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Understanding pesticide purchase practices and brand preferences among cotton growers in District Muzaffargarh, Punjab, Pakistan

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Abstract

In Pakistan, the pesticide use has increased over the years. Several companies market different pesticide brands and compete for capturing the attention of growers. This study was aimed at determining the pesticides buying behavior and brand preferences of cotton growers. Two leading cotton production districts including Multan and Muzaffargarh of South Punjab were selected. The study used quantitative research approach and data were collected from 160 cotton growers with the help of a survey questionnaire. The questionnaire included questions regarding farmers buying behavior and brand preferences towards pesticides. Data were analyzed using descriptive statistics and multivariate statistical techniques with the help of SPSS software. Results indicated that the major preferred brands included Bayer crop science, Syngenta, FMC Corporation and Arysta life science. Quality of the products and effectiveness were the major attributes that were given importance by cotton growers. Price of product, distance between farm and dealer shop, peer group advice, brand reputation, credit availability, and dealer suggestion were also given importance regarding purchase of pesticides. While discount and subsidy and advertisement were given less importance by the respondents. Results of this study can help pesticide firms in strategies formulation as well as product development to get attention of the cotton growers.

Keywords: Pesticides Buying Behavior; Brand Preferences; Cotton Growers; Quality of Product; Effectiveness; Consumer Behavior

1. Introduction

Cotton is a substantial cash crop in Pakistan and is regarded as the foundation of the country's economy(1). Pakistan is the 4th largest cotton producing country after China, USA and India. It accounts for about 0.3 percent of gross domestic product (GDP) and 1.4 percent of value added in agriculture. Cotton export and textile product have a share contribute 60 percent in overall export of the country. In 2020–21, the crop was cultivated on 2.079 million hectares of land, which is 17.4% below the 2.517 million ha used in 2019–20 (2). Pakistan cultivates both American and Desi types of cotton. Cotton holds significant importance in Pakistan as a prominent cash crop, with 80% of the overall pesticide usage being allocated to this cash crop (3).

According to the Government of Pakistan, 22.8% decrease in cotton production, resulting in a total of 7.064 million bales. This decrease in cotton crop yield can be attributed to various factors, including drought conditions, increase in insect pest infestation and use of local seed varieties. It has been found in recent years that the whitefly poses a greater damage to cotton crops than the pink bollworm. Damage caused by pink ball worm and whitefly at up to 4 million bales (4). According to Alam, farmers must consistently use pesticides to their crops in order to manage infestations by insects. Pesticides are chemical compounds that are used in farming practices to reduce the effect of weeds, insects and fungal organisms on crops (5). It deals with different variety of substances that possess diverse applications, including insecticides, herbicides, fungicides, nematicides and weedicides (6). Farmers' principal approach of pest management

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is to use chemical pesticides. However, while chemical pesticides have effectively managed pests and reduced labor demands, their widespread use has raised concerns about human health and environmental impacts (7). Despite their role in increasing agricultural productivity and controlling vector-borne diseases (8), pesticides pose a significant risk, especially in developing countries where farmers face exposure without adequate protective measures (9). The main benefit associated with pesticides is their ability to increase profits for successful farmers. It provides advantages to consumers, retailers, researchers and people from different background (10).

Pakistan ranks as the 2nd largest purchaser of pesticides in South Asia, with pesticide sales reaching 9 billion rupees by 1995, equivalent to US$222 million (11). Importantly, around 71% of Pakistan's pesticide market relies on imports, with an annual import volume of about 80,000 tons. Presently, Pakistan consumes approximately 130,000 metric tons of pesticides, with the majority about 90%, being used on crops such as cotton, rice and vegetables (12). Pesticides used in cotton cultivation have a significant impact, affecting not only the targets such as insects, fungi and weeds but also non-targeted organisms including animals, plants and humans. However, only 19% of farmers in Pakistan have the knowledgeable about how to appropriate use and purchase pesticides (13). Purchasing attitudes and proper use of pesticides of cotton farmers are greatly influenced by sales marketing strategies, which in turn directly influences their behavior (14). Concerning the buying process for pesticides, many farmers prefer obtaining them through credit arrangements. Price stands out as the foremost consideration when deciding on pesticide purchases. Other factors like product quality, brand reputation, packaging and dealer relationships also play roles in their decision-making (15). The pesticides effect to control pests and diseases is cited as the primary reason for brand preference. Consequently, brand quality, education and availability of brand pesticides are more significant and beneficial (16). According to Alam (17), customers often perceive purchasing products with low pricing, basic packaging and little brand recognition as being associated with a higher level of risk. This perception belief that the quality of such products may not be reliable.

Due to increasing harmful impact of insects and pests on the crops, farmers use agro-chemicals on their crops to increase the yield and to control the diseases caused by insect's pests. There is a need of effective farmer's knowledge regarding selection of different brands in the market. Agrochemical companies use different marketing tactics to attract the farmers toward their products and increase their share in the market. In Pakistan, there is limited research on the buying behavior and consumer preferences of the farmers towards pesticide. Therefore, this study is aimed at determining pesticide buying behavior and brand preferences of cotton farmers. This study will be very important because it will help pesticide companies in formulating strategies regarding brand development and marketing methods in order to seek good position in the market and attract farmers towards their products.

2. Material and methods

2.1. Study Area

The scope of this study should be expanded to encompass a broader range of cotton-producing areas in Pakistan, such as Multan and Muzaffargarh. However, this study included Muzaffargarh in South Punjab. This district was chosen due to their importance in cotton production.

2.2. Research Design

The study adopted a quantitative methodology and employed a deductive approach to derive specific outcomes from a broader reality. Its main goal was to gather primary data to ascertain the impact of diverse independent variables on the dependent variable defined within the framework. Quantitative research was chosen for its effectiveness in simplifying complex findings, enabling efficient data collection from sizable samples across various categories and facilitating statistical analysis to yield dependable research outcomes (18).

2.3. Research Instrument

In survey research, questionnaire is important to achieve the objective of data collection related to a particular opinion and actual behavior of respondents about a particular issue (19). Therefore, a well-structured questionnaire was designed to collect data about the buying behavior and brand preferences of cotton growers towards pesticides in Muzaffargarh Punjab, Pakistan. This questionnaire consisted of four major sections which represented brand preferences, satisfaction, buying behavior and demographic characteristics of cotton growers.

2.4. Study Sample

The study employed a convenience sampling approach to gather data from cotton farmers using pesticide products on their cotton crops, selecting them based on age and land size categories. The study targeted 160 cotton farmers who

had purchased and applied insecticides to their cotton fields. Data collection involved administering questionnaires to the 160 cotton growers, with each questionnaire item multiplied by 5, as per the methodology suggested by Worthington (20). Respondents were interviewed from Muzaffargarh districts. The selected sample size was considered optimal for obtaining accurate findings within the specified time constraints, while also considering various limitations.

2.5. Data collection

In this study, data from pesticide-using cotton producers was collected through a self-administered questionnaire. This method was selected due to its widespread use in surveys and its effectiveness in obtaining primary data for quantitative research. A total of 160 cotton producers were chosen from Muzaffargarh districts. The questionnaire, designed with a comprehensive list of inquiries and space for responses, was well-structured and printed for distribution.

The questionnaire contained four sections. Age, gender, education, experience and land size are included in Section 1st demographic characteristics of respondents. Section 2 contains a variety of inquiries regarding the purchasing habits of cotton producers. Section 3 contains questions regarding the brand preferences of cotton producers, while section 4 contains questions regarding the contentment of farmers with the application of pesticides. All the responses are numbered as follows: 1 = extremely important, 2 = important, 3 = neutral, 4 = less important and 5 = not at all important. The queries containing the word "yes" are worth one point, while those containing the word "no" are worth zero. Following data collection, the next stage is to transform the data into meaningful statements. The questionnaire was reviewed to ensure that the data responses were appropriate and accurate.

2.6. Data preparation

During this stage, the data underwent editing to evaluate its quality, particularly focusing on any errors that might have occurred during data collection by the cotton growers. The main objective during this stage of the management process was to arrange the data in an organized manner. Accordingly, SPSS software was utilized to structure the raw data in a meaningful way. Initially, a data sheet was prepared to establish codes corresponding to the questionnaire's inquiries. Using the data recorded in the sheet, numerical codes were assigned based on the provided information. Descriptive statistics were used to find any missing values, incorrect coding or entries in the data set after the data had been transformed in the software.

2.7. Data Analysis

The data analysis was directed to achieve the required results by following the procedure:

2.7.1. Descriptive Statistics

Using descriptive statistics, the fundamental characteristics of the gathered data were determined. Percentage and frequency descriptive statistics were compiled using descriptive statistical analysis. Frequency and percentage were calculated by using this formula.

P=F/N*100 Here, P= percentage, F= variable frequency, N= number of observations

2.7.2. Logistic regression

A logit model was utilized to investigate the factors affecting farmers' preferences for dealers or brands, employing multinomial logistic regression with a 5-point Likert scale to assign probability scores. The dependent variable was cotton growers' brand preferences, while independent variables such as product price, effectiveness, dealer recommendations, product quality, brand availability, discounts, advertising, distance to dealer, credit availability, peer advice and brand reputation were examined using SPSS.

3. Results and discussion

3.1. Demographic Characteristics of respondents

The demographic characteristics of cotton farmers include age, marital status, education, income, experience of cotton cultivation, gender, marital status are presented in Table 1.

Table 1 Socio-economic characteristics of respondents

Characteristics	Category	Percentage
Age (years)	18-25	5.6
	26-35	15.6
	36-45	35
	46-55	34.4
	56 and above	9.4
Marital status	Married	96.3
	Single	3.7
Education	Illiterate	48.1
	Primary	20.6
	Matric	20.6
	Intermediate	5.6
	Graduation & above	5
Family Income (PKR/month)	Up to 25000 PKR	24.3
	25000-50000	26.4
	50000-75000	21.1
	75000-100000	11.9
	100000 and above	16.3

Most of the respondents were between the ages of 36 and 55, with 35% in the 36-45 age group and 34.4% in the 46-55 age group. The majority of respondents (96.3%) were married, and nearly half (48.1%) were illiterate, with 20.6% having finished primary and matriculation. In terms of household income, the highest share (26.2%) fell between 25,001 and 50,000 PKR each month.

Table 2 Characteristics of Cotton Farm Respondents

Characteristics	Category	Percentage
Cotton growing experience (years)	1-10	35
	11-20	42.5
	21-30	15
	31-40	3.75
	41 and above	3.75
Cotton land (acres)	1-10	84.4
	11-20	11.9
	21-30	0.6
	31-40	2.5
	41 and above	0.6
Average yield of cotton (mounds/acre)	10-15	8.2
	16-20	21.2

	21-25	44.4
	26-30	20.5
	31 and above	5.7
Chief insect pest of cotton	Thrips	25.5
	Jassid	62.6
	White fly	10
	Pink bollworm	1.9
	Other	0
Cotton variety	CKC-3	15.6
	CKC-4	13.7
	CKC-6	13.2
	SS-32	36.8
	Other	20.7
Average cost of cotton production (per acre)	50000-75000 PKR	0.6
	75000-100000 PKR	17.5
	100000-125000 PKR	38.8
	125000-150000 PKR	42.5
	More than 150000 PKR	0.6
General level of pest prevalence	High	21.9
	Medium	61.9
	Low	16.2

The survey data in Table 2 reveals the farm characteristics of the 160 respondents. Around 35% of cotton growers had 1 to 10 years of experience, with 42.5% having 11 to 20 years. In terms of cotton cultivation, a sizable share (84.3%) was growing cotton on up to 10 acres. A lesser fraction (11.8%) reported farming cotton on 11 to 20 acres, with only 2.5% dedicating 31 to 40 acres to cotton cultivation. 44.3% of cotton farmers yielded 21 to 25 mounds of cotton, 21.2% produced 16 to 20 mounds, and 20.6% yielded 26 to 30 mounds of cotton.

Jassid was the most common insect pest affecting cotton farming, accounting for 62.5% of all cases, followed by thrips (25.6%) and whitefly (10%). In the classification of cotton types, SS-32 is the most popular, accounting for 36.8% of total cotton cultivation. The average cost of cotton production varied, with 38.7% of cotton growers allocating funds up to 125,000 PKR, 42.5% allocating funds up to 150,000 PKR, and 17.5% allocating money up to 100,000 PKR. The total pest frequency was found to be moderate for 61.8% of cotton growers.

3.2. Pesticides Buying Behavior

The pesticides buying behavior of cotton growers including buying frequencies, information source, purchase source and influencing source are given below in Table 3.

Table 3 Pesticides buying behavior of cotton growers

Pesticides Buying Behavior	Category	Percentage
Pesticides Buying frequency	Every week	91.2
	Monthly	7.6
	Twice a year	0.5
	Once a year	0.7
Information source	Sales representatives	33.2
	Fellow /agricultural workers	35
	Agriculture extension workers	1.8
	Others (dealer)	30
Purchase source	Dealer	96.8
	Extension worker	3.2
Purchase influence	Family recommendation	21.8
	Friends	56.3
	Company worker	12.6
	Dealer	8.7
	Others	0.6

The vast majority of cotton producers (91.2%) purchased pesticides on a weekly basis. This data indicated a persistent and recurring need for pest management measures in their cotton fields. Regarding the sources of pesticide-related information, it was noted that sales representatives played an important role, as indicated by 33.2% of participants who rely on them for relevant knowledge. Approximately 35% of cotton growers looked to their fellow farmers and agricultural laborers for valuable expertise. Approximately 30% of the information channels used were attributed to sources that were not explicitly specified.

The study revealed that a large proportion of respondents, nearly 90%, spent over Rs. 20,000 on pesticides, highlighting the considerable financial commitment involved in pest control for cotton farming. Most cotton cultivators, around 96.8%, obtain pesticides through dealers, indicating heavy reliance on these local sources. Family recommendations influenced 21.8% of buying decisions, while friends played a substantial role in 56.2% of cases. Additionally, company employees influenced 12.5% of cotton producers' purchasing choices. These findings emphasize the ongoing and significant demand for pesticides, the impact of interpersonal networks in pesticide information dissemination, and the pivotal role of local dealers in the purchasing process for cotton growers.

3.3. Brand Preferences of Cotton Growers

Cotton growers may have different pesticide brand preferences. Brands that have repeatedly shown effective pest management, minimal damage on the environment with safety requirements are preferred.

Table 4 illustrates the significance of various brands to cotton farmers in terms of their usage and preferences. The brands mentioned were Syngenta, Bayer Crop Science, FMC Corporation and Arysta Life Science and the category designations were "Extremely important," "Important," "Neutral," "Less important," and "Not important at all."

Bayer Crop Science appeared to be the most popular brand among cotton farmers, with approximately 35.6% rating it as extremely essential and 56.9% ranking it as important. This suggested that the majority of cotton farmers place a high value on Bayer Crop Science's cotton pesticide products. Syngenta also holds a substantial position, with 75.6% of cotton growers considered it to be essential and 15% considered it to be extremely important. In spite of this, Syngenta's influence in the cotton-growing community was demonstrated by the positive sentiment towards the company as a whole. FMC Corporation and Arysta Life Science were significant to cotton farmers to varying degrees. 15.6% of growers

considered FMC Corporation to be extremely essential, and 78.1% considered it to be crucial. In contrast, only 5% of growers considered Arysta Life Science to be extremely essential, while 58.1% considered it to be vital. However, a significant proportion of cultivators (28.8%) regarded Arysta Life Science as less important, indicating that their products or services can be enhanced. The "Others" category contains all brands not specifically mentioned in the list. This category had the least impact on cotton farmers, as no respondents deemed it exceedingly significant and only 13.8% deemed it significant. In contrast, a sizeable proportion of cultivators (55%) view these other brands as less essential, and 20.6% consider them to be unimportant. Bayer Crop Science and Syngenta were the most well-known and influential brands, while FMC Corporation also holds a significant position. The "Others" category seems to had the least impact on Arysta Life Science's reputation.

Table 4 Importance of Pesticides brands

Brand Name	Extremely important (%age)	Important (%age)	Neutral (%age)	Less important (%age)	Not important at all (%age)
Syngenta	15	75.6	5.6	3.8	0
Bayer crop science	35.6	56.9	5.6	1.9	0
FMC Corporation	15.6	78.1	3.8	2.5	0
Arysta Life science	5	58.1	7.5	28.8	0.6
Others	0	13.8	10.6	55	20.6

Table 5 Importance of factors in purchase decisions of pesticides

Factors	Extremely important (%age)	Important (%age)	Neutral (%age)	Less important (%age)	Not important at all (%age)
Dealer suggestion	15.6	45.6	11.9	20	6.9
Price of product	37.5	38.8	5	14.4	4.3
Effectiveness	58.1	38.8	3.1	0	0
Quality of product	42.5	45	4.4	5.6	2.5
Advertisement	5	15.6	14.4	34.4	30.6
Credit availability	17.5	38.8	6.8	21.3	15.6
Peer group advice	8.75	66.8	6.9	11.25	6.3
Brand reputation	34.4	34.4	10.6	13.7	6.9
Availability of preferred brand	15	37.5	13.8	23.1	10.6
Discount and subsidy	6.8	21.3	12.5	28.1	31.3
Distance between farm & dealer shop	13.1	37.5	15.6	19.4	14.4

The Table 5 highlights the significance of various factors on consumer preferences, especially in the context of pesticides. Factors include dealer recommendation, price of the product, effectiveness, quality of the product, advertising, credit availability, peer group advice, brand reputation, availability of preferred brand, discount and subsidy, and distance from the farm to the dealer store.

According to the data, the efficacy of the product was the most influential factor on consumer preferences, with 58.1% of respondents ranking it as extremely essential. This indicated that consumers place a premium on the efficacy and results of a product when making purchases. 37.5% of respondents considered the price of the product to be extremely important, closely followed by 42.5% of respondents who deemed the quality of the product to be extremely important. Reputation of the brand (34.4%) and availability of credit (38.8%) were also significant influences on consumer preferences. On the other hand, factors such as advertising, discounts and subsidies, and the availability of a preferred brand appeared to elicit contradictory responses from respondents, who fall into various importance categories. Intriguingly, factors such as dealer recommendation, peer group counsel, and the distance between the farm and the dealer store also played a role in determining preferences, but they did not appear to be as significant as the previously mentioned factors.

Table 6 Cotton growers' perceptions

Statement	Strongly agree (%age)	Agree (%age)	Neutral (%age)	Disagree (%age)	Strongly disagree (%age)
Farmers trust on established pesticide brand more than lesser-known brand	25	65.6	5.6	3.8	0
Farmers believe about well-known brands being more effective in controlling pests as compared to generic brands	61.3	35	1.85	1.85	0
Farmer's willingness to switch to a different pesticide brand if it offers better features or benefits	73.75	26.25	0	0	0
Farmer's loyalty to specific brand and hesitation to switch to a different brand	3.75	21.25	0.6	72.5	1.9

The Table 6. reflects the beliefs and attitudes of producers regarding various aspects of pesticide brands. Firstly, the data indicated that the vast majority of farmers (65.6%) had more faith in well-known pesticide companies than in lesser-known ones. This indicated that brand history and reputation played a significant role in influencing the preferences and decisions of farmers when selecting pesticides for their crops. Second, the vast majority of producers (61.3 %) believed that well-known brands were more effective than generic brands at controlling vermin. This perception may be influenced by the extensive marketing and visibility of well-known brands, which may cause producers to associate them with greater effectiveness and dependability. Thirdly, the data indicated that the majority of farmers (73.75%) were prepared to switch to a different brand of pesticide if it offered superior features or advantages. This suggests that farmers were open to investigating new options and technological advancements in pesticides, and that they placed a greater emphasis on efficacy and suitability than brand loyalty. However, the data also revealed that a sizeable percentage of producers (72.5% to be exact) exhibited brand loyalty and were reluctant to transfer to a different brand. This loyalty can be attributed to their familiarity with and positive experiences with their current brand of pesticide.

Table 7 Preferred Pesticides brands

Brand Name	Frequency	Percentage	Ranking
Bayer Crop Science	78	48.7	1
Syngenta	38	23.8	2
FMC Corporation	28	17.5	3
Arysta Life science	11	6.9	4
Other	5	3.1	5
Total	160	100	

Based on the Table 7. presented, Bayer Crop Science appeared to preferred brand of pesticides among cotton growers among 160 respondents, with 48.7% of respondents selecting this brand. Bayer's notoriety and efficacy in providing insect control solutions for cotton crops had contributed to the company's popularity. Syngenta follows closely behind and was favored by 23.8% of cotton cultivators. Syngenta's significant market share among cotton producers was largely attributable to its brand recognition and product performance. FMC Corporation was the third most popular brand, chosen by 17.5% of respondents, demonstrating its market presence. Arysta Life science and Other were less well-liked among cotton farmers, as 6.9% and 3.1% of respondents, respectively, opt for them. Overall, Bayer Crop Science emerged as the top choice among cotton producers, presumably due to its well-established brand reputation and the agricultural community's trust in its products.

3.4. Factors Influencing Brand Preferences

Multinomial logistic regression was employed to determine factors influencing the brand preferences of cotton growers. It is a statistical method for predicting the outcomes of categorical dependent variables with more than two categories. This model evaluates the probability of each category in this manner that the category with the highest probability is picked as the anticipated outcome.

Table 8 Model Fitting Information

Model	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood	Chi-Square	df.	Sig.
Intercept Only	404.759			
Final	157.323	247.435	168	.000

The model fitting information for a statistical model is depicted in Table 8. The model contains details regarding goodness of fit and likelihood ratio testing. No predictors were included in the "Intercept only" model, and the response variable was predicted solely by the intercept term. 404.759 is the value of "-2 Log Likelihood" for the Intercept Only model, which represented the model fit. In comparison to the Intercept Only model, the "Final" model incorporated predictors and provided a superior fit to the data. The "-2 Log Likelihood" for the Final model was 157,323, indicating that the addition of predictors had substantially enhanced the model's fit. The "Chi-Square" value for the likelihood ratio test was 247.435 with 168 degrees of freedom. This test compared the fit of the Intercept Only model and the Final model. The reported "Sig." value of 0.000 indicated that the difference in fit is statistically significant with a high degree of confidence. Overall, these model fitting criteria indicated that the Final model, which included predictors, fits the data substantially better than the Intercept Only model, indicating that the predictors play a significant role in explaining the variation in the response variable.

Table 9 Goodness-of -fit

	Chi-Square	**df.**	**Sig.**
Pearson	193.320	444	1.000
Deviance	150.156	444	1.000

Table 9 displays the goodness-of-fit measures for a statistical model. These metrics evaluate the model's fit to the observed data. The statistic for the "Pearson Chi-Square" test was 193.320, and it corresponded to 444 degrees of freedom. This test measured the deviation between the observed data and the model's predicted expected values. The "Sig." value was 1.000, indicating that the model's fit was not statistically significant. In other words, the observed data and the model's predicted values did not differ substantially, indicating that the model fit the data adequately. The "Deviance Chi-Square" test statistic was also 150.156, with 444 degrees of freedom. The Deviance test was another measure of goodness-of-fit that compares the observed data to the model's predictions. The "Sig." value of 1.000 indicated that the model's fit was statistically insignificant in this instance as well.

As the p-values were not statistically significant, both the Pearson and Deviance Chi-Square tests indicated that the model provides an adequate fit to the data. When evaluating the model's overall performance, it was essential to

interpret these results with caution and to consider other factors, such as the model's practical utility and the context of the analysis.

Table 10 Likelihood Ratio Test

Factors	**Model Fitting Criteria**	**Likelihood Ratio Tests**		
	-2 Log Likelihood of Reduced Model	Chi-Square	df.	Sig.
Intercept	157.323[a]	0.000	0	0.000
Distance b/w farm and dealer shop	213.628[b]	56.305	16	0.000
Availability of preferred brand	208.549[b]	51.225	16	0.000
Peer group advice	230.423[b]	73.100	16	0.000
Advertisement	343.323[c]	186.000	16	0.000
Dealer suggestion	202.568[b]	45.245	16	0.000
Price of product	162.524[d]	5.201	16	0.995
Effectiveness	191.606[b]	34.283	8	0.000
Quality of product	234.607[b]	77.283	16	0.000
Credit availability	197.390[b]	40.067	16	0.001
Brand reputation	209.387[b]	52.064	16	0.000
Discount and subsidy	224.148[b]	66.825	16	0.000

Table 10 displays the results of a likelihood ratio test conducted on a model-fitting criterion for various effects associated with factors influencing consumer preferences in a farm and dealer shop setting. The significance of each effect is determined by comparing the -2 Log Likelihood of the reduced model (model without the effect) to the Log Likelihood of the complete model (model with the effect).

A chi-square statistic of 157.323 for the intercept term demonstrates a significant difference from the reduced model, indicating that the overall model is significant. In addition, chi-square statistics ranging from 45.245-277.283 indicate significant differences between the full and reduced models for a number of factors, including the significance of distance between the farm and dealer shop, availability of preferred brand, peer group advice, dealer recommendation, product quality, brand reputation, discount, and subsidy. These findings suggest that these factors play a significant role in influencing consumer choices in the context of farms and dealer shops.

On the other hand, the chi-square statistics for the importance of product price and credit availability do not indicate any significant distinctions between the full and reduced models. This suggests that these factors may not significantly influence consumer preferences in this context.

In conclusion, the likelihood ratio test assists in identifying the significant effects that influence consumer decisions in the scenario involving the farm and dealer store. By comparing the full model to the reduced model, we can determine which factors play a significant role in influencing consumer preferences, which is valuable information for businesses and marketers in their efforts to understand and effectively target customers.

Table 11 Parameter Estimation

Most preferred brand by the respondent		B	Std. Error	Wald	df.	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Syngenta	Intercept	0.930	1.082	0.739	1	0.390			
	Price	0.181	0.214	0.710	1	0.400	1.198	0.787	1.824
	Effectiveness	0.182	0.432	0.179	1	0.673	1.200	0.515	2.797
	Dealer suggestion	-0.014	0.215	0.004	1	0.948	0.986	0.647	1.503
	Quality	0.241	0.322	0.561	1	0.454	1.273	0.677	2.392
	Advertisement	-0.060	0.221	0.074	1	0.785	0.941	0.611	1.452
	Credit availability	-0.038	0.194	0.039	1	0.844	0.963	0.658	1.407
	Peer group advice	-0.189	0.257	0.543	1	0.461	0.827	0.500	1.369
	Brand reputation	-0.153	0.233	0.431	1	0.511	0.858	0.543	1.355
	Availability of preferred brand	0.220	0.209	1.108	1	0.292	1.246	0.828	1.875
	Discount and subsidy	-0.386	0.209	3.414	1	0.065	0.680	0.451	1.024
	Distance b/w farm and dealer shop	0.251	0.196	1.643	1	0.200	1.285	0.876	1.887
FMC Corporation	Intercept	-1.606	1.372	1.371	1	0.242			
	Price	0.037	0.276	0.018	1	0.892	1.038	0.604	1.784
	Effectiveness	0.406	0.529	0.590	1	0.443	1.501	0.532	4.231
	Dealer suggestion	0.305	0.271	1.259	1	0.262	1.356	0.797	2.308
	Quality	0.495	0.406	1.486	1	0.223	1.641	0.740	3.636
	Advertisement	0.145	0.279	0.272	1	0.602	1.156	0.670	1.997
	Credit availability	-0.251	0.241	1.085	1	0.298	0.778	0.486	1.247
	Peer group advice	-0.390	0.345	1.272	1	0.259	0.677	0.344	1.333
	Brand reputation	-0.163	0.294	0.308	1	0.579	0.850	0.478	1.510
	Availability of preferred brand	0.141	0.259	0.297	1	0.586	1.152	0.694	1.912
	Discount and subsidy	-0.221	0.261	0.713	1	0.399	0.802	0.480	1.339
	Distance b/w farm and dealer shop	0.280	0.251	1.249	1	0.264	1.324	0.809	2.164
Arysta Life science Corporation	Intercept	-0.574	1.945	0.087	1	0.768			
	Price	-0.076	0.368	0.042	1	0.838	0.927	0.450	1.909
	Effectiveness	0.273	0.744	0.135	1	0.714	1.314	0.306	5.651
	Dealer suggestion	-0.290	0.372	0.606	1	0.436	0.749	0.361	1.552
	Quality	-0.773	0.645	1.435	1	0.231	0.462	0.130	1.635

	Advertisement	-0.643	0.392	2.687	1	0.101	0.526	0.244	1.134
	Credit availability	-0.138	0.336	0.169	1	0.681	0.871	0.451	1.682
	Peer group advice	0.589	0.413	2.038	1	0.153	1.802	0.803	4.048
	Brand reputation	0.157	0.404	0.152	1	0.697	1.170	0.530	2.582
	Availability of preferred brand	-0.003	0.344	0.000	1	0.993	0.997	0.508	1.957
	Discount and subsidy	0.235	0.377	0.388	1	0.534	1.264	0.604	2.645
	Distance b/w farm and dealer shop	0.367	0.317	1.344	1	0.246	1.444	0.776	2.687
Others	Intercept	2.196	3.172	0.479	1	0.489			
	Price	-0.065	0.853	0.006	1	0.939	0.937	0.176	4.990
	Effectiveness	0.604	1.071	0.319	1	0.572	1.830	0.224	14.920
	Dealer suggestion	1.349	0.745	3.281	1	0.070	3.855	0.895	16.601
	Quality	0.243	0.906	0.072	1	0.788	1.275	0.216	7.527
	Advertisement	-0.567	0.650	0.761	1	0.383	0.567	0.159	2.029
	Credit availability	-0.810	0.804	1.015	1	0.314	0.445	0.092	2.150
	Peer group advice	-1.689	1.002	2.842	1	0.092	0.185	0.026	1.316
	Brand reputation	0.277	0.666	0.174	1	0.677	1.320	0.358	4.866
	Availability of preferred brand	0.358	0.743	0.233	1	0.630	1.431	0.333	6.142
	Discount and subsidy	-1.050	0.633	2.751	1	0.097	0.350	0.101	1.210
	Distance b/w farm and dealer shop	-0.251	0.707	0.126	1	0.723	0.778	0.195	3.110

Table 11 appears to be a summary of parameter estimation results from a statistical analysis, likely a logistic regression analysis. The table presents results for several brands, for each brand, there are estimates for different parameters. The reference category for this analysis is "Bayer Crop Science." This means that all the estimated parameters are compared to Bayer Crop Science, which is treated as the baseline or reference. The parameters in the table represent the influence of various factors on the preference for a brand. The parameters are typically estimated using statistical techniques. The primary goal is to determine whether each factor has a significant impact on the preference for a brand. Columns B represents the estimated coefficients for each parameter. The standard error indicates the degree of uncertainty associated with each estimate. Wald statistic measures the significance of each parameter. The larger the value, the more significant the parameter is. df is degrees of freedom associated with the Wald statistic. The p-value associated with each parameter. A low p-value indicates that a parameter is statistically significant. Exp (B) is the estimated odds ratio. It shows how much the odds of preferring a brand change for a one-unit change in the parameter."95% Confidence Interval for Exp (B) provides a range within which the true odds ratio is likely to fall with 95% confidence. Each brand has an intercept value, which represents the baseline preference for that brand, assuming all other factors are zero. Various factors are listed in the table, such as Price, Effectiveness, Dealer Suggestion, Quality, Advertisement, Credit Availability, Peer Group Advice, Brand Reputation, Availability of Preferred Brand, Discount and Subsidy and Distance between Farm and Dealer Shop.

To interpret the results, you would examine the coefficients (B) and associated p-values (Sig.). Coefficients that are statistically significant (p-value < 0.05) indicate a significant effect on brand preference. The Exp(B) values provide information about the direction and strength of the effect. Values greater than 1 indicate a positive influence on brand preference, while values less than 1 indicate a negative influence. For example, if the "Price" parameter for Syngenta

has an Exp (B) value of 1.198, it means that for a one-unit increase in price, the odds of preferring Syngenta increase by a factor of 1.198. Overall, this table summarizes the results of a statistical analysis that helps in understanding which factors influence the preference for different pesticides brands, with reference to Bayer Crop Science.

4. Conclusion

Research findings suggest that pesticides play a crucial role in protecting crops, especially cotton, and enhancing yields in South Punjab, Pakistan. Cotton farming in this region greatly benefits from pesticide applications due to the crop's susceptibility to insect pests. Farmers typically procure pesticides on credit from local vendors, with multinational brands such as Bayer Crop Science, Syngenta, FMC Corporation and Arysta Life science being the preferred choices. Among these, Bayer Crop Science products are the most popular among cotton growers, as indicated by a survey of 160 farmers. 78 farmers favored Bayer Crop Science products for their effectiveness against cotton pests, followed by 38 preferring Syngenta, 28 favoring FMC Corporation and 11 favoring Arysta Life science. Other pesticide products garnered only minimal preference. Farmers primarily rely on information and guidance about pesticide usage from their peers and company sales representatives.

Compliance with ethical standards

Disclosure of conflict of interest

All author read and approved the final manuscript. The Authors declare that there is no conflict of interest.

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