address the challenges they face in pesticide application. As presented in the Table 1, the most frequently suggested solution (65.84% of respondents) was the need for timely knowledge about the selection of appropriate pesticides and their recommended doses. It emphasizes the importance of educational interventions to improve farmers' understanding of pesticide use. Providing farmers with accurate and timely information through agricultural extension services, workshops, and manuals can significantly enhance their ability to make informed decisions, thereby improving pest control efficacy and reducing misuse of pesticides. Creating awareness about Integrated Pest Management (IPM) and bio-pesticides was the second most suggested solution, supported by 56.66% of the respondents. This recommendation advocate for promoting IPM practices to reduce dependence on chemical pesticides, lower costs, and minimize environmental impact. IPM strategies encourage

the use of a combination of biological, cultural, mechanical, and chemical methods, which can effectively manage pest populations while promoting sustainable farming practices.

Training on proper pesticide application techniques was another significant suggestion, with 46.66% of respondents highlighting its importance. Hands-on training and demonstrations are critical for improving farmers' skills in pesticide application. Effective training programs, such as those provided through extension services can help farmers apply pesticides more efficiently and safely, reducing the risk of over-application or improper use. Additionally, 40.83% of respondents suggested the need for knowledge about the usage, repair, and maintenance of plant protection equipment. Proper maintenance of equipment is crucial for effective pesticide application and long-term cost savings. Training farmers in equipment maintenance ensures that the tools are in good working condition, thereby preventing equipment failure during critical pest management periods.

Lastly, 29.16% of respondents recommended that plant protection appliances should be made more accessible at nearby locations. This highlighted the challenges farmers face in accessing agricultural tools and equipment in remote areas. By improving the availability of plant protection appliances locally, farmers can reduce travel time and costs, thereby enhancing the overall efficiency and timeliness of pesticide application. These suggestions underscore the importance of targeted interventions and support services to equip farmers with the necessary knowledge, skills, and resources to improve pesticide application practices, ultimately contributing to more sustainable and productive agricultural systems.

Table 2: Suggestions by the farmers in pesticide application (n=120)

Sr no	Suggestions	Frequency	Percentage	Rank
1	Knowledge about the selection of proper pesticides and their recommended dose should be provided timely	79	65.84	I
2	Plant protection appliances should be made available at a nearby place	35	29.16	V
3	Training must be imparted to the farmers about pesticide application	56	46.66	III
4	Knowledge about usage repair and maintenance of plant protection equipment should be provided	49	40.83	IV
5	Awareness should be created among the farming community about IPM and biopesticides	68	56.66	II

Conclusion

The study underscored the critical challenges faced by farmers in effectively applying pesticides. The primary obstacles identified included a lack of knowledge about pesticide selection, recommended dosages, and equipment maintenance. The complexity of pesticide options available in the market further exacerbated these challenges, hindering farmers' ability to make informed decisions for pest control. Additional constraints included limited access to field demonstrations, high labour costs during spraying and the unavailability of necessary equipment at the village level. To address these issues, farmers proposed a series of targeted interventions. These included providing comprehensive education on pesticide selection and dosages, promoting awareness of Integrated Pest Management and bio-pesticides as sustainable alternatives and offering training on pesticide application and equipment maintenance. Ensuring that plant protection appliances are more accessible at the local level was also deemed essential. The findings of this study emphasize the urgent need for enhanced agricultural extension services and policy support to equip farmers with the necessary knowledge and resources. By implementing these recommendations, it is possible to significantly improve the overall efficiency and safety of pesticide use in vegetable farming. This, in turn, will contribute to healthier crops, safer farming practices, and better environmental outcomes.

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