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Pesticide Use Behavior and Perceived Environmental Impact: A Study in Karnataka, India

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ABSTRACT

This study investigates pesticide use behavior and its perceived environmental impact among farmers in northern Karnataka, India, focusing on three key crops: paddy, cabbage, and grape. Conducted between 2019 and 2022, the research surveyed 240 farmers (80 for each crop) from the districts of Koppal, Belagavi, and Vijayapura. A structured interview process was used to collect data on seven dimensions of pesticide use behavior: pest identification, pesticide selection, concentration and mixing, types of sprayers and spraying methods, personal protection, environmental-friendly practices, and pesticide waste disposal.

The methodology involved calculating a Pesticide Use Behavior Index for each crop, with scores based on farmers' responses across these dimensions. The data was analyzed using frequency, percentage, and categorization into low, medium, and high pesticide use behavior groups. Results showed that grape farmers exhibited the highest behavior index (50.48%), followed by paddy (48.52%) and cabbage (43.28%). Farmers demonstrated strong pest identification skills, with over 60% showing competence in identifying pests in all crops. However, the use of organic pesticides was minimal (3.88% to 9.88%) across crops, and adherence to Integrated Pest Management (IPM) practices was similarly low.

The study also examined farmers' perceptions of the environmental impact of pesticide use. While (47.50%) of paddy farmers perceived a high impact, (37.50%) of grape farmers and (35.00%) of cabbage farmers rated the impact as medium. The findings highlight the need for greater adoption of organic alternatives and awareness of sustainable pesticide practices to mitigate environmental harm.

Keywords: *Pesticide use behavior, Environmental impact, Paddy, Cabbage, Grape, Organic pesticides, Sustainable practices.*

INTRODUCTION

Pesticides play a critical role in modern agriculture by protecting crops from pests, diseases, and weeds, ensuring high yields, and contributing to food security. However, the overuse and misuse of chemical pesticides have raised significant concerns about their environmental and health impacts. Global pesticide usage exceeds 5 billion kilograms annually, with synthetic pesticides remaining the dominant method of pest control despite the availability of more sustainable alternatives [1].The indiscriminate application of pesticides has led to soil degradation, water contamination, biodiversity loss, and adverse health effects on humans [7]. These risks are particularly acute in developing countries like India, where farmers often lack the knowledge and resources to use pesticides safely and effectively[5].

In India, pesticide usage varies widely by region and crop. Recent data show that India's pesticide consumption is relatively low at 0.31 kg/ha, compared to other countries like China (13.07 kg/ha) and Brazil (5.95 kg/ha) [1]. However, pesticide use is concentrated in key crops such as rice, cotton, and vegetables, which account for (90%) of total pesticide consumption The increasing reliance on pesticides in rice and vegetable farming, particularly in states like Karnataka, poses significant environmental challenges, as over-application can lead to pest resistance, ecosystem imbalances, and contamination of food supplies [10].

Karnataka is a major agricultural state in India, producing a variety of crops, including paddy, cabbage, and grapes, which are known for high pesticide application. The excessive use of chemical pesticides in these crops has been documented, with the majority of farmers relying on synthetic insecticides and fungicides to manage pests [11]. Despite the availability of organic alternatives and Integrated Pest Management (IPM) practices, adoption remains low, as reflected in recent studies. For instance,[6] found that only a small percentage of farmers in northern China adopted IPM practices, similar to the trends observed in Karnataka, where organic pesticide usage is less than (10.00%).

The health risks associated with pesticide use are also a growing concern. Studies conducted in rural India and other developing regions have shown that farmers often lack adequate protective equipment and knowledge about safe pesticide handling, leading to high rates of pesticide exposure and related health issues [13]. In high-income agricultural settings like Italy, over 90% of farmers use personal protective equipment (PPE), whereas in India, PPE usage remains below 40% across many farming regions[14].

Given the growing environmental and health concerns, this study aims to assess pesticide use behavior and its perceived environmental impact among farmers in northern Karnataka. By examining pesticide use patterns across paddy, cabbage, and grape crops, the study seeks to identify gaps in knowledge and practice, and propose strategies for promoting sustainable pesticide management, including the adoption of organic alternatives and IPM practices.

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MATERIALS AND METHODS

A total of 240 farmers from the districts of Koppal, Belagavi, and Vijayapura were surveyed for this study. The data was collected via structured interviews, focusing on the seven dimensions of pesticide use behavior. The survey assessed pesticide identification, selection, concentration, sprayers, and spraying methods, protective measures, environmental practices, and disposal methods.

RESULTS AND DISCUSSION

Table 1. Pesticide use behavior of farmers in selected crops

(n=240)

SL. NO.	Dimensions	Behavior index %		
		Paddy (n_1=80)	Cabbage (n_2=80)	Grape (n_3=80)
I.	**Identification of pests**	**69.44**	**53.63**	**60.13**
1.1.	Pest identification in the field (general)	69.58	66.67	69.58
1.2.	Identification insect pests (specific)	66.88	65.16	66.25
1.3	Identification beneficial insects	42.29	25.21	42.50
II.	**Pesticides selection**	**68.44**	**47.56**	**55.81**
2.1	Insecticides	50.94	42.66	50.31
2.2	Fungicides /bactericides	64.79	30.16	66.67
2.3	Herbicides	62.97	46.09	42.81
III.	**Concentration /dose and mixing**	**59.53**	**77.34**	**72.03**
3.1	Concentration /Dose	55.00	62.19	61.56
3.2	Mixing	62.25	82.40	75.52
IV.	**Types of sprayers and spraying methods/intensity/stages**	**49.56**	**32.06**	**52.44**
4.1	Types of sprayers	49.13	41.75	42.25
4.2	Sprayers cleaning	38.75	33.54	65.00
4.3	Spraying methods	31.72	31.25	33.75
4.4	Stages of application	61.56	65.52	71.04
4.5	Intensity of spraying	66.67	56.04	67.71
4.6	Time of application of pesticide	66.25	70.42	70.63
4.7	Farmers re-entry field interval (days) after pesticide spray	12.08	33.13	33.13
4.8	Harvesting waiting period after pesticide spray	64.58	30.00	52.44
V	**personnel protective Hygiene**	**39.89**	**34.94**	**39.94**
5.1	Personal protection	25.63	16.13	25.25
5.2	Hygiene	51.77	50.63	52.19
VI.	**Environmental friendly pesticides and IPM practices**	**7.50**	**7.43**	**4.31**
6.1	Organic pesticides	3.88	9.88	3.88
6.2	IPM practices	13.54	5.83	6.46
VII.	**Storage and disposal of pesticides**	**52.32**	**53.57**	**58.75**
7.1	Storage methods	64.17	51.04	74.58
7.2.	Disposal pesticide waste containers	35.94	32.97	46.88
	Overall index	**48.52**	**43.28**	**50.48**

Table 2. Overall distribution of farmers based on perception on pesticide use behavior Paddy crop

(n=80)

Sl. No.	Category	Distribution	
		f	%
1	Low (<73.12)	10	12.50
2	Medium (73.12-82.79)	47	58.75
3	High (>81.79)	23	28.75
Total		**80**	**100**
Mean 77.46 SD 10.20			

Figures in the parenthesis represent percentage
f-frequency % -Percentage

Table 3. Distribution of farmers based on overall perception on pesticide use behaviour in cabbage crop

(n=80)

Sl.No.	Category	Distribution	
		f	%
1	Low (<80.64)	21	26.25
2	Medium (80.64-90.19)	29	36.25
3	High (>90.19)	30	37.50
	Total	**80**	**100**
	Mean 85.42 SD 11.23		

Figures in the parenthesis represent percentage
f-frequency % -Percentage

Table.4 Distribution of farmers based on overall perception on pesticide use behaviour in grape crop

(n=80)

Sl.No.	Category	Distribution	
		f	%
1	Low (<89.94)	8	10.00
2	Medium (89.94-101.41)	61	76.25
3	High (>101.41)	11	13.75
	Total	**80**	**100**
	Mean 96.00 SD 12.93		

Figures in the parenthesis represent percentage
f-Frequency % -Percentage

Pesticide Use and Health Impact: According to recent studies, prolonged pesticide exposure has been linked to significant health risks among farmers[8]. Pesticide use in India has been rising, particularly in rice and vegetable cultivation, which is consistent with global trends observed by [1]. Farmers are often unaware of the long-term health effects of pesticide residues, with 21.7% of rice samples in India exceeding the Maximum Residue Limit (MRL) [10].

Environmental Impact: Studies have highlighted the detrimental effects of pesticide overuse on the environment. [2] emphasize the harmful consequences of pesticide residues on soil and water quality. Moreover, the [3]

warns of biodiversity loss due to the elimination of beneficial insects and pollinators, aligning with the findings of this study that show high pesticide use behavior in pest identification.

Adoption of Organic Alternatives: Despite increasing global awareness of organic pesticides and Integrated Pest Management (IPM) practices, the use of organic alternatives remains minimal. In this study, organic pesticide use was under 10% for all crops, reflecting global findings by [4] and [6] who reported similar trends in other developing countries where organic practices are still underutilized.

Pesticide Use Behavior in Karnataka

The Pesticide Use Behavior Index varied significantly between crops, with grape farmers showing the highest index at 50.48%, followed by paddy farmers at (48.52%), and cabbage farmers at (43.28%). While the farmers demonstrated high competence in pest identification, their adoption of protective measures and environmentally friendly practices was low. Notably, the use of personal protective equipment (PPE) was reported to be higher in other countries, such as Italy, where over (90%) of pesticide applicators use PPE [14]. whereas in India, this remains below (40%) for all surveyed crops.

Future Scope

Future research can expand to different regions and crops within India to understand broader patterns and challenges in pesticide use and sustainable practices. Additionally, exploring the effectiveness of training programs on IPM and organic alternatives among diverse farmer groups may provide valuable insights for tailored interventions.

Conflict of interest

The authors declare no conflicts of interest regarding the publication of this study.

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Conclusion

This study underscores the urgent need for educational interventions and policy changes to promote sustainable pesticide use. The low adoption of organic alternatives and IPM practices among farmers in Karnataka mirrors global trends. As recommended by Calliera&L'Astorina (2018), flexible training programs tailored to the local context should be implemented to increase farmer awareness and adoption of sustainable practices.

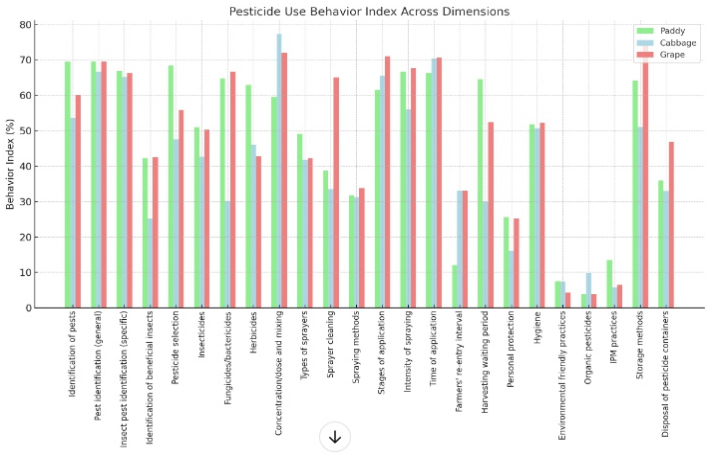

Fig :1 Pesticide Use Behavior Index

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