ORIGINAL RESEARCH ARTICLE

HERBICIDE SALES IN GROUNDNUT FARMING: AN ANALYSIS OF FARMER AND DEALER BUYING BEHAVIOR IN RAJKOT DISTRICT, INDIA

ABSTRACT

The world population is increasing and to meet the demands of population, a major increase in food production, trade, and agricultural activities will be required. Weeds cause more crop losses than pests and diseases together. It is responsible for more than 45% of all agricultural output losses. To tackle this problem herbicides are substances used to eradicate undesirable plants that could hinder crop growth and productivity. Weed competition reduced groundnut pod yield. So, for this reason, it is required to study buying pattern of farmers for herbicides used, factors affecting farmers during purchase of herbicides and factors affecting dealers with respect to herbicides.

The research design was a descriptive type. Non-probability sampling method and purposive sampling technique were used. To accomplish the objectives of the study primary data were collected from 120 farmers and 80 dealers from Rajkot, Gondal, Jetpur and Jasdan talukas of the Rajkot district. Study reveal that the majority of farmers belong to the thirty-five to fifty years age group, having below SSC level education and one to five lakh annual income. Most of the farmers live in a joint family having three to five members in their family. The majority of farmers belong to the semi-medium size of land holding and four to eight acres of land under groundnut cultivation with more than fifteen years of farming experience used herbicides ten to twenty years and used only post-emergence herbicides. Most farmers used Targa super, Shaked and Patela herbicides. Based on dealer recommendations majorly farmers purchase herbicides and applied two sprays with less than ₹1000 cost per acre. Major factors affecting to the farmers during the purchase of herbicides were a performance of product, brand name and dealer suggestions while major factors affecting to the dealers with respect to herbicides are past experience, brand image and margin.

Keywords: Buying pattern, Herbicides, Purchase, Farmers, Dealers, Groundnut

1. INTRODUCTION

With the continuous growth of the global population, there is an increasing need for food resources. By the year 2050, it is anticipated that the global population will reach a milestone of 10 billion people. (thebusinessresearchcompany.com) This substantial population growth is expected to have a significant impact on the herbicide industry. In order to meet the demands of this expanding population, there will be a necessary increase in crop production, trading volumes and farming activities.

Herbicides are compounds used to destroy undesirable plants that may interfere with crop growth and yield. In India, weeds are more responsible for crop losses than pests and diseases together. It accounts for more than 45% of the entire annual loss of agricultural products.

In groundnut, weed competition occurs between 3 to 6 weeks after sowing, depending on numerous environmental conditions. Weed competition reduced groundnut pod yield by 30 to 34%, with sometimes up to 100%. When compared to an irrigated crop and Virginia runner, yield losses are greater in rainfed crops as well as Spanish bunch. Herbicides have been regarded as a cost-effective method for controlling weeds in groundnuts. (ikisan.com)

According to a report by IMARC Group, the global herbicides market achieved a value of USD 30.32 billion in 2021 and is projected to reach USD 39.34 billion by 2027. This forecasted growth indicates a compound annual growth rate of 4.20% during the period of 2022 to 2027. Among the different regions, Asia-Pacific emerged as the leading market for herbicides in 2022

(thebusinessresearchcompany.com). In 2020 USA, Brazil and Argentina were the top herbicide-consuming countries (fao.org).

The Indian pesticide market was worth INR 212 billion in 2021. The market is expected to reach INR 320 billion by 2027, according to IMARC group, with a CAGR of 7.07% from 2022 to 2027 (imarcgroup.com). India is the Asia-Pacific region's fastest-growing herbicide market (mordorintelligence.com). UPL, BASF, and PI were India's top three agrochemical companies in 2022 based on net sales (statista.com). In 2021-22 Maharashtra and Uttar Pradesh were the top pesticide consuming states (ppqs.gov.in).

In 2021-22 world groundnut production was 50,109 thousand metric tonnes. Whereas in India and Gujarat groundnut production was 6800 and 4359 thousand metric tonnes respectively (ipad.fas.usda.gov, dag.gujarat.gov.in).

Ramoliya & Prajapati (2022) found that effective input management is crucial for optimal groundnut production. The quantity of inputs used by farmers directly affects cultivation costs. Farmers tend to excessively utilize inputs such as seeds, fertilizer, labour, bullock and irrigation for groundnut production. However, they underutilize inputs like farm equipment, plant protection chemical and manure. Larger farmers have higher returns and input-output ratios. Encouraging proper training and awareness of recommended practices and technologies among groundnut farmers is essential for increasing production.

Padaliya *et al.* (2021) revealed that the better result than their competitors, long-term and positive effect on crops, increase productivity and after-field demonstration were major factors that affect farmers when purchasing herbicides followed by expert's recommendations and past experience, credit and cost concern, crops and weeds condition and stage.

Surender *et al.* (2021) concluded that the most influencing factors for the purchase of herbicides were economic factors such as herbicides application saving time for the farmer, reducing production costs by cutting labour costs and saving money for the farmers followed by psychological or motivational factors such as the influence of dealers, easy to use, very effective in controlling the weeds, morphological factors such as type of weed and type of crop and situational factors such as landholding size and weed infestation intensity.

Bharpoda & Prajapati (2020) revealed that for effectively market herbicide products to small and medium farmers, companies rely on tools like field demonstrations, testimonials, farmers' meetings, newspaper ads, TV and jeep campaigns. The most impactful methods are field demonstrations and farmers' meetings, while product quality and packaging size greatly influence purchasing behaviour.

Prabha and Raviselvam (2020) concluded that the majority of the respondents were between the 45 to 55 age group. Most of the respondent's monthly income, expenditure and savings were between ₹10000 to ₹20000, ₹10000 to ₹15000 and less than 2500 respectively. Also, the study shows that the standard of living has improved as a result of government action in providing fundamental requirements such as health care, education and hygiene.

Momin and Shaikh (2019) found that farmers consider price as the most significant element when purchasing pesticides, followed by product quality, brand image, yield performance, packing, and dealer relationships. Farmers lastly accept recommendations from progressive farmers while purchasing pesticides.

Ahmad *et al.* (2018) revealed that farmers primarily cultivate castor on irrigated land using drip irrigation as a method of irrigation. Farmers have been growing hybrid castor seeds for more than five years. Farmers typically buy hybrid castor seeds based on their personal experience. Most farmers purchase seeds mainly on a cash basis. Castor yield, wilt resistance, brand image, timely availability and germination percentage are the most important elements influencing farmer purchase behaviour when purchasing hybrid castor seeds.

Hosurkar and Kerur (2018) concluded that the majority of farmers purchase pesticides from private agro-service centers followed by Raita Samparka Kendra on a subsidy basis. Due to the lack of credit from dealers, most farmers purchase pesticides on a cash basis. The majority of farmers purchase pesticides one day before spraying. Study also revealed that brand image was the major preference factor and field demonstration was the most influential promotional tool for the purchase of pesticides.

Masudkar *et al.* (2017) found that the majority of the respondents belong to the middle age group and have a large size of family. Most respondents were from the open cast category and had education up to the middle level. Majority of farmers were a marginal farmers and middle-level of income. So, the overall socio-economic status of the study region was middle-level.

Metaliya (2016) revealed that major factors affecting the dealers while purchasing agrochemical products were quality and margin followed by product performance, credit facility, brand image, farmer trust, timely availability, after-sales service, effective administration. Also found that increase

margin, competitive price with other brands and increase field demonstration activities were the main suggestions from the dealer side.
Keesara (2012) concluded that major factor influencing while dealing with company's product was quality of the product after that margin comes. Also found that there was a significant relationship between dealers' experience and satisfaction level for credit period.

Objectives

1. To study the socio-economic profile of farmers in selected talukas of Rajkot district
2. To study the buying pattern of farmers for herbicides used in Groundnut crop
3. To study the factors affecting farmers during purchase of herbicides
4. To study the factors affecting dealers with respect to herbicides

2. METHODOLOGY

2.1 Source of data

Primary data were collected with the help of a semi-structured schedule from the respondents.
Secondary data were collected from government publications, websites, journals, articles, etc.

2.2 Research design

To adequately investigate and evaluate the attributes of a group, population, or event, a descriptive research design was used.

2.3 Sampling method

The sampling method used was a non-probability sampling method since it does not require a full survey frame and is a simple, quick and cheaper way to collect data.

2.4 Sampling technique

In the study, purposive sampling technique was used because the survey was on the farmers who grow Groundnut in the Kharif season.

2.5 Sampling unit

Groundnut farmers and agro-input dealers were chosen as the sampling unit and information was gathered from them in order to meet the stated objectives.

2.6 Sample size & area

Since the last few years area under groundnut cultivation is increasing in the Rajkot district and also for the study purpose 120 farmers and 80 agro-input dealers were chosen from the Rajkot, Gondal, Jetpur and Jasdan talukas of Rajkot district.

2.7 Research instrument

In order to consider the nature of the study and obtain reliable information from the respondent, data were collected using a semi-structured schedule.

2.8 Analytical tools

Tabular analysis and weighted average mean were used to study the objectives.
Statistically, the formula below is used to determine the weighted mean:
Weighted Average Mean (X) = $(F_1X_1 + F_2X_2 + F_3X_3 + F_4X_4 + F_5X_5) / X_t$
Where:
F = Weight given to each response
X = Number of responses
X_t = Total number of responses

3. RESULTS AND DISCUSSION

3.1 Socio-economic profile of the farmers

Table 1 revealed Socio-economic profile of the farmers. Farmers of different ages may have various levels of expertise and skills in farming operations. Out of total 120 farmer respondent's majority of the farmers were between the age group of 35 to 50 years (48.30%) followed by 50 to 65 years (31.70%), more than 65 years (13.30%) and 20 to 35 years (6.70%).

Majority of the respondents having below SSC level education (42.50%) followed by 35.80% farmers were illiterate, 11.70% farmers educate up to HSC level and 10% farmers educate up to the SSC level.

Most of the farmers (65.83%) belong to the ₹1-5 lakh income group followed by 20.83% of farmers belong to the less than ₹1 lakh income group and 13.33% of farmers belong to the ₹5-10 lakh income group.

Family size of the majority of the farmers were joint family (60.83%) followed by 25.83% farmers belong to a nuclear family and 13.33% farmers belong to an extended family and most of the farmers (44.17%) have 3 to 5 members in their family followed by 41.66% of farmers having more than five members in their family and 14.17% farmers having only two members in their family.

As far as the farming experience majority (73.30%) of farmers were having more than fifteen years of experience. 20% farmers were having ten to fifteen years of experience and only 6.70% farmers were having five to ten years of experience. All the farmers of the study region were having experience in groundnut farming same as total experience in farming.

Majority about 60% of farmers belonged to the semi-medium size land holding (2-4 ha) group followed by 26.70% of farmers belong to small size land holding (1-2 ha) and 13.30% of farmers belonged to a medium category of land holding (4-10 ha).

About groundnut cultivation area majority (55%) of the farmers were having 4-8 acres of land under groundnut cultivation followed by 25% farmers were having less than 4 acres of groundnut cultivated area, 11.70% farmers were having 8-12 acres of groundnut cultivated land and only 8.30% farmers were having more than 12 acres of land under groundnut cultivation.

Table 1. Socio-economic profile of the farmers

Sr. No.	Parameter	Percentage (%)
1	**Age**	
	20-35 years	6.70
	35-50 years	48.30
	50-65 years	31.70
	>65 years	13.30
2	**Education**	
	Illiterate	35.80
	Below SSC	42.50
	SSC	10.00
	HSC	11.70
3	**Annual Income (₹)**	
	< 1 lakh	20.83
	1-5 lakh	65.83
	5-10 lakh	13.34
4	**Family type**	
	Nuclear	25.83
	Joint	60.83
	Extended	13.34
5	**Family size**	
	2 members	14.17
	3-5 members	44.17
	Above 5 members	41.66
6	**Farming Experience**	
	5-10 years	6.70
	10-15 years	20.00
	>15 years	73.30
7	**Landholding**	
	1-2 ha (Small)	26.70
	2-4 ha (Semi-medium)	60.00
	4-10 ha (Medium)	13.30
8	**Groundnut cultivation area**	
	< 4 acres	25.00
	4-8 acres	55.00
	8-12 acres	11.70
	> 12 acres	8.30

3.2 No. of years using herbicides

Table 2 shows no. of years using herbicides. Out of the total respondents 59.20% (71) farmers using herbicides since the last ten to twenty years. 27.50% (33) farmers using herbicides below ten years and 13.30% (16) farmers using herbicides more than 20 years.

Table 2. No. of years using herbicides

No. of years	Frequency (n)	Percentage (%)
Below 10 years	33	27.50
10-20 years	71	59.20
More than 20 years	16	13.30
Total	120	100.00

3.3 Stage at which herbicides is used by farmers

Table 3 shows the type of herbicides used by farmers. Most, almost 60.80% (73) farmers used post-emergence type of herbicides and 39.20% (47) farmers used both pre-emergence and post-emergence type of herbicides.

Table 3. Type of herbicides used by farmers

Type of herbicides	Frequency (n)	Percentage (%)
Post-emergence	73	60.80
Pre-emergence & Post-emergence	47	39.20
Total	120	100.00

3.4 Herbicides used by the farmers

Table 4 shows different herbicides used by farmers of the study region. The majority of the farmers (47) used Targa super herbicides which are for the control of narrow leaf weeds followed by 41 farmers used Shaked and 18 farmers used patela herbicides for the control of both broad and narrow-leaf weeds. For pre-emergence herbicides 14 farmers used dabooch, 6 farmers used dhanutop, 7 farmers used Amicus, 9 farmers used Stomp and 11 farmers used Strongarm. Tornado, Irish, Agile, Hachimen, Pursuit, Kawayat and Amora herbicides are used by 7, 15, 4, 9, 8, 5 and 7 farmers respectively.

Table 4. Herbicides used by the farmers

Herbicides (Brand name)	Company name	Dose/acre	Frequency (n)
Targa super	Dhanuka Agritech Ltd.	300-400 ml	47
Tornado	Dhanuka Agritech Ltd.	175 ml	7
Dabooch	Dhanuka Agritech Ltd.	12.4 gm	14
Dhanutop	Dhanuka Agritech Ltd.	1-1.5 lt	6
Patela	Swal Corporation Ltd.	400 ml	18
Irish	United Phosphorus Ltd.	400 ml	15
Amicus	United Phosphorus Ltd.	800 ml	7
Shaked	ADAMA Ltd.	800 ml	41
Agile	ADAMA Ltd.	300 ml	4
Hachimen	Insecticides India Ltd.	175 ml	9
Pursuit	BASF Ltd.	400 ml	8
Stomp	BASF Ltd.	1-1.5 lt	9
Kawayat	Dharmaj Crop Guard Ltd.	300 ml	5
Amora	Crystal Crop Protection Ltd.	600 ml	7
Strongarm	Dow Agro Science LLC	12.4 gm	11

3.5 No. of spray applied by the farmers

Table 5 shows the no. of herbicide sprays applied by the farmers in the groundnut crop. Out of the total respondents 75 (62.50%) farmers applied herbicides two times followed by 45 (37.50%) farmers who applied herbicides one time in their field.

Table 5. No. of spray applied by the farmers

No. of spray	Frequency (n)	Percentage (%)
One	45	37.50
Two	75	62.50
Total	120	100.00

3.6 Cost of herbicides per acre

Table 6 shows the cost of herbicides per acre. The majority (40%) of the farmers have less than ₹1000 cost of herbicides per acre followed by 31.66% (38) of farmers having more than ₹1400 cost of herbicides per acre and 28.33% of farmers having a cost of herbicides between ₹1000-₹1400 per acre.

Table 6. Cost of herbicides per acre

Cost/acre	Frequency (n)	Percentage (%)
< ₹1000	48	40.00
₹1000 - ₹1400	34	28.33
> ₹1400	38	31.66
Total	120	100.00

3.7 Influencer person for purchase of herbicides for the farmer

Table 7 shows that while purchasing herbicides by the farmers they influence with different persons. Majority of farmers (112) purchase herbicides based on the dealers' recommendations followed by 80 farmers who purchased based on recommendations from progressive farmers, 64 from company recommendations and 24 from agricultural extension worker.

Table 7. Influencer person for purchase of herbicides for the farmer

Opinion from	Frequency (n)
Dealer	112
Progressive farmer	80
Company's person recommendation	64
University/Agricultural Extension worker	24

3.8 Factors affecting farmers during purchase of herbicides

Table 8 shows that major factors affecting to the farmers during the purchase of herbicides were a performance of product, brand name and dealer suggestion followed by a demonstration by company, intensity of weed, credit period, price of the product, farmer advice, TV advertisement, type of weed, field staff advice and package size.

Table 8. Factors affecting farmers during purchase of herbicides

Factors	WAM	Rank
Performance of product	4.65	1
Brand name	4.20	2
Dealer suggestion	4.03	3
Demonstration by company	3.73	4
Intensity of weed	3.63	5
Credit period	3.58	6
Price of the product	3.43	7
Farmer advice	3.26	8
TV advertisement	3.02	9
Type of weed	2.91	10
Field staff advice	2.71	11
Package size	2.20	12

3.9 Factors affecting dealers with respect to herbicides

Table 8 shows that major factors affecting to the dealers while dealing with herbicides were past experience, brand image and margin followed by credit period, timely availability, promotional strategy and packaging

Table 9. Factors affecting dealers with respect to herbicides

Factors	WAM	Score
Past experience	4.53	1
Brand image	4.23	2
Margin	4.10	3
Credit period	3.73	4
Timely availability	2.74	5
Promotional strategy	2.73	6
Packaging	2.30	7

4. CONCLUSIONS

From the study it was found that majority of farmers belong to the thirty-five to fifty years age group, having below SSC level education and one to five lakh annual income. Most of the farmers live in a joint family having three to five members in their family. The majority of farmers belong to the semi-medium size of land holding and four to eight acres of land under groundnut cultivation with more than fifty years of farming experience. A majority of farmers use herbicides ten to twenty years and use only post-emergence herbicides. Most farmers using Targa super, Shaked and Patela herbicides. Based on dealer recommendations majorly farmers purchase herbicides and applied two sprays with less than ₹1000 cost per acre. Major factors affecting the farmers during the purchase of herbicides are a performance of product, brand name and dealer suggestions while major factors affecting to the dealers with respect to herbicides are past experience, brand image and margin. As a stakeholder for survival in the market, it is suggested to focus more on product quality and performance which will provide stability and growth in the long run.

Consent

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

REFERENCES

1. Ahmad M, Parmar, G, & Leua A. Study on buying pattern and buying behaviour of hybrid castor growing farmers in Aravalli district of Gujarat state. International Journal of Commerce and Business Management. 2018;11(1):38-43.
2. Bharpoda M R, & Prajapati M R. Study on herbicide market and farmer purchasing behaviour toward use of herbicide in Dahod district. International Journal of Agriculture Sciences. 2020;12(24):10481-10482.
3. Hosurkar M A & Kerur N M. Pesticide purchasing behaviour of farmers in Dharwad district. International Research Journal of Agricultural Economics and Statistics. 2018;9(1):108-112.
4. Keesara S. A comprehensive study of pesticides dealers satisfaction in Guntur district of Andhra Pradesh. 2012; (Project report, Junagadh agricultural university). Retrieved from https://krishikosh.egranth.ac.in/handle/1/5810024138
5. Padaliya S P, Ramoliya R K, & Pundir R S. Purchasing behaviour of farmers towards herbicides for soybean crop. Gujarat Journal of Extension Education. 2021;32(1):25-30.
6. Prabha N, & Raviselvam G. Socio-economic status of farmers in Thanjavur district – a study. International Journal of Management. 2020;11(11):3672-3676.
7. Ramoliya R K, & Prajapati M R. A study on level of input and economics of production of groundnut in Gujarat. Current Journal of Applied Science and Technology. 2022;41(37):30-41.
8. Surender S, Balaji P, Ashok K R, & Velavan. A study on factors influencing the purchase of herbicides by the farmers among the select districts of Tamil Nadu. The Pharma Innovation Journal. 2021;10(10):887-891.

9. Masudkar D D, Kamble V B, & Anarase M S. Socio-economic status of the farmers in adopted village. Journal of Pharmacognosy and Phytochemistry. 2017;6(6S):1117-1119.
10. Metaliya N. Farmers' buying behaviour and dealers' perception towards use of pesticides for cumin crop in Surendranagar district. 2016; (Project report, Navsari agricultural university). Retrieved from https://krishikosh.egranth.ac.in/handle/1/5810037905
11. Momin I A, & Shaikh N. Farmers' buying behaviour for pesticides of Vadodara district. Gujarat Journal of Extension Education. 2019;70-72.
12. Business Research Company. Herbicides global market report. Retrieved from https://www.thebusinessresearchcompany.com/report/herbicides-global-market-report
13. Directorate of Agriculture Gujarat. Retrieved from https://dag.gujarat.gov.in/estimate.htm
14. Directorate of Plant Protection, Quarantine & Storage. Statistical database. Retrieved from https://ppqs.gov.in/statistical-database
15. Food and Agriculture Organization Retrieved from https://www.fao.org/
16. Ikisan. Tamilnadu Groundnut Weed Management. Retrieved from https://www.ikisan.com/tn-groundnut-weed-management.html
17. International Market Analysis Research and Consulting Group. Retrieved from: https://www.imarcgroup.com/
18. International Production Assessment Division, Foreign Agricultural Service, United States Department of Agriculture. Commodity view. Retrieved from https://ipad.fas.usda.gov/cropexplorer/cropview/commodityView
19. Mordor intelligence. Global herbicides market industry. Retrieved from https://www.mordorintelligence.com/industry-reports/global-herbicides-market-industry
20. Statista. India pesticide companies based on net sales. Retrieved from https://www.statista.com/statistics/1315790/india-pesticide-companies-based-on-net-sales