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### Knowledge and constraints faced by the farmers in purchase of agro-chemical for vegetable crops in Bharuch district of Gujarat India

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#### Abstract

Agro-chemicals play a very important role in increasing food production of agricultural crops in India; it is required to feed the increasing population. But in recent days, excessive use of agrochemicals leads to polluting soil and water. The residuals are also accumulating in the human food chain. The study was done in Bharuch district to understand the knowledge of farmers towards purchase of agrochemicals. The study was conducted in selected blocks with the random sampling method with a sampling size of 360. The data were collected using a pre-tested interview schedule and personal interview method and analysed using excel and the results were discussed. From the results, it is identified that the knowledge of the farmers was medium to low with respect to use and residual effects of agrochemicals. The farmers have lack of training and information regarding agrochemicals. The farmers face high price, lack of technical information, poor quality, lack of training and non-availability of finance were the major problems faced by the farmers. The farmers were expecting scientific information regarding use and residual effects of agrochemicals should be more useful for farmers to protect soil and environment.

**Keywords:** Agrochemicals, vegetable crops, constraints, knowledge, purchasing

#### 1. Introduction

World population is projected to reach approximately 8.5 billion by 2030, 9.7 billion by 2050, and around 10.4 billion in the 2080s (UN 2024). Automatically, this growing population creates pressures on agricultural land to fulfil the daily requirements of the huge growing population for food and other requirements. In India agriculture directly employs 42% to 46% of the workforce accounts 68.4 million households (DA&FW 2024-25). The use of agrochemicals was promoted by the India government since 1960s along with the green revolution movement mainly to feed the growing population of India. Over the year's consumption and use of agro chemicals increased and now India is leading producer and consumer of agrochemicals in the world. The advancements in agriculture results of green revaluation promotes use of agrochemicals and chemical fertilizers in horticulture and other crops. According to the Food and Agriculture Organization the total global use of pesticides in agriculture was approximately 3.70 million tonnes in the year 2022. Effective usage of these agrochemicals increases yield per hectare as well as quality of the produce. The appropriate use of these chemicals leads to high risk to soil, human and environmental health were well documented under various conditions (Ojo 2006) <sup>[12]</sup>. India is the major producer of pulses, spices, tea, milk, etc., and the second largest producer of rice, wheat, sugarcane, cotton, oilseeds, fruits and vegetables further, fruits and vegetables account for nearly 90% of total horticulture production in the country (Sabnavis & Jagasheth 2019) <sup>[15]</sup>.

Indian farmers are extensively use agrochemicals for the cultivation of cereals, pulses and horticultural crops.

Agriculture is the livelihood of the rural households in Bharuch, although the main cereal crops wheat and rice but majority of the farmers are vegetable growers brinjal, tomatoes, ginger, peas, capsicum and other seasonal vegetables. The farmers use agro chemicals, plants growth promoters, herbicides, insecticides, weedicides, nematocides, viricides and rodenticides to increase the crop production but excessive use of agrochemical on crops leads to soil contamination, air contamination and water contamination. Many of these agrochemicals have a harmful effect on human beings and critical exposure leads to death or serious illnesses (WHO 2003). Across the globe around 3,55,000 people die every year due to unintentional acute poisonings and two-thirds of these deaths occur in developing countries only (Goldman & Tran 2002) <sup>[6]</sup>. These deaths were associated with the excessive exposure and inappropriate use of toxic fungicides and sometimes it leads to chronic health conditions like cancer, reproductive, endocrine, immunological, congenital and developmental disorders (Jurewicz *et. al.*, 2008) <sup>[8]</sup>. The first report of poisoning due to pesticides in India came from Kerala in 1958 where, over 100 people died after consuming wheat flour contaminated with parathion chemical (Gupta 2004) <sup>[7]</sup>.

In 2022 global usage of crop protection chemicals reached 117.9 kg among fungicides consumption had highest per-hectare (48.4 kg), followed by herbicides at 44.8 kg (Nandhini *et. al.*, 2025) <sup>[10]</sup>. In recent years there was a

fluctuation in overall consumption of agrochemicals from 2018-2019 to 2023-2024 with a decline or stagnation from the peak (Source: Indiatat). In 2023-2024 agrochemicals consumption in India was 55.24 tonnes, which was below the peak levels of 63.41 tonnes in 2017-18, still the average consumption over the 24 years is about 52.07 tonnes (Nandhini *et al.*, 2025) <sup>[10]</sup>. The farmers spend nearly seven percent of the cost on agrochemicals for protection of these crops (Balaji *et al.*, 2018) <sup>[2]</sup>. Agrochemicals are the substances used to control several agents like insects, arthropods, animal disease transmitters, plants and microbial pathogens. Agrochemicals are usually sold out worldwide and utilized at industrial and domestic level (Dadaby and Tulk, 2017) <sup>[4]</sup>. Exposure of farmers to pesticides is huge especially in rural areas, so understanding farmer's knowledge of agrochemical safety is essential. The current study aims to study farmer's knowledge and constraints faced by the farmers in purchase of agrochemicals help to find the understood information in the usage of agrochemicals. Therefore, a study was planned to examine whether the farmers are using agrochemicals wisely or they are cognisant of the harmful effects of these chemicals on health as well as the environment.

## 2. Review of literature

These section delivers a comprehensive understanding of previous studies related to vegetables growers' knowledge, buying behaviour pattern, usage patterns and perceived constraints in usage and purchase of agrochemicals. This foundation helps define present knowledge gaps and director's future exploration.

The findings of Lakshmana 2023 <sup>[13]</sup> showed that knowledge level is adequate among farmers but this did not reflect in their practice. There is a need for continuous pesticide safety education along with training to the farmers regarding use of personal protective devices, personal hygiene and sanitation practices during and after application of pesticides through community services. At the same time, studies from Sri Lanka Malaysia, Indonesia, Pakistan, and Ethiopia consistently reveal significant gaps in farmers' knowledge, perceptions, and safety practices regarding pesticide use (Bakhtawer, 2021 and Ocho *et al.*, 2016) <sup>[1, 11]</sup>. Dabhi and Thakkar (2024) <sup>[3]</sup> found that most of the farmers got knowledge about fungicides from agro service centre and the most influencing factors for purchase of fungicides were found to be dealer recommendation followed by past experience and price. Zapda and Thakkar (2024) <sup>[19]</sup> reported that farmers' brand preferences for specific insecticides were influenced by competitive pricing, past experiences, and the opinions of progressive farmers. It was also found that farmers' choices were also strongly influenced by farmer meetings and field demonstrations the farmers were high cost of fungicides followed by lack of technical knowledge. Majority of the farmers were not aware about disposing of the bags or containers properly as per the manufacturer's instructions, thus affecting the environment. It was revealed that 42.53% of agrochemical users did not use any precautions while applying these chemicals (Shalini 2022) <sup>[16]</sup>.

Paghadar and Thakkar (2023) <sup>[14]</sup> found that farmers mostly relied on past experience, dealer recommendation and brand image of the company while buying insecticides. The major problems faced by farmers included high price, no discount, poor quality of products, fear of adulteration and product availability. Shalini (2022) <sup>[16]</sup> found that 72.88% of small landowners used pesticides and fertilizers to increase income, with 33.89% investing 5-10% of their funds in these products. However, 73.73% used pesticides more than four times per season and 42.53% did not take necessary precautions. These findings underscore the need for policies to ensure safe and effective agrochemical use, aiming to improve yields and reduce health and environmental risks. Janaki Rani *et al.*, (2025) stated that pesticide consumption patterns vary due to varied farmer knowledge, which are formed by reasons such as education, attitudes, cultural values, beliefs, societal influences, and relevant laws and regulations.

## 3. Materials and Methods

The study was so planned to identify the agrochemical practices of the farmers, to discovery whether chemical farming improved their economy, their knowledge while using the chemicals and understanding about hazards caused to health and the ecosystem. The study was conducted in Bharuch district based on simple random sampling method during the year 2023-24. For the study 2 blocks were selected Ankleshwar and Hansot purposively. Because these talukas have higher area under vegetable cultivation as compared to other talukas of district. Total twelve villages were selected randomly from each block accounts six villages. From each selected village 20 vegetable growing farmers were selected based on random selection procedure thus with the total sample size of 360. Primary data was collected with the help of pre tested interview schedule designed based on selective parameters and indicators. The respondents were asked question using local language for the better understanding. The data gathered were subjected to analyse by using the statistical tools, such as percentage, weighted mean, average, standard deviation and correlation coefficients.

## 4. Results and Discussion

### 4.1 Farmers' knowledge regarding different categories of agrochemicals used in agriculture

Different types of agrochemicals like insecticide, fungicide, herbicide etc were frequently used by the farmers. Table 1 relives farmers have highest knowledge (95%) regarding insecticides like organophosphates, synthetic pyrethroids and neonicotinoids and only 5% of them were not aware. Because these chemicals are commonly applied to vegetable crops to control aphids, hoppers and bollworms. Around 50% of the farmers have information regarding fungicide like and nearly 51% for farmers don't have proper information regarding. The respondents were having least knowledge only 5.28% have information regarding herbicides and 94.72% of farmers doesn't have any information regarding. These results were in line with (Shalini, 2022 and Kanchan *et al.*, 2023) <sup>[16, 9]</sup>

**Table 1:** Distribution of the respondents according to farmers' knowledge regarding different categories of agrochemicals used in agriculture

| Sr. No | Name of agro-chemical | Frequency |     | Percentages |       |
|--------|-----------------------|-----------|-----|-------------|-------|
|        |                       | Yes       | No  | Yes         | No    |
| 1      | Insecticide           | 342       | 18  | 95.00       | 5.00  |
| 2      | Fungicide             | 177       | 183 | 49.17       | 50.83 |
| 3      | Herbicide             | 41        | 319 | 11.39       | 88.61 |
| 4      | Others                | 19        | 341 | 5.28        | 94.72 |

#### 4.2 Time of purchase of agrochemicals in vegetable crops by the farmers

The purchase behaviour of agrochemicals by the farmers were explained in Table 2. The table explained 73.33% of farmer's purchase agrochemicals only at the time of pest attack followed by 17.50% farmers purchase after certain loss. The agrochemicals were available to the farmers at local stores near to their villages on time. Only 9.17% of farmers purchase and keep ready before pest attack. These farmers think defiantly attack of pests is common in fruits and vegetables so they purchase chemicals before pest attack.

**Table 2:** Distribution of the respondents according to time of purchase of agrochemicals

| Sr. No | Time of purchase    | Frequency | percentages |
|--------|---------------------|-----------|-------------|
| 1      | Before pest attack  | 33        | 9.17        |
| 2      | Time of pest attack | 264       | 73.33       |
| 3      | After certain loss  | 63        | 17.50       |
|        | Total               | 360       | 100.00      |

#### 4.3 Purchasing sources of agrochemical by the farmer

Farmers have accessibility to purchase agrochemicals from different sources that were available to their nearby localities i.e dealer shop, retailer shop and co-operative society. From Table 3 91.11% of the farmers purchase agrochemicals from retailer shops because retailer's shops were easily available to farmers nearby their villages. Only around 5% of farmers purchase cooperative societies and followed by nearly 4% farmers purchase from dealer shops. It's because dealers and cooperative societies have limited access to the farmers and the timely availability of stock in those sources were very limited. If the farmer's available discounts on agrochemicals farmers approach cooperative societies.

**Table 3:** Distribution of the respondents according to source of purchase of agrochemicals by farmers

| Sr. No. | Source of purchase   | Frequency | Percentages |
|---------|----------------------|-----------|-------------|
| 1       | Dealers              | 15        | 4.17        |
| 2       | Retailers            | 328       | 91.11       |
| 3       | Co-operative society | 17        | 4.72        |
|         | Total                | 360       | 100.00      |

#### 4.4 Farmers' knowledge about purchase of agrochemicals in vegetable crops

An attempt has been made to assess the knowledge level of the farmers regarding purchase of agrochemicals in vegetable crops. The teacher made test of 15 items was prepared to assess the knowledge level of the farmers. The score of 'one' was assigned to correct answer and 'zero' to incorrect answer. Based on knowledge score attained, the

index for each farmer was calculated. The farmers on the basis of knowledge index were classified into three categories. The data in this regard presented in Table 4.

**Table 4:** Distribution of the farmers' according to their knowledge regarding purchase of agrochemicals in vegetable crops

| Sr. No. | Categories | Score                  | Frequency | Percentage |
|---------|------------|------------------------|-----------|------------|
| 1       | Low        | Up to 61.00            | 70        | 19.44      |
| 2       | Medium     | Between 61.00 to 75.00 | 248       | 68.89      |
| 3       | High       | Above 75.00            | 42        | 11.67      |
|         | Total      |                        | 360       | 100.00     |

The results from the table describes that 68.89% farmers have medium level of knowledge with the score of 61.00 to 75.00, 19.44% of the farmers having low level of knowledge with the score of up to 61.00 and only 11.67% having high level of knowledge. This deficiency of knowledge among the farmers of vegetables growers was mainly because lack of availability scientific information. Maximum farmers the source of information regarding the utilization of these chemicals was local retailers. These people advices only the quantity of usage, specific chemical for the particular disease based on their experience, they don't have any scientific knowledge regarding side effects of these chemicals, precautionary and disposal measures should be followed by the farmers while using these chemicals.

#### 4.5 Reasons behind selection of a particular brand by the farmers

From the results it's identified that farmers prefer to purchase repeatedly particular brand of agrochemicals. Maximum farmers (93.33%) want to purchase agrochemicals base on easily availability because they approach local retails and 90.28% of farmers purchase repeatedly based on the effectiveness. That indicates farmers purchase agrochemicals based on their personal experience. Price (8.61%) and promotional activities (10.28%) were least bothered by the farmers in purchase of agrochemicals.

**Table 5:** Distribution of the respondents according to reasons behind selection of particular brand by the farmers

| Sr. No. | Particular             | Frequency |     | Percentages |       |
|---------|------------------------|-----------|-----|-------------|-------|
|         |                        | Yes       | No  | Yes         | No    |
| 1       | Effectiveness          | 325       | 35  | 90.28       | 9.72  |
| 2       | Availability in market | 336       | 24  | 93.33       | 6.67  |
| 3       | Rate                   | 31        | 329 | 8.61        | 91.39 |
| 4       | Advertising activity   | 37        | 323 | 10.28       | 89.72 |

#### 4.6 Relationship between the profile of vegetable growers and their knowledge in purchase of agrochemical to vegetable crops

The Karl Pearson's correlation coefficient test was used to test association between personal variables and knowledge of vegetables growers and results obtained is presented in Table 6. The results from the table shown that age ( $r = 0.017$ ), gender ( $r = 0.090$ ) and social participation ( $r = 0.091$ ) showed positive and non-significant relationship with the knowledge in purchasing pattern of agrochemicals. These variables show non-significant means no relationship between these variables with knowledge of farmers to

purchase of agrochemicals. Because usually purchase of agrochemicals was done male farmers based on the guidance given by the retailers nearby villages. The variables education ( $r = 0.188^*$ ), extension participation ( $r = 0.179^*$ ), economic motivation ( $r = 0.192$ ), scientific orientation ( $r = 0.186$ ) shown positive and significant relationship (0.05) with knowledge in purchase of agrochemical to their vegetable crops. This positive significance indicates that increase in these variables helps to increase in knowledge of purchasing behaviour of agrochemicals. Because these variables help to widen the knowledge of the farmers automatically increases the awareness and knowledge regarding positive and negative effectiveness of these farmers. The variables like annual income ( $r = 0.223$ ), size of land holdings ( $r = 0.251$ ), area under vegetable cultivation ( $r = 0.259$ ) and farming experience ( $r = 0.291$ ) shown positive and highly significant relationship with the knowledge of vegetable growing farmers in purchasing agrochemicals. This indicates that increase in these variables leads to highly increase the knowledge of the vegetable growing farmers in purchase of agrochemicals. If the farmers want to earn more and regular income from the vegetable cultivation they should definitely have proper knowledge regarding purchase and usage of agrochemicals. The farming experience and land under cultivation of

vegetables helps the farmers to increase the income of the farmers.

**Table 6:** Relationship between the profile of vegetable growers and their knowledge regarding use of agrochemicals

| Sl. No. | Independent Variables            | 'r' value |
|---------|----------------------------------|-----------|
| 1       | Age                              | 0.017     |
| 2       | Gender                           | 0.090     |
| 3       | Educational qualification        | 0.188*    |
| 4       | Extension participation          | 0.179*    |
| 5       | Social participation             | 0.091     |
| 6       | Annual income                    | 0.223**   |
| 7       | Size of land holding             | 0.251**   |
| 8       | Scientific orientation           | 0.186*    |
| 9       | Area under vegetable cultivation | 0.259**   |
| 10      | Farming Experience               | 0.291**   |
| 11      | Economic motivation              | 0.192*    |

\*\* Significant at 0.01 level of probability \* Significant at 0.05 level of probability

#### 4.7 Constraints faced by farmers in purchase of agrochemicals

Farmers always face problems while purchase of agrochemicals. From this study, based on the scores given by farmers the following problems were identified as the major constraints mentioned in Table 7.

**Table 7:** Distribution of the respondents according to constraints faced by farmers in purchase of agrochemicals

| Sr. No. | Constraints                                   | Frequencies | Percentages | Rank |
|---------|-----------------------------------------------|-------------|-------------|------|
| 1       | Short of technical knowledge                  | 294         | 81.67       | II   |
| 2       | Price of agrochemicals was high               | 323         | 89.72       | I    |
| 3       | Timely availability of chemicals              | 15          | 4.17        | VII  |
| 4       | Details regarding residual effect on the crop | 36          | 10.00       | VI   |
| 5       | Poor quality of agrochemicals                 | 239         | 66.39       | III  |
| 6       | No finance available                          | 142         | 39.44       | V    |
| 7       | Lack of training                              | 216         | 60.00       | IV   |

The results from the table identified that the maximum number (89.72%) of the farmers face high price of the agrochemicals was the problems ranks first. Farmers spending maximum amount their income in purchase of agrochemicals. Even though the cost of these chemicals was high there was no alternative option for them. The second constraint was shortage of technical knowledge (81.67%), most of the farmers purchase agrochemicals from the local retailers these people don't have scientific knowledge regarding the chemicals, the small information communicated by the vendors they pass on to the farmers. So they lack proper information regarding the usage and problems of the agrochemicals. The third constraint was quality of agrochemicals was poor ranks 3<sup>rd</sup> (66.39%), it's mainly depending on local retailers. The fourth important constraint was lack of training, 60% of the farmers feel that they don't have proper training regarding use and handling of agrochemicals. Local retailers provide information regarding dosage and time of chemical application. The 5<sup>th</sup> constraint was lack of finance, 39.44% of the farmers face the problem related price of chemicals. The chemical price was high and can't afford to pay that because maximum farmers belong to middle to poor level of economic income might be the reason. Details regarding residual effects of agrochemicals was provided by the retailers (10.00%) and

timely availability of chemicals (4.17%) stands 6<sup>th</sup> and 7<sup>th</sup> rank respectively. Indicates farmers as well as retailers were least bothered regarding the residual effects of agrochemicals and they don't have proper knowledge regarding.

#### 5. Conclusion

The results from the analysis concludes that maximum farmers purchase insecticides and fungicides regularly with retailers at the time of pest attack. They select agrochemicals based on the effectiveness of the product and availability of the product in the market. Maximum farmers having medium to low level of knowledge regarding usage of agrochemicals and having least knowledge regarding residual effects. The variables like education, extension participation, economic motivation, scientific orientation, annual income, size of land holdings, area under vegetable cultivation and farming experience having positive and significantly related to the farmer's knowledge towards purchasing of agrochemicals for vegetable crops. From the results it's identified that the information regarding residual effects and the proper use of agrochemicals were not received by the farmers regarding agrochemicals. The farmers were expecting proper training progress should be organised to understand the residual effects of the agrochemicals.

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