Revised Research Article

Farmers' Purchasing Behaviour of Insecticides in Cumin (*Cuminum cyminum*) and Problems Faced by Farmers for Cumin in Dhrol Taluka of Jamnagar District, Gujarat, India

ABSTRACT

Background: In agriculture, the use of pesticide has been the dominant form of pest management since the early 1950s to control pest organisms including insects, fungi, weeds and nematodes. In recent times, use of pesticides in cumin cultivation has increased rapidly and this scenario contributes significant impact towards adverse effects on human health, environment and on overall bio-diversity as the cumin crop is among the major growing spices crop in India [8].

Methods: The data collection involved the use of a semi-structured schedule carried out through personal interview method for both cumin farmers and agri-input dealers. The research involved non-prabability sampling technique for primary data collection. The study was conducted in the area of Dhrol taluka of Jamnagar district. The collected data were analysed using various analytical methods, including tabular analysis, Pearson Chi-square test, Garrett's Ranking Technique, and Weighted Average Mean.

Finding: The findings indicate that the majority of respondents were middle-aged with a primary level of education. Most of the farmers had land holdings ranging from 1 to 2.5 hectares, and among them, the area dedicated to cumin cultivation was less than 1 hectare. These farmers had an average farming experience of 21 to 30 years. The majority of farmers primarily relied on farming as their occupation, with some also engaging in animal husbandry. In terms of annual income, most farmers earned between 1 to 5 lakh rupees. The study revealed that Price was the primary factor influencing the purchase of pesticides, followed by considerations of Quality and Brand name. Lack of access to credit facilities was identified as the major problem faced by farmers, alongside the high cost of inputs. Among the promotional activities, Demonstration was found to be the most influential in pesticide purchasing decisions, followed by Farmer meetings. For agri-input dealers, the major problems encountered were Low margins, Raising costs, and High competition.

Keywords: Agrochemicals, Pesticide, Cumin, Insecticide, Farmers, Agri-input dealers

1. Introduction

As the backbone of the Indian economy agriculture is continues to be the main sector driving the Indian economy. India's GDP is 17 per cent derived from agriculture, while 60 to 70 per cent of the population is employed in this sector [10]. There are two major components of Indian economy, village farming and modern agriculture. Since the 1950s to kill pest

organisms including insect pests, fungi, weeds, and nematodes as well as control bacterial and viral infection the pesticide has been uses as dominant form of pest management [8]. In India, the population is growing significantly. The World Bank projects that population of India was 1.39 billion in 2021 and number will rise to 1.66 billion by 2050. In India, still more than a half of the population still relies on agriculture for a livelihood. After the United States, Japan, and China, India is the world's 4th largest producer and 13th largest exporter of pesticides globally. it is anticipated that the Indian agrochemical market will expand at a Compound Annual Growth Rate (CAGR) of 8–10 per cent until 2025 [1]. In India, as per the recent data of the Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture and Farmers Welfare, Government of India, state-wise consumption of chemical pesticide for 2021-22 lead by Maharashtra and followed by UP, Punjab, Telangana. Haryana, WB, Karnataka, Rajasthan and Gujarat ranked ninth in the country [4].

1.1 Global scenario of agrochemicals

The global agrochemicals market size was 235.2 US Dollar billion in 2023 and is projected to reach USD 282.2 billion by 2028, at a CAGR of 3.7 per cent during the forecast. The largest market for agrochemicals is Asia Pacific and the fastest-growing market is North America. With a value of USD 79.4 billion in 2023, the agrochemical market in the Asia Pacific region had tremendous growth. At a CAGR of 3.9 per cent throughout the projection period, it is expected to reach USD 96.2 billion by 2028. About 15 per cent of the global market for agrochemicals comes from India [9].

China is a major consumer, producer and exporter of fertilizers and insecticides. China's agriculture uses the most pesticides in the world in unit cropland areas [9].

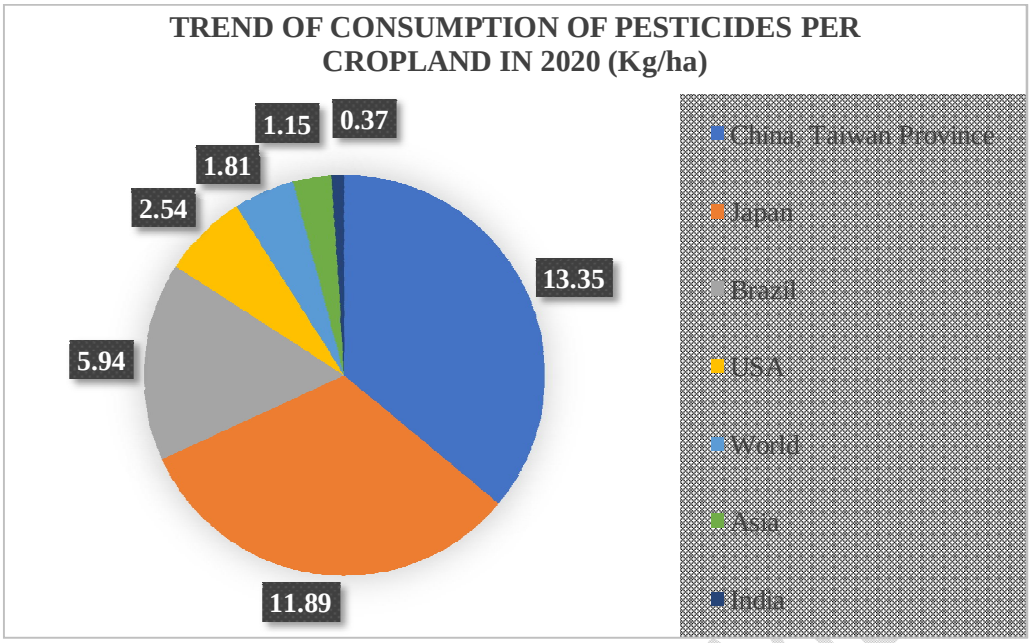


Figure 1: Trend of Consumption of Pesticides Per Cropland in 2020 (Kg/ha)

Source: FAO 2022. FAOSTAT: Pesticides indicators (2022) [6]

1.2 Indian scenario of agrochemicals

In India, the population is growing significantly. The World Bank projects that the population of India was 1.39 billion in 2021 and the number will rise to 1.66 billion by 2050. Considering these factors, industries like agrochemicals, seeds, and fertilizers, which are essential agricultural inputs, play a significant role in the expansion of the nation's economy. Therefore, these industrial sectors are driven by legislation, government rules and regulations, policies and interventions.[11] According to the National Statistical Office (NSO), Ministry of Statistics and Programme Implementation, Government of India's Annual Provisional Estimates of National Income, the contribution of agriculture and related sectors to India's Gross Value Added (GVA) for the fiscal year 2020–21 is 20.2 per cent [1].

After the United States, Japan, and China, India is the world's 4th largest producer and 13th largest exporter of pesticides globally. In terms of exports, the sector has seen good growth in the past years. In terms of the consumption of pesticides, India ranks 9th globally. According to a PricewaterhouseCoopers internal report, the Indian agrochemicals industry is valued at around USD 5.72 billion in the financial years 2020–21, out of that USD 2.72 billion was used domestically, and USD 3.00 billion was exported. Additionally, it is anticipated that the Indian agrochemical market will expand at a CAGR of 8–10 per cent until 2025. The total

area under cultivation in India in 2020–21 is 188.595 million hectares, of which 147.349 million hectares are covered by chemical and bio-pesticides, according to the All India Statistics of Area under Cultivation and Under Use of Chemical and Bio-Pesticides published by the Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture and Farmers Welfare, Government of India [1].

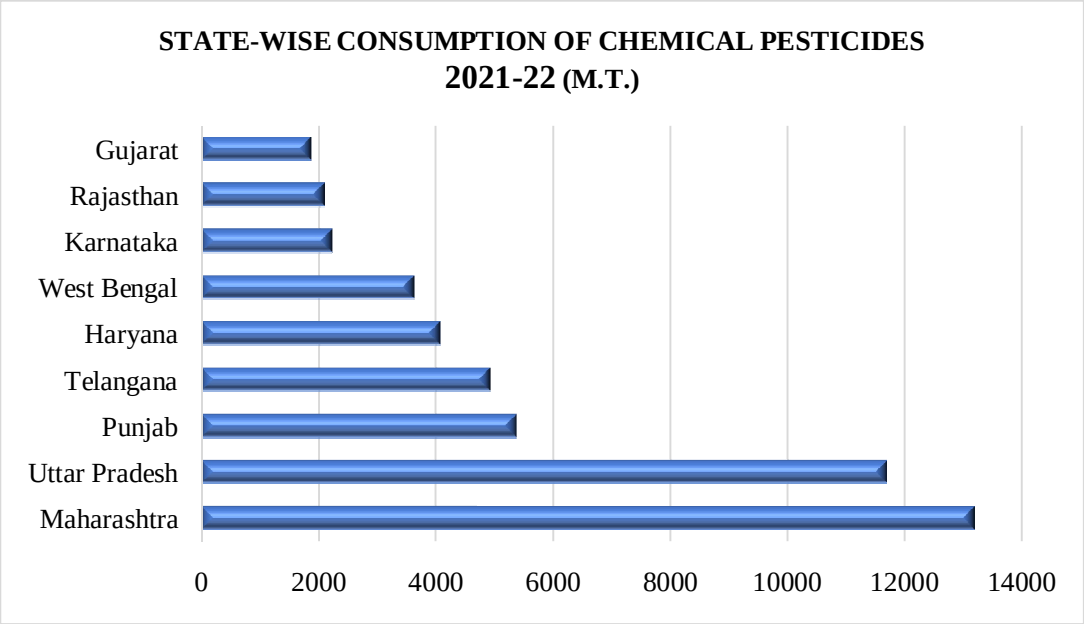


Figure 2: State-Wise Consumption of Chemical Pesticides 2021-22(M.T.)

Source: Directorate of Plant Protection, Quarantine and Storage (2022-23) [4]

1.3 Cumin (*Cuminum cyminum*)

The biggest producer and consumer of cumin is India. About 70 per cent of the world's total production is obtained from it. India benefits from a supply gap on the global market since India harvests in March–April while other major producing nations including Turkey, Syria, Iran, China, and Latin America harvest in June–July [2].

India accounts for 81 per cent of all cumin exports worldwide, making it the top exporter in the world. From 2.14 lakh tonnes in 2019–20 to 2.99 lakh tonnes in 2020–21, India's export of cumin has risen. The largest importer of Indian cumin is China. Following the resolution of the pesticide residue disputes with China, demand for cumin has increased in the

international market, particularly in China. Additionally, this might cause cumin prices to rise in 2022 [2].

Gujarat and Rajasthan are leading cumin-growing states of India and in total production of the country, contribution of Gujarat is around 50 per cent. The expected area planted with cumin in Gujarat for 2021–22 is reported to be 2.89 lakh ha, down from 4.74 lakh ha the previous year (2020–21). Gujarat's cumin sowing area has decreased by 39 per cent from the previous year. This is due to the fact that cumin prices remained constant throughout 2021 and that many farmers switched to growing mustard during this rabi season, when mustard oil prices reached a record high [2].

In the state of Gujarat, the major Cumin producing districts with their Area, Production and Yield are given in table below :

Table 1: Major cumin producing districts in Gujarat (2020-21)

District Name	Area (Hectare)	Production (Tonnes)	Yield (Kg/ha)
Banaskantha	772.08	807.51	1045.90
Devbhumi Dwarka	885.21	645.93	729.69
Kuchchh	807.51	640.93	892.69
Surendranagar	753.56	551.28	731.57
Patan	334.48	268.90	803.93
Rajkot	322.63	293.62	910.07
Jamnagar	**235.41**	**224.46**	**729.69**
Gujarat	**4738.02**	**4738.02**	**842.95**

Source: Director of Agriculture, Government of Gujarat (2022) [3]

It is important to note that the reasons behind yield variations can be complex and multifaceted. The major probable factors that contribute to the variations in yield could be soil quality, climate and weather conditions, water availability and irrigation, farming practices, pest and disease management, access to agricultural inputs, farmer knowledge and skills etc. Detailed analysis and field-level investigations considering the specific conditions

of each district would provide more accurate insights into the major factors contributing to the yield gap in cumin production in Gujarat.

1.4 Problems faced by farmers and dealers

Cumin growers faces a several problems which may be production constraints, marketing constraints, finance and crdit related problems, farm-input related problems, social and interpersonal problems, electricity and water supply related problems and, handling of agro-chemicals. The study was identified a major problems faced in purchasing of insectcides by them are highlighted in result and discussions.

Also, agro-input dealers faces few problems regarding technical knowledge and support, family related problems, market related problems, credit and finance related problems, market intelligence related problems, infrastructure related problem, farmers (consumers) related problems and, social and personal problems. The study was identified a major problems faced in selling of insectcides by them are highlighted in result and discussions.

1.5 Study Objectives

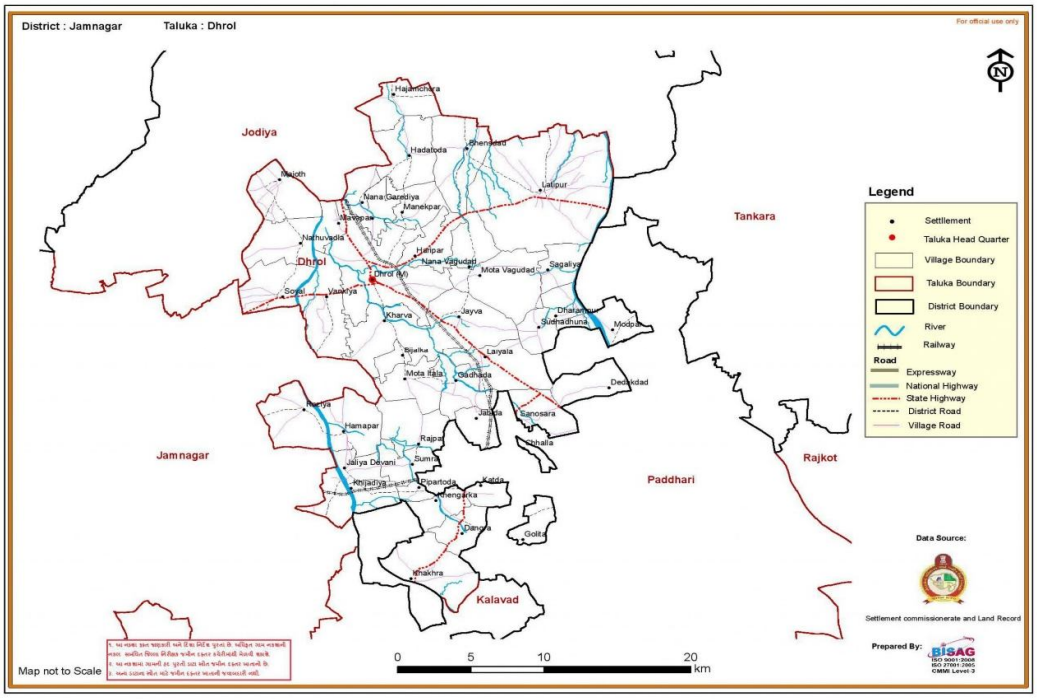
The study was undertaken in Dhrol tehsil of Jamnagar district of Gujarat with the objective to study the socio-economic profile of farmers, to study the factor affecting purchasing behaviour of farmers towards insecticide uses in cumin, to identify the problems faced by farmers who grown cumin in Dhrol taluka of Jamnagar district. With another objective associated with agri-input dealer was to identify the problems faced by dealers and to identify different promotional activities used by agri-input companies.

2. Materials and Methods

The survey involved selecting 10 respondents from each of the 10 identified villages from the Dhrol taluka of Jamnagar district, Gujarat. These respondents were specifically chosen from among the farmers who produced cumin and they used insecticides. The primary data were collected using separate semi-structured schedule for farmers and dealers with personal interview method. The data were analysed by using various analytical tools, including tabular analysis, Garrett's Ranking Technique, Chi-square test, graphical presentation and Weighted average mean.

The socio-economic profile of farmers was examined using tabular analysis and graphical representation. The factors influencing farmers' purchasing behavior towards Insecticides were assessed using Garrett's Ranking Technique. To identify the challenges encountered by

farmers, tabular analysis and the Weighted Average Mean method were employed. Similarly, tabular analysis and the Weighted Average Mean method were used to identify the issues faced by dealers. Lastly, to identify various promotional activities employed by agri-input



companies, tabular analysis and the Weighted Average Mean method were utilized.

Figure 3: Location of the study areas: Dhrol taluka of Jamnagar district

Source: Sattlement Commissionerate of Land Record and Settlement, Govt. of Gujarat (2023) [15]

2.1 Source of the Data

The collected data were analyzes using Microsoft Excel and IBM Statistical Package for Social Science (IBM SPSS) and represented with graphical representation and tabular analysis.

2.1.1 Primary data: Primary data were collected by from the selected areas with the help of survey instrument semi-structured schedule. The data were collected from total 120 (100 farmers and 20 dealers) respondents with personal interview method.

2.1.2 Secondary data: Secondary data were collected from the reviews from the other literature and from other published sources like Govt. database, journals, articles and other websites.

2.2 Research Design

The research conducted was descriptive in nature, aiming to provide a comprehensive understanding of a particular subject. The sampling method employed was non-probability sampling, specifically using purposive sampling. This technique involved selecting participants based on specific criteria to obtain a sample that would best represent the population of interest. The sample units consisted of farmers involved in cumin production and uses insecticides and dealers who sell insecticides. The sample size comprised 100 farmers and 20 dealers. The study was carried out in Dhrol Taluka, located in the Jamnagar district. To gather data, a semi-structured schedule was used. This research design and methodology allowed for in-depth exploration and analysis of the perspectives and experiences of farmers and dealers involved in cumin production in the specified area.

2.3 Data Analysis

- **Analytical Tools:** Tabular analysis, Garrett's Ranking Technique, Pearson Chi-square test, Graphical presentation and Weighted Average Mean.

  Garrett ranking technique was used to rank the preference indicated by the respondents on different factors. As per this method, respondents had been asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value with the help of the following formula:

$$Percent\ position = \frac{100(R_{ij} - 0.5)}{N_j}$$

  Where,

  Rij = Rank given for the ith variable by jth respondent

  Nj = Number of variable ranked by jth respondent [5]

Weighted average mean was used to analyze the purchasing behaviour of farmer toward insecticides. After collecting all the completed schedules from the respondents, the total number of responses for each item was gathered and organized into a table. To interpret the data using the Likert scale, a weighted mean was calculated for each question. To calculate the weighted mean, each response value was multiplied by its corresponding weight. The sum of all the weighted values was calculated to determine the total weight. The total value was then divided by the total weight to obtain the weighted mean. Mathematically, the formula for calculating the weighted mean is:

Weighted Average Mean,

$$\bar{x} = \frac{(W1X1 + W2X2 + W3X3 + W4X4 + W5X5 + \cdots + WiXi)}{Xt}$$

Where,

W = Weight given to each response

X= Number of responses

Xt= Total number of responses

This calculation helps in determining the average value of the responses, considering the importance or weight assigned to each response option.[14]

- ✓ **Hypothesis 1**

  H_0 : There is no significant relation between age and education of the farmers

  H_1 : There is significant relation between age and education of the farmers

- ✓ **Hypothesis 2**

  H_0 : There is no significant relation between age and income of the farmers

  H_1 : There is significant relation between age and income of the farmers

- ✓ **Hypothesis 3**

  H_0 : There is no significant relation between education and income of the farmers

  H_1 : There is significant relation between education and income of the farmers

3. Result and Discussions

3.1. Age Distribution of Respondents

Table 2. Age Distribution of Respondents

Sr. No.	Age Group	Frequency (n)	Percentage (%)
1	<20 years	3	3.00
2	21-40 years	34	34.00
3	41-60 years	41	41.00
4	61-80 years	22	22.00
	Total	100	100.00

The age of the respondents is a significant demographic factor that influences their purchasing patterns and decision-making processes. According to the data presented in Table 3, 3.00 per cent of the respondents were below 20 years old, 34.00 per cent were aged between 21-40 years, 41.00 per cent were aged between 41-60 years, and 22.00 per cent were

above 60 years old. It was evident that a majority of the respondents fell within the 41-60 age group. This suggests that the adoption of new agricultural practices may be challenging, as older respondents tend to be hesitant in adopting new technologies without observing their results beforehand.

3.2 Educational qualification of respondents

Table 3. Educational qualification of respondents

Sr. No.	Qualification	Frequency (n)	Percentage (%)
1	Illiterate	12	12.00
2	Up to Primary	45	45.00
3	≤ SSC	27	27.00
4	≤ HSC	14	14.00
5	Graduation & above	2	2.00
	Total	100	100.00

The educational background of the respondents is a significant factor that impacts their purchasing behavior and decision-making process regarding agricultural inputs. Upon reviewing the data presented in Table 3, it can be observed that 12.00 per cent of the respondents were illiterate, 45.00 per cent had completed primary education, 27.00 per cent had education up to SSC (Secondary School Certificate), 14.00 per cent had education up to HSC (Higher Secondary Certificate), and only 2 per cent had attained a graduate-level education or higher.

3.3 Total land holdings of respondents

Table 4. Total land holdings of respondents

Sr. No.	Total land holdings (ha)	Frequency (n)	Percentage (%)
1	Less than 1	18	18.00
2	1 to 2.5	45	45.00
3	2.5 to 5	22	22.00
4	More than 5	15	15.00
	Total	100	100.00

The landholding of farmers plays a vital role in determining their consumption of agricultural inputs and their ability to take risks. The data presented in Table 4 indicates a significant percentage of farmers owned land in the range of 1 to 2.5 hectares, accounted for a total of 45.00 per cent. It was followed by farmers with 22.00 per cent having land ranging from 2.5 to 5 hectares. Additionally, 18.00 per cent of respondents reported owned less than 1 hectare of land, while the remaining 15.00 per cent of farmers possessed more than 5 hectares of land.

3.4 Area under cumin crop

Table 5. Area under cumin crop

Sr. No.	Area under cumin crop (ha)	Frequency (n)	Percentage (%)
1	Less than 1	61	61.00
2	1 to 2.5	35	35.00
3	2.5 to 5	4	4.00
4	More than 5	0	0.00
	Total	100	100.00

Also, the area under cultivation of cumin plays a crucial role in found out their consumption of specific kinds of agro-inputs used specifically for cumin crop. The data shown in the above Table 5 revealed that a significant percentage of farmers had less than 1 hectare of land dedicated to cumin crop were 61.00 per cent. It was followed by farmers with 35.00 per cent having land ranging from 1 to 2.5 hectares. Additionally, 4.00 per cent of respondents reported having land in the range of 2.5 to 5 hectares, while none of them possessed more than 5 hectares of land for cumin cultivation.

3.5 Gender Distribution of respondents

Table 6. Gender Distribution of respondents

Sr. No.	Gender Group	Frequency (n)	Percentage (%)
1	Male	76	76.00
2	Female	24	24.00
	Total	100	100.00

From the above Table 6, the data shown that out of 100 respondents, majority i.e., 76 per cent were found males, and 24 per cent were found females.

3.6 Annual income of respondents

Table 7. Annual income of respondents

Sr. No.	Annual Income (₹)	Frequency (n)	Percentage (%)
1	< 1 lakh	26	26.00
2	1-5 lakhs	46	46.00
3	5-10 lakhs	19	19.00
4	>10 lakhs	9	9.00
	Total	100	100.00

Income plays a crucial role in ensuring the sustainability of a family and enabling farming activities to be carried out without incurring debts and also plays a major role in purchasing behaviour of agricultural inputs. According to the information provided in Table 7, it can be observed that 26.00 per cent of the respondents had an annual income below ₹1 lakh, 46.00 per cent had an annual income ranging from ₹1 to 5 lakhs, 19.00 per cent had a annual income between ₹5 and 10 lakhs, and a mere 9.00 per cent of the respondents had a annual income exceeding ₹10 lakhs.

3.7 Farming experience of respondents

Table 8. Farming experience of respondents

Sr. No.	Farming Experiance (Years)	Frequency (n)	Percentage (%)
1	≤10	4	4.00
2	11 to 20	28	28.00
3	21 to 30	36	36.00
4	31 to 40	24	24.00
	Total	100	100.00

Based on the data presented in Table 8, it was observed that 36.00 per cent of the respondents had farming experience ranging from 21 to 30 years, while 28.00 per cent had experience spanning 11 to 20 years. Additionally, 24.00 per cent of the respondents had farming

experience ranging from 31 to 40 years, and 4 per cent had less than 10 years of experience. The analysis of the data in the aforementioned table clearly shows that the majority of respondents possessed extensive farming experience.

3.8 Source of income of respondents

Table 9**:** Source of income of respondents

Sr. No.	Pesticide usage	Frequency	Percentage (%)
1	Farming	66	66.00
2	Farming +Animal Husbandary	29	29.00
3	Farming + Other	5	5.00
	Total	100	100.00

According to the information shown in Table 9, the data indicates that the majority of respondents, accounting for 66.00 per cent of them, relied solely on Farming as their source of income. Furthermore, 29.00 per cent of the farmers engaged in both Farming and Animal husbandry combined for their income source, while only 5.00 per cent of the respondents pursued farming alongside other source of income.

3.9 Factors influence farmers while buying the Insecticide

Table 10: Factor influence farmers while buying the Insecticide

Sr. No	Factor	Garrett Score	Rank
1	Price	2121	**I**
2	Quality	1980	**II**
3	Brand Name	1634	**III**
4	Word of Mouth Buzz	1616	**IV**
5	Easy Availability	1386	**V**
6	Promotional Activities	1168	**VI**
7	Packaging Quality	1113	**VII**
8	Less Side effects	982	**VIII**

The study presented in Table 10 for the factors influencing the purchase of insecticides. The data reveals that the majority of respondents considered the Price factor as the most attractive factor for making a purchase. This was followed by Quality, Brand name, Word-of-mouth buzz, Easy availability, Promotional activities and the factor of having Less side effects. These findings are similar with Prajapati *et al.* (2016).

3.10 Problems faced by farmer while purchasing insecticide

Table 11: Problems faced by farmer while purchasing insecticide

Sr. No.	Factor	WAM	Rank
1	Lack of credit facility	3.93	**I**
2	High cost	3.78	**II**
3	Lack of technical expertise & advisory services	3.68	**III**
4	Timely non-availability	3.23	**IV**
5	Recommendation according to profit of the dealer	2.92	**V**
6	Unawareness about adverse effect on health & residue on crop	2.51	**VI**
7	Lack of application equipment & labour	2.4	**VII**
8	Poor quality	1.9	**VIII**

WAM- decipher

Based on the data presented in Table 11, it is observed that the majority of farmer respondents identified Lack of credit facility as the major problem they faced when purchasing insecticides. This was followed by High cost, Lack of technical expertise & advisory services, Timely non-availability, Recommendations based on the dealer's profit, Unawareness about adverse effects on health and crop residue, Lack of application equipment and labor, and Poor quality of insecticides. The results of this study align with the findings of Kumar *et al.* (2022).

3.11 Promotional activities influence the farmers at the time of purchasing Insecticide

Table 12: Promotional activities influence farmers most at the time of purchasing Insecticide

Sr. No.	Factor	WAM	Rank
1	Demonstration	4.15	**I**
2	Farmer meeting	3.78	**II**
3	Poster/Wall paintings	3.75	**III**

4	TV advertisement	3.68	**IV**
5	Word of mouth buzz	3.66	**V**
6	Exhibition/fair	3.65	**VI**
7	Product/ Literature display	3.57	**VII**
8	Internet & social media	3.45	**VIII**
9	Leaflets	3.00	**IX**
10	Telemarketing	2.39	**X**

WAM- decipher

Based on the data presented in Table 12 regarding the promotional activities that had the most influence on respondents when purchasing insecticides. The study revealed that the majority of respondents identified Demonstrations as the most influential factor, and was followed by Farmer meeting, Poster/Wall paintings, TV advertisement, Word of mouth buzz, Exhibition/fair, Product/ Literature display, Internet & social media, Leaflets, and least influenced by Telemarketing. This findings are similar with Zalavadiya *et al*. (2022).

3.12 Problems faced by dealers while selling of Insecticide

Table 13: Problems faced by dealers while selling of Insecticide

Sr. No.	**Factor**	**WAM**	**Rank**
1	Low margin	4.20	**I**
2	Raising cost	4.05	**II**
3	High competition	4.00	**III**
4	Uncertainty in demand	3.90	**IV**
5	Lack of market intelligence	3.80	**V**
6	Lack of infrastructure	3.70	**VI**
7	Unable to supply on time (seasonality)	3.60	**VII**
8	Quality assurance	3.50	**VIII**
9	Marketing before expiry	2.85	**IX**
10	Lack of training	2.40	**X**

Based on the information provided in Table 13, which examines the problems faced by dealers when selling insecticides, the study revealed that the majority of respondents identified Low margins as the primary problem. It was followed by Rising costs, High competition, Uncertainty in demand, Lack of market intelligence, Lack of infrastructure, Quality assurance,Unable to supply products on time due to seasonality, Marketing before expiry, and the least impactful problem reported was the Lack of training. The results of this study align with the findings of Narayan *et al*. (2021).

3.13 The Pearson Chi-Square test

Hypothesis 1

Table 14: Crosstabulation of Age & Education

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	46.531[a]	12	.000
Likelihood Ratio	39.246	12	.000
N of Valid Cases	100		

Table 14 shows the pearson chi-square test value of hypothesis. The table shows that p value is 0.000 which is smaller than 0.05 and calculated chi-square value is 46.531 which is greater than the table value 21.026, implies that null-hypothesis is rejected. This indicates that there is positive and significant relation between age and education. The value is positive implies that there is significant relation between age and education.

Younger farmers may be more open to adopting new technologies and practices, including purchasing innovative equipment, machinery, or specialized agricultural inputs, where, older farmers who have accumulated years of experience, may rely more on traditional methods and have established purchasing patterns for their farming needs.

Hypothesis 2

Table 15: Crosstabulation of Age & Income

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	22.543[a]	9	.007
Likelihood Ratio	23.434	9	.005
N of Valid Cases	100		

Table 15 shows the pearson chi-square test value of hypothesis. The table shows that p value is 0.007 which is smaller than 0.05 and calculated chi-square value is 22.543 which is greater than the table value 16.919, implies that null-hypothesis is rejected. This indicates that there is positive and significant relation between age and income of the farmers. The value is positive implies that as the age of the farmers increases, their income also increases.

Farmers with higher income levels tend to have more financial resources to invest in advanced farming techniques, equipment, and inputs. They may be more willing to purchase high-quality, branded products and adopt modern farming practices. Where, farmers with limited income may prioritize cost-effectiveness and seek affordable solutions for their farming needs. They may be more inclined to purchase generic or less expensive products.

Hypothesis 3

Table 16: Crosstabulation of Education & Income

	Value	**df**	**Asymptotic Significance (2- sided)**
Pearson Chi-Square	24.752[a]	12	.016
Likelihood Ratio	24.895	12	.015
N of Valid Cases	100		

Table 16 shows the pearson chi-square test value of hypothesis. The table shows that p value is 0.016 which is smaller than 0.05 and calculated chi-square value is 24.752 which is greater than the table value 21.026, implies that null-hypothesis is rejected. This indicates that there is positive and significant relation between education and income of the farmers. The value is positive implies that as the education of the farmers increases, their income also increases.

Farmers with higher levels of education may have better access to information, technological advancements, and knowledge about efficient farming practices. They may be more likely to make informed purchasing decisions and invest in innovative solutions. Where, farmers with limited education may rely more on traditional knowledge or local practices. They might have more conservative purchasing behaviors and prioritize familiar or proven methods.

4. Conclusions

It was concluded that the major portion of farmers was middle aged had higher farming experience but the adoption of new agricultural practices might be challenging, as older aged farmers with tend to be more resitant in adopting new technologies without observing their outcomes beforehand. The Pearson Chi-square analysis revealed that there was a significant

association among age and education, age and income, and education and income. The majority of farmers took Price into consideration when buying pesticides, so price was the foremost psychological factor that comes into consideration when purchasing insecticides, surpassing all other factors. In the study of farmers' problems, the major problem faced was Lack of credit facility, followed by High cost, which hindered their ability to expand their business. Regarding the influence of promotional activities on farmers' purchasing decisions, the majority of respondents identified Demonstrations as the most impactful factor, followed by Farmer meetings, therefore it is clear that they are influencing most with face-to-face interaction and live meetings. The majority of dealers indicated that the major problems encountered by them were Low margin, followed by Rising costs and High competition, so profit margin of dealers was found most important problem than any other.

The study highlights the demographics and characteristics of farmers and dealers involved in the agricultural sector. It also identifies key factors influencing the purchase of insecticide, promotional activities used by agri-input companies and the problems faced by farmers and dealers in the process. These findings provides valuable insights for stakeholders to address and improve the current issues faced by farmers and dealers in the insecticide market.

5. References

1. Agropages Report (2022). *Evolution of Indian Agrochemical Industry – Challenges, Opportunities & Way Forward 2022*. Retrieved on 7 May, 2023, from https://news.agropages.com/News/NewsDetail---41622.htm
2. Anand Agricultural University (2023). *Cumin Price Forecast at Harvest- 2022*. Retrieved on 2 May, 2023, from http://www.aau.in/sites/default/files/25cumin_post_harvest_pf_2021_22_mar_eng.pdf
3. Directorate of Agriculture – Agriculture, Farmers Welfare and Co-operation Department- Govt. of Gujarat (2023). *District-wise Area, Production and Yield of Important Food & Non-food Crops in Gujarat State Year : 2018-19, 2019-20 & 2020-21*. Retrieved on 6 May, 2023, from https://dag.gujarat.gov.in/Portal/News/1238_12_APY-2018-19-2019-20-2020-21-red.pdf
4. Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture and Farmers Welfare- Govt. of India (2023). Retrieved on 6 May, 2023, from https://ppqs.gov.in/

5. Decisions, I. S. P. (2019). Application of Henry Garrett ranking method to determine dominant factors influencing smartphone purchase decisions of customers. *Jour of Adv Research in Dynamical & Control Systems, 11*(6), 213-218.
6. FAO (2022). *FAOSTAT Database.* Retrieved on 9 May, 2023, from https://www.fao.org/faostat/en/#data
7. Kumar, C., Gauraha, A. K., & Joshi, S. K. (2022). Constraints faced by farmers for purchase and uses of pesticide and suitable measures to overcome them. *The Pharma Journal 11*(7), 4191-4193.
8. Kumar, R., Sharma, P. K., Slathia, P. S., & Sharma, N. (2016). Pesticide Use in Cereals: An Analysis of Farmers' Perception and Knowledge in Jammu District. *Int.J.Curr.Microbiol.App.Sci (2017) 6*(10): 2411-2419.
9. Markets and Markets (2023). *Global Agrochemical Market Report-2023.* Retrieved on 11 May, from https://www.marketsandmarkets.com/Market-Reports/global-agro-chemicals-market-report-132.html
10. Momin, I. A., & Shaikh, N (2019). Farmers' Buying Behaviour for Pesticides of Vadodara District. *Guj. J. Ext. Edu. Special Issue 1*(1), 70-72.
11. Mordor Intelligence Research & Advisory. (2023). *Agrochemicals Market Size & Share Analysis - Growth Trends & Forecasts (2023 - 2028).* Mordor Intelligence. Retrieved June 24, 2023, from https://www.mordorintelligence.com/industry-reports/agrochemicals-market
12. Narayanan, T. & Pushpa, J. & Velusamy, Ramasamy & Amarnath, J. & Prabhakaran, K.. (2021). Impact Study on Agro Input Dealers in Madurai District—SWOC Analysis. *International Journal of Current Microbiology and Applied Sciences. 10*(01). 1766-1772.
13. Prajapati, V. V., Chauhan, S. M., & Tunvar, M. A. (2016). Factors Affecting Farmers'purchase Decisions Of Insecticides. *Gujarat Journal of Extension Education*, *2*(27), 140-144.
14. Rangaswamy R. (2013). *Textbook of agricultural statistics (2nd ed.).* New age International.
15. Sattlement Commissionerate of Land Record and Settlement, Govt. of Gujarat (2023). Retrieved on 6 May, 2023, from https://landrecords.gujarat.gov.in/maps
16. Zalavadiya, D., Mishra, S., Gondaliya, S., Bhatiya, M., Vaghasiya, V., & Venkat, N. (2022). Problem Identification of Groundnut Cultivation in Bhadthar Market of

Devbhoomi Dwarka District, India. *Asian Journal of Agricultural Extension, Economics & Sociology, 40*(12), 430-435.