



## **Socioeconomics Influencing Pesticide Management Practices in the Tribal Area of Maharashtra**

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### **Abstract**

The current study was carried out in the Gadchiroli district of Maharashtra, India, where rice cultivation relies on pesticides. The study aims to identify challenges faced by farmers in pesticide use and seeks input from farmers to develop strategies for rational pesticide use. The research explores farmers' behavior and perceptions regarding pesticide usage. It investigates socio-economic influences on buying behavior, the level of awareness about pesticide risks and safety measures, purchasing patterns, and promotional strategies employed by a pesticide company. Findings reveal that while pesticides contribute to crop protection, farmers lack proper knowledge about their safe use and potential risks. Lack of awareness and affordability issues lead to improper application, impacting human health and the environment. The study underscores the need for tailored educational programs to improve farmers' understanding of pesticides, emphasizing safe practices and optimal usage. Providing safety gear and measuring containers, ensuring affordability, and strengthening the distribution network is a must. We highlighted the importance of integrated pesticide management, involving scientific knowledge and traditional practices to achieve sustainable agriculture. The current information contributes to the development of effective strategies that align farmers' needs with responsible pesticide use, ultimately supporting both farmer livelihoods and environmental sustainability.



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### **Introduction**


Agriculture plays a crucial role in providing food for humanity. The expansion of the industrial sector,

urban growth, and community development have led to a decline in the available land for agricultural activities. The increasing reliance on high technology

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and pesticides to boost crop productivity and meet growing population demands has contributed to soil damage. The use of chemical pesticides poses hazardous effects to workers, who may not be fully aware of the dangers due to limited literacy levels.<sup>1</sup> The remarkable surge in agricultural production can be attributed to factors such as the utilization of crop protection products, specifically pesticides to combat pests, stands out as a significant driver.<sup>2</sup> According to,<sup>3</sup> multiple approaches have been devised to combat pests, such as host plant resistance, physical barriers, botanical pesticides, biological control, biotechnological methods, and synthetic pesticides. Among these strategies, chemically based management is the most commonly employed technique. Synthetic pesticides are favored for their effectiveness in safeguarding crops, thereby ensuring abundant yields. Contemporary agricultural practices have integrated pesticides as a crucial element in cultivating crops. These chemicals have given rise to significant issues, such as the emergence of pest resistance, the decline of natural predators, environmental pollution, and adverse effects on non-target species and human well-being.<sup>4-5</sup> Pesticides, a diverse group of substances, encompass insecticides, fungicides, herbicides, rodenticides, molluscicides, and nematocides.<sup>6</sup> They are widely acknowledged for their vital contribution to agricultural progress as they help minimize agricultural product losses, enhance yields, and improve the affordability and quality of food.<sup>7-8</sup> Unfortunately, the current practices are not only harmful to users and consumers but also have adverse effects on the environment. The excessive and/or improper use of pesticides results in toxic substances that pollute the air, soil, and water and in turn, negatively impact animals and humans. Farmers primarily rely on the application of pesticides as their primary strategy to safeguard crops against destructive insects and diseases, despite their efficacy in agriculture, these substances also bring detrimental consequences for the environment and human health, as noted by.<sup>9</sup> To fulfill the United Nations' Sustainable Development Goal (SDG) of eliminating hunger, it is essential to boost rice production through modern and sustainable agricultural practices. Consequently, the utilization of pesticides to safeguard rice crops becomes an unavoidable necessity. Approximately 90% of the pesticides in India are employed in cultivating rice, cotton, and vegetables.<sup>10</sup> The advent of Bt cotton

has led to a decline in pesticide usage in the cotton sector, while pesticide consumption in rice cultivation has shown a rising trend.<sup>11-12</sup> According to the Food and Agricultural Organization,<sup>13</sup> farmers in Zimbabwe (43%), Mexico (25%), and India (23%) are experiencing significant issues related to pesticide poisoning from their farm work. The situation in India's rice ecosystems is particularly noteworthy due to several reported cases of pesticide poisoning. The concern about pesticide use in India's rice production is further supported by a recent report from the Food Safety Standards Authority of India (FSSAI), which analyzed 1177 rice samples. The report revealed that 256 samples (21.7%) exceeded the FSSAI's maximum residue level (MRL), raising serious concerns about clean production practices. Additionally, 65 rice samples (5.5%) were found to contain non-approved pesticides, leading to questions about farmers' awareness.<sup>14</sup> The utilization of pesticides on agricultural farms frequently leads to a range of health problems in humans. These issues can vary from short to long-term effects, such as mild to severe poisoning, respiratory complications, reproductive disorders, and genetic and neurological ailments.<sup>15-1</sup> It is crucial to have a fundamental grasp of farmers' actions and the different factors influencing their pesticide usage. This knowledge is vital for effectively devising, promoting, and executing widespread pesticide use policies.<sup>16</sup> Farmers refrain from embracing possibly efficient methods and practices, primarily because these approaches do not align with their perceived or actual needs, for such methods to gain wider acceptance and have a significant impact, it becomes crucial to tailor them to better suit the specific requirements of farmers.<sup>17</sup> To achieve this, a key step is to gain a comprehensive understanding of how farmers perceive the agricultural challenges they face and the potential benefits of each suggested method in addressing those challenges. Urgent attention must be given to evaluating pesticide usage's effects on both the general population and the environment, particularly in developing nations. By doing so, we can ensure sustainable and responsible agricultural practices that not only optimize productivity but also safeguard human health and the ecosystem. According to.<sup>18</sup> employing appropriate protective measures and maintaining good personal hygiene are considered essential guidelines for safely applying pesticides, the proper utilization of pesticides plays a crucial

role in minimizing environmental contamination and the risk of acute or chronic pesticide poisoning in agricultural areas.<sup>19</sup> highlighted that implementing protective measures during and after pesticide application is highly effective in minimizing health risks for farmers, these measures play a crucial role in safeguarding the well-being of agricultural workers and contribute significantly to sustainable farming practices.<sup>2</sup> Conducted a study in Bangladesh with 917 farmers and found that among vegetable growers, a majority were well aware of the harmful effects of pesticides on agricultural product quality, the environment, and human health. This awareness was less clear among rice and mixed crop growers, who were only well informed about the harm to the environment. In the North, most farmers lacked awareness of pesticide harm to agricultural products and human health but were aware of its environmental impact. Conversely, farmers in the South were well informed about the harmful effects. In the South-East, most farmers were well informed about pesticide harm across all aspects, while in the South-West, information varied. Most crop growers were knowledgeable about why pesticides are banned, and the majority understood that reducing pesticide use could improve the environment and income. There were differing opinions on whether increased pesticide use affects product prices, with vegetable farmers showing clearer views than rice and mixed crop growers. The North and South-East regions had contrasting opinions on this matter, while the other two regions had mixed views.<sup>9</sup> conducted a study in Tu Ky district, Hai Duong province of Vietnam, which revealed significant issues regarding farmers' awareness and habits concerning pesticide use. The study found that only 12% of farmers in vegetable production communities understood the toxicity information on pesticide labels. Merely 9-12% of farmers followed the correct principles for pesticide use, and a small number knew the list of banned pesticides. Farmers' post-spraying activities also demonstrated limited awareness, with a vast majority (94.5%) spraying all chemicals and not taking proper hygiene measures. In the vegetable production commune, 51.5% rinsed their mouth and 13.5% used eye drops after pesticide application, while these numbers decreased to 41 and 11% in An Thanh commune, respectively. These practices have led to adverse impacts on farmers' health and the environment due to pesticide exposure. In a

study conducted by<sup>19</sup> in a Southern Indian village, farmers' practices and perceptions regarding pesticide usage were examined. The research found that a significant number of farmers used sticks and bare hands to mix pesticides. Almost all farmers claimed to wash their hands with soap post-handling pesticides. About three-fourths of the farmers were aware of the need for protective equipment (PPEs) which is the most commonly used safety gear. Hand pumps were the primary method for pesticide application among 77% of farmers. Pesticide storage practices varied, with some storing it inside their houses. Disposal methods also varied, with many farmers disposing of used containers in open fields. The study revealed that washing equipment outside the house resulted in pesticide residues draining into the soil, and some farmers washed their equipment near water bodies, contributing to pollution in canals and drainage systems.

Overusing and misusing pesticides by farmers and agriculturalists can have severe consequences, leading to sickness and even death. Lack of knowledge about their proper use and the potential risks exacerbates the problem. Two types of toxicity are associated with pesticide misuse: acute toxicity, which can quickly cause death unless immediate medical attention is provided, and chronic toxicity, which gradually affects the body, leading to ailments like headaches and cancer. This issue not only impacts users but also affects others living in the pesticide-laden environment, disrupting ecological balance, and causing insecticide resistance, leading to the spread of pests and diseases. The intense use of chemical substances in agriculture has resulted in a decline in bee populations. Long-term effects include chemical contamination of the environment and food sources, ultimately impacting human health across generations. Economically, this misuse leads to losses due to safety ignorance and lack of awareness.

This research encompasses various objectives aimed at gaining comprehensive insights into the farmers' behavior and perceptions regarding pesticide usage in the study area. (1) It aimed to analyze the socio-economics of farmers to understand their financial status and how they influence their choices. (2) The study assessed the level of awareness among farmers about pesticide

usage, including potential risks and safety measures. (3) It focused on understanding the purchasing patterns of farmers concerning pesticides, which can offer valuable information for agrochemical companies. (4) The research aimed to explore the promotional strategies adopted by companies to reach farmers effectively. (5) The study aimed to identify the challenges and obstacles faced by farmers when buying and using pesticides. (6) The study highlighted the potential barriers to the rational and safe use of pesticides. (7) The research will actively seek input and suggestions from farmers themselves on developing strategies for the rational use of pesticides. By engaging with the farming community directly, the study aimed to develop more effective and sustainable approaches to pesticide management. The outcomes of this research could prove invaluable in understanding farmers' risk perceptions related to unsafe pesticide practices, potentially helping predict and mitigate adverse health effects. These findings can then be utilized to design targeted agricultural extension programs that emphasize the safe and responsible use of pesticides. The study holds significant potential to contribute positively to both farmer livelihoods and environmental sustainability in the study area and beyond.

**Materials and Methods**

A descriptive cross-sectional research design was adopted to investigate the buying behavior and usage patterns of farmers and the promotional strategies employed by a pesticide company in the

Gadchiroli district of Maharashtra. We employed a total of 150 farmers who were selected using a multi-stage sampling approach. The Gadchiroli district was purposely selected as a study area. Subsequently, three out of the twelve talukas in the district were randomly chosen for the study. Within each selected taluka, five villages were randomly selected. From each village, ten farmers were randomly chosen to participate in the study, resulting in a sample size of 150 farmers. The data was collected at a single point in time, making it a cross-sectional study design.

The choice of a descriptive cross-sectional research design allowed the researcher to capture a snapshot of the farmers' buying behavior and usage patterns concerning the company's pesticide products, as well as the promotional strategies employed by the company. By using multi-stage sampling, the researcher ensured that samples were representative of the broader population of farmers in the Gadchiroli district. The structured interview schedule facilitated the systematic collection of data from the selected farmers, enabling the researcher to analyze and compare their responses. The cross-sectional nature of the data collection further enabled the researcher to gain insights into the current situation without the need to track participants over an extended period, which could have been more resource-intensive and time-consuming. Through this methodological approach, the researcher aimed to provide valuable information to the pesticide company to improve its marketing strategies and better cater to the needs of farmers in the study area.

**Table 1: Demographic profile of the farmers**

Characteristics	Options	(N=150)	Percentages (%)
Age	21 to 35 years	28	18.67
	36 to 50 years	82	54.67
	Above 50 years	40	26.66
Education	Illiterate	32	21.53
	Highschool	84	56.0
	SSC (10 <sup>th</sup> )	22	14.67
	HSC (12 <sup>th</sup> )	12	8.0
Annual Income	< 1 Lakh	48	32.0
	1 – 2 Lakhs	91	60.67
	2 – 4 Lakhs	11	7.33
	Above 4 Lakhs	0	0

**Results**

Simple statistics such as Percentages, Averages, Rankings, etc. were used to analyze data. Other parameters were measured with the help of a four-point scale ranging from 1 (Least Important), 2 (Important), 3 (Very Important), and 4 (Most Important).

Table 1 shows that a total of 150 farmers were selected for this study. It was found that 21.53% of the interviewed farmers were illiterate, while 56% had completed their high school education. 14.67% had education up to the 10<sup>th</sup> standard, and 8% had completed their education up to the

12<sup>th</sup> standard. The age distribution of the farmers revealed that 54.67% fell in the age group of 36 to 50 years, signifying the prevalence of middle-aged farmers in the region. The next largest group was farmers above 50 years, accounting for 26.66% of the sample. Farmers aged between 21 to 35 years represented 18.67% of the participants. Regarding their annual income, almost half of the farmers (49.90%) earned less than 1 lakh rupees. The next substantial segment, comprising 32.7% of the farmers, had an income ranging between 1 to 2 lakhs. A smaller proportion, 17.40% of the farmers, reported an annual income between 2 to 4 lakhs.

**Table 2: Land holding, source of irrigation and crops cultivated by the farmers**

Characteristics	Options	(N=150)	Percentages (%)
Land Holding	< 1 ha (Marginal)	10	6.67
	1 – 2 ha (Small)	57	38.0
	2 – 4 ha (Semi Medium)	72	48.0
	4 – 10 ha (Medium)	11	7.33
	10 ha > (Large)	0	0
Source of Irrigation	Well	27	18.0
	Tubewell	4	2.67
	Canal	25	16.66
	Unirrigated	94	62.67
Cultivated Crops	Paddy only	90	60.0
	Paddy + Maize	11	7.33
	Paddy + Cotton	49	32.67

Table 2 shows that, after conducting an assessment of the land holdings, sources of irrigation, and crops cultivated by the farmers, the results reveal some interesting trends. The majority of the farmers (58%) were categorized as marginal, indicating that they owned relatively small plots of land. Following this group, 18.90% fell into the semi-medium category, signifying a slightly larger landholding, while 14.10% were classified as medium, suggesting that they possessed more substantial agricultural lands. A small portion (9%) of the farmers belonged to the large landholding category. When it comes to sources of irrigation, 62.67% of farmers faced challenges as they had no access to any formal source of irrigation. This could have implications for their crop productivity and overall livelihood. On the other hand, 18% relied on wells, indicating that they were more fortunate to have a private water source.

Meanwhile, 16.66% obtained their water from canals, potentially benefiting from a shared irrigation system. A mere 2.67% had tubewells, providing them with a more modern and efficient irrigation method. As for the crops cultivated, it was observed that a majority of the farmers focused solely on cultivating Paddy. This could be due to regional preferences, market demands, or the suitability of the land for Paddy cultivation. It's essential to note that 32.67% adopted a diversified approach, cultivating both Paddy and Cotton. This suggests a level of risk management and income diversification in their agricultural practices. 7.33% opted for a combination of Paddy and Maize cultivation, indicating another group exploring crop diversification to potentially improve their income and mitigate risks associated with mono-cropping.

**Table 3: Pesticides used by the farmers**

Parameters	(N=150)	Percentages (%)
Insecticides only	150/150	100
Insecticides + Herbicides	118/150	78.67
Insecticides + Herbicides + Fungicides	19/150	12.67

Table 3 shows that, among the farmers who participated in the survey, it was found that every single one of them used Insecticides exclusively to protect their crops. Additionally, a substantial proportion, specifically 78.67% of the respondents, relied on a combination of Insecticides and Herbicides for their agricultural practices. Furthermore, a smaller percentage, precisely 12.67%, utilized a more comprehensive approach by employing a combination of Insecticides, Herbicides,

and Fungicides to safeguard their crops. This data indicates that Insecticides are widely adopted among the farmers surveyed, while a considerable portion also recognizes the benefits of combining Insecticides with Herbicides. Moreover, a notable subset of farmers believes in the added protection offered by using a combination of Insecticides, Herbicides, and Fungicides to ensure the health and productivity of their crops.

**Table 4: Type of herbicide used by the farmers**

Parameters	(N=150)	Percentages (%)
Pre emergence only	0	0
Post-emergence only	100	66.67
Pre and Post emergence both	18	12
Not using herbicide	32	21.33
Total	150	100

Table 4 shows that the survey focused on farmers and their herbicide practices. It was found that the majority of the participants, 66.67%, solely relied on Post-emergence herbicides. On the other hand, a smaller portion (12% ) utilized both Pre and Post-emergence herbicides in their farming routines. 21.33% reported not using any herbicides at all, suggesting alternative farming methods or integrated pest management strategies. These results shed light on the prevalence of Post-emergence herbicides among farmers, indicating their preference for this type of treatment in managing weeds. It also highlights a significant proportion of farmers who choose to combine both Pre and Post-emergence herbicides, possibly to ensure comprehensive weed control throughout various stages of crop growth. The notable segment of farmers not using any herbicides raises questions about their reasons and the potential ecological impact of their practices.

Table 5 shows that 68% adhered to the suggested guidelines for pesticide application, while the remaining 32% did not follow the recommended method. An encouraging fact is that all farmers, without exception, used face coverings while applying pesticides, indicating a widespread awareness of safety measures. Remarkably, 100% reported not experiencing any health problems after using pesticides, suggesting that proper protective measures were taken. All of them were well aware of the harmful effects of pesticides on the environment and human health, demonstrating a high level of knowledge among the farming community regarding the potential risks associated with pesticide usage. Another positive aspect is that every farmer washed their hands with soap and water after applying pesticides, illustrating a responsible approach to mitigate any potential contamination.<sup>20</sup> discovered contrasting outcomes



compared to our study, they discovered that most of the farmers who were interviewed acknowledged that they do not implement any safety precautions except for using cloth to cover their mouth and nose while spraying pesticides. They revealed that while farmers expressed interest in pest control, they

lacked full awareness of the dangers associated with insecticides. The observations concerning the adoption of appropriate safety and protective measures for insecticide application practices were rather disappointing.

**Table 5: Questions about the awareness of the farmers regarding pesticide usage**

Questions	Options	(N=150)	Percentages (%)
Do respondents follow the recommended method of pesticides application	Yes	102	68
	No	48	32
Face cover used by the respondents while using pesticides	Yes	150	100
	No	0	0
Any health issues experienced by respondents after using pesticides	Yes	0	0
	No	150	100
Thoughts of respondents on the harmfulness of pesticides to the environment & human health	Harmful	150	100
	Not Harmful	0	0
Washing of hands by the respondents after using pesticides	Soap and Water	150	100
	Water only	0	0
	Not washing	0	0

**Table 6: Importance of information source of pesticides for the farmers**

Parameters	MI (4)	VI (3)	I (2)	LI (1)	Score	Mean	Rank
Advice of Dealer	-78	-54	-10	-8	502	3.35	1
	312	162	20	8			
Peer's Experience	-52	-42	-36	-20	426	2.84	3
	208	126	72	20			
Demonstration	-58	-39	-31	-22	433	2.89	2
	232	117	62	22			
Pamphlets	-5	-35	-39	-71	274	1.83	6
	20	105	78	71			
Newspaper Advertisement	-5	-35	-39	-70	276	1.84	5
	20	105	78	70			
TV Commercials	-38	-36	-24	-53	358	2.39	4
	152	108	48	53			

LI - Least Important; I - Important; VI - Very Important; MI - Most Important

Table 6 shows that the advice provided by dealers emerged as the foremost and pivotal source of information when it came to knowledge about pesticides. This was closely trailed by the significance of demonstrations, where farmers could witness the practical application of pesticides, thereby enhancing their understanding. The experiences shared by their

peers in the farming community stood as another valuable avenue for gathering insights about pesticide usage. Television commercials played a notable role, as they reached a wide audience and contributed to farmers' awareness about various pesticide products. Newspaper advertisements also played a role in this regard, albeit to a somewhat

lesser extent, as they allowed farmers to access written information about different pesticide options. The distribution of pamphlets also played a modest role in imparting knowledge about pesticides to farmers. These compact informational materials often contained essential guidelines, safety precautions, and details about various pesticide

products. However, it's interesting to observe that while all these sources contributed to farmers' understanding of pesticides, the advice provided by dealers remained the most influential, perhaps owing to the direct and personalized nature of this interaction.

**Table 7: Purchase behaviour of pesticides by the farmers**

Parameters	Options	(N=150)	Percentages (%)
Time of Purchase of Pesticides	After the occurrence of a pest/disease	129	86
	As preventive measure	21	14
Alternate Purchase Plan for Pesticides	Wait for the required one	55	36.67
	Go for alternative	95	63.33

Table 7 shows that, among the examined farmers, a significant proportion of them opted to purchase pesticides after the occurrence of pest/disease, whereas a few of the farmers chose to purchase pesticides as a preventive measure to prevent pest infestations. The majority of the farmers chose to go for an alternative brand of pesticides and 1/3rd of the farmers chose to wait for the required one. Interestingly, the research conducted by<sup>20</sup>

yielded different results compared to our present study, their findings indicated that the majority of farmers displayed a propensity to use insecticides even before witnessing any significant damage caused by pests in their crops. This tendency was characterized by their consistent application of pesticides throughout the entirety of the crop season, a practice that extended to the harvesting phase.

**Table 8: Factors affecting the purchasing of pesticides by farmers**

Parameters	MI (4)	VI (3)	I (2)	LI (1)	Score	Mean	Rank
Brand	-51	-41	-32	-26	417	2.78	4
	204	123	64	26			
Price	-67	-48	-27	-8	474	3.16	1
	268	144	54	8			
Prior Experience	-60	-44	-38	-8	456	3.04	2
	240	132	76	8			
Availability	-56	-41	-33	-20	433	2.89	3
	224	123	66	20			

LI - Least Important; I - Important; VI - Very Important; MI - Most Important

Table 8 shows that the primary determinant influencing the decision to purchase pesticides was the price of the pesticide itself. This was followed in significance by factors such as the farmers' prior experience with pesticides, the availability of the required pesticides, and the brand. The financial aspect of pesticide procurement played a pivotal

role, with farmers considering the price as a crucial factor. Their past experiences with pesticides, the ease of obtaining the products, and their trust in specific brands also contributed to their decision-making process when it came to purchasing pesticides for their agricultural needs.



**Table 9: Importance of promotional strategies adopted by the company**

Parameters	MI (4)	VI (3)	I (2)	L (1)	Score	Mean	Rank
Farmers Meeting	-64 256	-39 117	-28 56	-19 19	448	2.99	2
Field Visits/ Demonstrations	-70 280	-42 126	-30 60	-8 8	474	3.16	1
TV Commercials	-56 224	-37 111	-22 44	-35 35	409	2.76	4
Pamphlets	-52 208	-36 108	-33 66	-29 29	411	2.74	5
Newspaper Advertisements	-51 204	-34 102	-32 64	-33 33	403	2.69	6
Jeep Campaigns	-60 240	-37 111	-27 54	-26 26	431	2.87	3

LI - Least Important; I - Important; VI - Very Important; MI - Most Important

Table 9 shows that the farmers held Field visits/ demonstrations in the highest regard as the primary promotional approach employed by the company. This was closely trailed by Farmers' meetings, Jeep campaigns, TV commercials, as well as the distribution of Pamphlets and Newspaper advertisements. The farmers' preferences indicated a strong inclination towards experiential learning and interactive sessions, such as field visits and

demonstrations, signifying the effectiveness of hands-on experiences in conveying product information. The survey illuminated the diversified marketing channels employed by the company, ranging from traditional methods like Newspaper advertisements to more contemporary approaches like TV commercials, showcasing a well-rounded promotional strategy that caters to a broad spectrum of farmer preferences and demographics.

**Table 10: Constraints faced by the farmers while buying pesticides**

Parameters	Options	(N=150)	Percentages (%)
While buying the Pesticides	High cost	94	62.67
	Low efficacy	56	37.33
While using the Pesticides	Unawareness about usage	103	68.67
	Fear of poisoning	47	31.33

Table 10 shows that, when purchasing pesticides, approximately one-third of the farmers included in the survey reported encountering issues with the effectiveness of the pesticides in managing pest infestations. For the remaining farmers, the primary concern revolved around the high cost associated with pesticides. Interestingly, a significant number of farmers lacked proper knowledge regarding the proper usage of pesticides, and a minority of them even expressed concerns about the potential toxicity and risks of pesticide exposure. These findings

align with a study carried out by,<sup>20</sup> which highlighted that farmers display a strong inclination towards procuring insecticides that are not only reasonably priced but also easily accessible. This suggests that there is a clear demand within the farming community for cost-effective and easily attainable pest control solutions. It underscores the importance of addressing these issues to better assist farmers in effectively managing pests while considering their financial limitations and apprehensions related to pesticide usage.

### Discussion

All farmers surveyed in the study were men, as farming activities especially those related to pesticide use are performed exclusively by men in the area. The findings highlight the predominant crop, Paddy, in the study area and its potential for paddy-specific pesticides. The results suggested the need for a focused approach towards product development and sales promotion activities tailored to this crop. It was observed that farmers showed a preference for post-emergence herbicides and systemic insecticides, indicating a lack of awareness about the benefits of pre-emergence herbicides and contact insecticides. Thus, the company's field officers should concentrate on raising awareness about these products among farmers, considering that farmers rely heavily on dealer recommendations when making purchases. Ensuring timely availability of the products in the market is crucial, as the unavailability of the company's products led to farmers resorting to alternative options, resulting in switching costs for the company. The study advocates for intensified field visits, demonstrations, and farmers' meetings as effective promotional strategies. To boost pesticide sales, the paper proposes the continuous incentivization and support of distributors and dealers through improved margins, leisure tours, and training programs. To strengthen market penetration and maintain healthy relationships with distributors, the company should proactively address farmers' concerns at the field level, employing market development officers as well as company officers. The research underscores the significance of tailoring marketing strategies, enhancing product awareness, and fostering strong distributor relations to maximize sales potential and support sustainable agricultural practices in the study area.

<sup>21</sup>Suggested that the way farmers perceive risks could be influenced by their understanding of pesticides. The farmers' suggestions encompass a range of practical and pertinent recommendations. (1) Ensuring safety measures, such as providing safety gear along with pesticides can significantly enhance the protection of users. (2) The usage of measuring containers with pesticides can aid in precise and controlled application. (3) Offering comprehensive guidance on pesticide usage from both sellers and company field officers is crucial for

promoting responsible practices. (4) Addressing affordability concerns by maintaining competitive pricing for pesticides, which can be instrumental in encouraging their rational and sustainable utilization. These suggestions collectively underscore the importance of an integrated approach to pesticide management, considering factors that contribute to efficacy, safety, and accessibility for all stakeholders involved.

There are several promising directions for future research in this area. To mitigate bias, researchers could explore mixed-method approaches, combining self-reported data with observations or market analyses. Longitudinal studies could be employed to track farmer buying behavior over an extended period, capturing the dynamic changes that occur. Conducting similar studies in diverse geographical settings could provide a more comprehensive understanding of the factors influencing farmer purchasing decisions across different contexts.

### Conclusion

A comprehensive investigation was conducted in the Gadchiroli district of Maharashtra, delving into the local agricultural landscape. The predominant crops cultivated in the Gadchiroli district encompassed Paddy, Cotton, and Maize, with Paddy emerging as the foremost crop under cultivation. We unveiled that farmers exhibited a limited understanding of pesticides and lacked awareness regarding Integrated Pest Management, along with an incomplete grasp of the repercussions stemming from pesticide utilization in specific crops. Farmers perceived a noticeable uptick in pest severity over the years, which consequently led to a heightened demand for larger quantities of pesticides to effectively manage the issue. We underscored the substantial expenditure associated with pesticide usage, particularly in the paddy and cotton crops and the findings emphasized that the majority of farmers procured pesticides through distributors or dealers. Financial constraints loomed as a significant impediment during pesticide purchases, whereas a lack of awareness about proper pesticide application posed a significant challenge during usage. The immediate impact of practical knowledge on pesticide application underscores the paramount importance of hands-on expertise over theoretical understanding. Practical knowledge, intertwined with

skills, aims to enhance overall efficiency. Educational and training institutions focusing on agriculture should prioritize bolstering farmers' comprehension of pesticides. This should encompass critical aspects such as the optimal preharvest interval for pesticides, appropriate dosage, pesticide toxicity thresholds, ideal application timing, and frequency of use. It is strongly recommended that the state's agricultural extension department take an active role in promoting modern pesticide technologies and disseminating information about recommended dosages, novel compounds, and active ingredients suitable for rice crops. Embracing such an approach will inevitably lead to an improved pesticide application process with minimal repercussions for farmers' health and the environment. The implementation of well-suited policy initiatives becomes imperative to ensure the judicious utilization of pesticides in rice cultivation.

This entails seamlessly integrating scientific knowledge with traditional pest management practices employed by farmers, thus fostering a harmonious and sustainable agricultural ecosystem.

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