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RESEARCH ARTICLE

Discriminant analysis of agricultural input dealer's perceptions in fertilizer and secondary nutrient brands

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Abstract

Agri-input dealers play an intermediary role between fertilizer manufacturers and farmers, serving as a crucial link in the agricultural value chain. This study investigates the perceptions of agri-input dealers regarding various fertilizer and secondary nutrient brands and develops a perceptual map to visualize their market positioning. Discriminant analysis is used as a method for categorizing entities into distinct groups. This analytical approach differentiates two or more collections of objects or individuals based on their specific characteristics. Perceptual mapping, on the other hand, is an attribute-centric strategy employed by brand managers to understand customer perceptions of their brands compared to rival brands. This study aims to explore how dealers associate various agriculture input companies with key factors influencing brand preferences, such as product quality, pricing, brand reputation, credit availability, profit margin and marketing support. By understanding dealers' perspectives, fertilizer manufacturers can gain valuable insights into their brand positioning, identify areas for improvement and develop strategies to enhance their market share and customer satisfaction within the agri-input dealer channel. Notable distinctions were observed in this study, particularly in terms of product quality and pricing.

Keywords

agriculture input; dealers' perception; fertilizers; secondary nutrients; perceptual mapping; discriminant analysis

Introduction

Indian agriculture plays a critical role in the country's economy, employing around 41.5% of the workforce and contributing about 18 % to the GDP (1). The sector is diverse, with crops ranging from staple cereals like rice and wheat to cash crops like cotton, tea and spices. India is one of the world's largest producers of several agricultural products, including rice, wheat, pulses, spices and horticultural crops like fruits and vegetables (2). Over 53 % of the rural households depend on agriculture as their principal means of livelihood (3). Agriculture is considered the backbone of the Indian economy for three main reasons. Although it has declined over time, agriculture contributed 55 % to the national income in the 1950s, reducing to 25 % by the early 2000s. Second, more than half of India's workforce is employed in the agriculture sector. Third, the growth of other sectors and the overall economy depends to a considerable extent on the performance of agriculture (4). To

achieve the goal of self-sufficiency in agriculture, a new agricultural strategy was initiated in 1966-67. The fundamental principle of this strategy is the application of science and technology to increase yield per hectare. This strategy, known as the New Agricultural Strategy or Green Revolution, is based on the introduction of high-yielding varieties that respond well to heavy doses of fertilizers. It includes a package of improved agricultural practices that are implemented in selected areas with assured rainfall or irrigation facilities.

Due to degradation from both natural and man-made factors, valuable natural resources, such agricultural land, are becoming scarce in most parts of the world. We are losing about 1000 tons of topsoil every second and year after year arable land shrinks by 20000 hectares (5). Over time, soil can become depleted of nutrients due to continuous cropping and leaching. Fertilizers help replenish these nutrients, maintaining soil fertility and ensuring sustainable agricultural practices. Fertilizers are needed in agriculture to provide essential nutrients to the plants, such as nitrogen, phosphorus and potassium, which play a crucial role in their growth and development. Fertilizers help replenish the soil with these nutrients, ensuring that the plants have what they need to thrive and produce high yields. Farmers often directly use fertilizers but may lack knowledge on their application. Today, fertilizers have significantly contributed to increased agricultural productivity. Fertilizers are a superior and advanced means to promote and enhance productivity (6). Fertilizers can significantly enhance crop productivity by providing nutrients in the right amounts and at the right times, leading to better growth, higher yields and improved quality of product. Overuse of fertilizers harms the environment by causing soil degradation, water pollution and greenhouse gas emissions. Excess nutrients lead to eutrophication in waterways and disrupt soil health while releasing nitrous oxide.

Calcium, magnesium and sulphur are essential plant nutrients. They are called “secondary” nutrients because plants require them in smaller quantities than nitrogen, phosphorus and potassium. On the other hand, plants require these nutrients in larger quantities than the “micronutrients” such as boron and molybdenum. Calcium is crucial for plant structure, aiding in cell wall formation, normal cell division and improving disease resistance. In the soil, calcium helps replace hydrogen ions, which reduces soil acidity and supports the activity of nitrogen-fixing bacteria. Calcium deficiency can lead to restricted plant growth and is most likely to occur in acidic, sandy soils (7). Magnesium is a core component of the chlorophyll molecule and is essential for photosynthesis. It also acts as a phosphorus carrier and is necessary for cell division and protein formation. Magnesium deficiencies often occur in acidic soils, impacting photosynthesis and overall crop growth (8). Sulfur is vital for protein synthesis and enzyme function in plants (7).

In the year 2021-22, Uttar Pradesh emerged as the highest consumer of fertilizer nutrients in India, utilizing 5169000 tonnes. There is a significant contrast in fertilizer consumption among states, with Uttar Pradesh leading at 16621.29 kilo tonnes and Andhra Pradesh (9). The top 5 states, namely Uttar Pradesh, Maharashtra, Madhya Pradesh, Karnataka and Punjab, contribute significantly to the overall fertilizer consumption (Table 1). Tamil Nadu is ranked 13th among the states, with a consumption of 1130000 tonnes of fertilizer nutrients in 2021-22. This accounts for about 22 % of Uttar Pradesh's consumption, the highest-consuming state.

Table 1. State wise consumption of Fertilizer Nutrients (N+ P_2O_5+K_2O) - 2021-22

Sl. No	State	Consumption in ‘000’ tonnes
1.	Uttar Pradesh	5169
2.	Maharashtra	3136
3.	Madhya Pradesh	2652
4.	Karnataka	2192
5.	Punjab	1990
6.	Gujarat	1700
7.	Andhra Pradesh	1700
8.	Telangana	1636
9.	Bihar	1613
10.	Rajasthan	1611
11.	West Bengal	1543
12.	Haryana	1374
13.	Tamil Nadu	1130
14.	Chhattisgarh	758
15.	Odisha	587
16.	Assam	262
17.	Jharkhand	202
18.	Kerala	166
19.	Uttarakhand	136
20.	Jammu &Kashmir	120
21.	Himachal Pradesh	56

Source: Statistical Handbook of Tamil Nadu-2020-21

There is a significant variation in fertilizer consumption across districts within Tamil Nadu. Villupuram district has the highest consumption at 83967 MT, while Karur has the lowest at 9877 MT. The top five consuming districts in Tamil Nadu are Villupuram, Cuddalore, Tiruvannamalai, Thanjavur and Erode. Coastal and delta regions, such as Thanjavur, Nagapattinam and Thiruvarur generally show higher fertilizer consumption, likely due to intensive agriculture in these areas (Table 2). On the other hand, hill districts like The Nilgiris have relatively lower consumption at 15055 MT, possibly due to different agricultural practices or a lesser cultivated area. The wide range of consumption levels across states and districts indicates a need for tailored agricultural and environmental policies to address region-specific needs and challenges.

Agricultural input dealers

Agri input dealers are individuals that supply essential agricultural inputs to farmers and agricultural producers. These inputs include fertilizers, which enhance soil fertility and promote plant growth; pesticides, which control pests, diseases and weeds threatening crops; and seeds suited for specific climate and growing conditions. They provide herbicides to manage unwanted plants, agricultural equipment for planting, cultivating and harvesting. They also supply soil amendments like lime and organic matter to improve soil quality. Agri input dealers play a crucial role in the agricultural supply chain by offering farmers the

Table 2. Fertilizer Consumption by District in Tamil Nadu 2020-21

Sl.no	District	Fertilizers (MT)	Sl.no	District	Fertilizers (MT)
1.	Kancheepuram	29685	16.	Karur	9877
2.	Thiruvallur	32166	17.	Perambalur	18075
3.	Cuddalore	58012	18.	Ariyalur	16576
4.	Villupuram	83967	19.	Pudukkottai	26862
5.	Vellore	39516	20.	Thanjavur	50422
6.	Tiruvannamalai	52298	21.	Nagapattinam	29449
7.	Salem	31577	22.	Thiruvarur	41877
8.	Namakkal	19625	23.	Madurai	26707
9.	Dharmapuri	18928	24.	Theni	18996
10.	Krishnagiri	27011	25.	Dindigul	25279
11.	Erode	49913	26.	Ramanathapuram	25021
12.	Coimbatore	40145	27.	Virudhunagar	14325
13.	Tiruppur	37065	28.	Sivaganga	21508
14.	The Nilgiris	15055	29.	Tirunelveli	37798
15.	Tiruchirappalli	38639	30.	Thoothukkudi	22649

Source: Statistical Handbook of Tamil Nadu-2020-21

products and advice necessary to optimize crop production and improve yield quality. Additionally, they serve as key sources of information about best practices and the latest innovations in agricultural technology (10).

Fertilizer dealers play a crucial role in agricultural extension by serving as informal sources of information for farmers. They often act as intermediaries between farmers and agricultural experts. Farmers frequently view input dealers as their "friend, philosopher and guide" and they are a true change agent who serve as a vital link between farmers and agricultural development organizations (11). They offer advice on various fertilizers, application methods and nutrient management (12). In addition to providing technical support and training on soil health and crop-specific needs, they sometimes establish demonstration plots to illustrate the benefits of proper fertilizer use (13). Dealers collaborate with research institutions to transfer new technologies to farmers and act as a feedback mechanism, communicating farmers' challenges to manufacturers and researchers (14). As a result, farmers in the village gave priority to agri-input suppliers. The Agriculture Department could communicate technology to farmers at the level of Agri-input dealers, with an extensive range of outreach (15).

Sleeba's explanation highlights the vital role that dealers play in the distribution chain, acting as intermediaries between manufacturers and consumers. Dealers purchase goods from wholesalers, distributors, or sometimes directly from manufacturers and sell these goods to the ultimate consumers. Manufacturers rely on dealers to extend their reach to consumers, as it's not feasible for manufacturers to directly cater to all consumers. Dealers are crucial for covering the market within their locality, helping manufacturers ensure that products are available to consumers across different regions. Through dealers, manufacturers can tap into diverse markets and reach a wider consumer base, making it convenient for consumers to access products locally. Dealers expect to earn an income through commissions, which serve as an incentive for their role in the distribution process.

This commission is usually a percentage of the sales made. To cover their operational costs and the effort invested in marketing and selling products, dealers often demand higher commissions from manufacturers. However, they face challenges in negotiating these commissions due to intense competition, buyer-supplier pressure, fluctuating demand and slim profit margins, further compounded by transparency issues and regulatory restrictions. Additionally, dealers actively work to improve market presence within their localities by engaging with customers, providing information about products and building relationships to drive sales. By being the face of the brand in their area, dealers help build and maintain the brand's reputation among consumers. Dealers are essential for manufacturers not just for the physical distribution of goods but also for brand building. Their ability to reach consumers, provide customer service and maintain product availability makes them key partners in the overall marketing strategy. The trust and rapport they build with customers can directly impact how a brand is perceived in the market. Furthermore, the success of a brand in different markets often hinges on the effectiveness of its dealer network. Manufacturers need to maintain good relationships with dealers, offer competitive commissions and provide support to ensure mutual success.

The public extension service is frequently accused of failing to meet the diverse needs of the agricultural sector. The extension scenario now includes private sector extension providers such as Input Dealers, Producers Association, NGOs, Corporate sector, etc. Additionally, examples like low adoption rates of modern farming techniques due to inadequate extension support could make the argument more compelling. Almost all the country's rural areas are home to about 2.82 lakh Agri-Input Dealers. Farmers often regard input dealers as their “guide" serving as true change agent and essential intermediaries between farmers and agricultural development organizations. The dealer network has expanded into the villages and is seen as a powerful medium for connecting with the enormous rural community. They must get scientific agriculture knowledge if they want to help this network better serve the farming community. As a result, farmers in the village gave priority to agri-input suppliers. The Agriculture Department could communicate technology to farmers at the level of Agri-input dealers, with an extensive range of outreach.

Materials and Methods

Study area

The agriculture input sector in Northern Tamil Nadu plays a crucial role in shaping the region's agricultural productivity and sustainability. Northern Tamil Nadu, characterized by its diverse agro-climatic conditions, includes districts like Vellore, Tiruvannamalai, Kanchipuram and Chengalpattu, which are pivotal for both food crops and cash crops. This sector encompasses a wide range of inputs essential for enhancing agricultural output, including seeds, fertilizers, pesticides, machinery and irrigation systems. In this region, both organic and inorganic fertilizers are used, with an increasing emphasis on sustainable practices to prevent soil degradation and reduce environmental impact.

While the agriculture input sector in Northern Tamil Nadu has made significant strides, it faces challenges such as fluctuations in input prices, access to quality products and the need for improved infrastructure.

However, there are also opportunities for growth, including the expansion of digital platforms for input distribution, increased focus on sustainable practices and greater support for research and development in agriculture.

Overall, the agriculture input sector in Northern Tamil Nadu is a dynamic and evolving field that underpins the region's agricultural success and contributes to its economic development.

Data was collected from 30 dealers for both fertilizer and secondary nutrient brands on six attributes, namely product quality, pricing, brand reputation, credit availability, profit margin and marketing support. As this project was commissioned by Griffin Crop Sciences Private Limited - Activa, the survey focused on 30 dealers supplied by Activa to evaluate its performance in comparison to other major brands. The variables are measured using a five-point rating scale, with a higher value indicating a favourable response.

Data collection and sample

Data was collected from four northern districts of Tamil Nadu namely Tiruvannamalai, Kanchipuram, Chengalpattu and Vellore from 30 dealers for both fertilizer and secondary nutrient brands on six attributes, namely product quality, pricing, brand reputation, credit availability, profit margin and marketing support.

A questionnaire was prepared keeping in view the objective of the study. The data was collected through 'the personal contact' after approaching the respondents personally and explaining in detail about the survey objectives and purpose of the study. The variables were measured using a five-point rating scale, with a higher value indicating a favourable response. General attributes like age, level of education, experience and product line dealt may have a big impact on how many different seeds, pesticides, herbicides, fertilizers and promotional strategies are sold, as well as how successful dealers are in their businesses. As a result, information on the subject was gathered, examined and the findings are presented in this section.

Four major fertilizer producing brands were selected for this study namely FACT, Coromandel, IPL and Linga Chemicals and four major secondary nutrient producing brands namely Activa, SPIC, Chakra Gold and Biofort as they represent the majority market share among the fertilizer and secondary nutrient brands.

Market share

Market share refers to the percentage of an industry's sales that a particular company or brand controls. It's a measure of a company's competitiveness within its market. Market share can indicate a company's size relative to its competitors and it can be a key indicator of business performance and market power.

FACT was found to be the major player in fertilizer sales in the study area with a market share of 32.34 %, followed by Coromandel (23.43 %), followed by Linga Chemicals (23.10 %), followed by IPL (21.12 %) (Table 3).

Activa was found to be the major player in fertilizer sales in the study area with a market share of 48.07 %, followed by SPIC (25.46 %), followed by Biofort (15.22 %), followed by Chakra Gold (11.23 %) (Table 4).

Table 3. Market share of major fertilizer brands in Northern Tamil Nadu

Sl.no	Major Brands	Total quantity sold (in tonnes)	Price of product (per ton)	Value (in lakhs)	Market share (%)
1	FACT	98	24000	23.52	32.34
2	Coromandel	71	24000	17.04	23.43
3	Linga Chemicals	70	24000	16.80	23.10
4	IPL	65	24000	15.36	21.12
	Total	**304**	**24000**	**72.72**	**100**

Table 4. Market share of secondary nutrient brands in Northern Tamil Nadu

S.no	Major Brands	Total quantity sold (in tonnes)	Price of product (per ton)	Value (in lakhs)	Market share (%)
1	Activa	107	18000	19.26	48.07
2	SPIC	102	10000	10.20	25.46
3	Biofort	61	10000	6.10	15.22
4	Chakra gold	45	10000	4.50	11.23
	Total	315		40.06	100

Statistical Analysis

To fulfil the study's objective, discriminant analysis was employed to determine the characteristics most closely linked to specific agricultural input brands and to categorize them based on various attributes. Additionally, perceptual mapping of the attributes alongside the agricultural input brands was conducted to explore the fundamental dimensions that distinguish dealers' perceptions about the chosen input brands.

Results and Discussion

The Perceptual mapping of Major fertilizer brands and secondary nutrient brands

To construct the perceptual map, agricultural input dealers evaluated selected brands based on six key attributes: price, brand reputation, profit margin, credit availability, product quality and marketing support. These attributes were rated on a five-point Likert scale ranging from 1 (Very Poor) to 5 (Excellent). A discriminant analysis was conducted using SPSS and the results were systematically tabulated for interpretation (Table 5).

Table 5. Demographic profile of sample dealers

S.No	Characteristic	Frequency	Percent
1.	**Age (years)**		
2.	25-40	13	43.30
3.	41-55	7	23.30
4.	>55	10	33.40
	Educational Status of the Dealers		
1.	Higher secondary	8	26.70
2.	Diploma	19	63.30
3.	Graduate	2	6.70
4.	Postgraduate	1	3.30
	Experience in Dealing Agricultural Inputs (years)		
1.	Less than 10	8	26.70
2.	11-20	5	16.70
3.	21-30	4	13.30
4.	More than 30	13	43.30
	Product line Dealt by the Sample Dealers		
1.	Pesticides+ fertilizers	30	100.0
2.	Pesticides+ fertilizers+ herbicides	18	60.00
3.	Pesticides+ fertilizers+ herbicides+ seeds	12	40.00
	Total sales turnover of the Sample Dealers (Rs in lakhs)		
1.	Up to 40	5	16.70
2.	Above 40-60	7	23.30
3.	Above 60-90	6	20.00
4.	Above 90	12	40.00

Univariate ANOVA test

To evaluate differences between groups based on specific characteristics, such as test scores or measurements, a Univariate Analysis of Variance (ANOVA) was performed prior to conducting more complex analyses (Table 6, 7).

Table 6. Tests of equality of group means (Univariate ANOVA Test for Fertilizers)

	Wilks' Lambda	F	Sig.
Price	.570	3.778	.019
Brand reputation	.855	.850	.510
Profit margin	.933	.357	.836
Credit availability	.885	.647	.635
Product quality	.533	4.381	.010
Marketing support	.701	2.136	.114

Table 7. Univariate ANOVA Test for secondary nutrients

	Wilks' Lambda	F	Sig.
Marketing support	.847	.960	.436
Price of the product	.814	1.222	.334
Product quality	.574	3.963	.027
Credit availability	.737	1.905	.170
Profit margin	.941	.333	.801

The Wilks' lambda statistic was used to assess group differences, where lower values of Wilks' lambda indicate more substantial differences between groups. A low significance level (p-value) further supports the presence of significant group differences. In this analysis, the lowest values of Wilks' lambda were observed for pricing and product quality, indicating these attributes exhibit the greatest group differentiation.

Eigenvalues in Discriminant Analysis for Fertilizers and secondary nutrients

The eigenvalue for each discriminant function represents the ratio of between-group to within-group sums of squares. Higher eigenvalues indicate that the corresponding function is more effective in discriminating between groups.

The largest eigenvalue corresponds to the eigenvector that reflects the maximum spread of group means, whereas the second largest eigenvalue represents the eigenvector associated with the next largest spread and so on. (Table 8, 9). The square root of each eigenvalue indicates the length of the corresponding eigenvector. Small eigenvalues yield eigenvectors with negligible length, contributing minimally to the overall dispersion. The "percentage of variance" column helps assess which canonical variable explains most of the variance. In this case, the first eigenvalue accounts for 77 % of the total variance.

Table 8. Eigenvalues for fertilizers

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	2.599[a]	77.3	77.3	.850
2	.602[a]	17.9	95.2	.613
3	.126[a]	3.7	99.0	.334
4	.034[a]	1.0	100.0	.181

Table 9. Eigenvalues for secondary nutrients

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.493[a]	77.7	77.7	.774
2	.284[a]	14.8	92.5	.470
3	.144[a]	7.5	100.0	.355

Standardized Canonical Discriminant Function Coefficients

The standardized canonical discriminant function coefficients are utilized as multipliers for variables that have been standardized to a mean of 0 and a variance of 1 (Table 10, 11).

Table 10. Standardized canonical discriminant function coefficients for fertilizers

	Function		
	1	2	3
Price	-.108	1.081	.122
Brand reputation	-.153	-.387	.869
Profit margin	.125	.631	-.344
Credit availability	-.065	.472	.130
Product quality	.979	.584	.390
Marketing support	.882	.407	-.004

Table 11. Standardized canonical discriminant function coefficients for secondary nutrients

	Function		
	1	2	3
Marketing support	-.168	-1.165	.432
Price of the product	.761	.171	.828
Product quality	1.000	.121	-.264
Credit availability	-.208	-.203	.464
Profit margin	.239	1.134	.207

standardization enables the evaluation of the relative importance of each variable in the discriminant function, allowing for direct comparison of their contributions to group differentiation. The table highlights the relative importance of factors across the three discriminant functions. Larger absolute coefficients indicate stronger contributions of variables to group discrimination while controlling for the effects of other variables.

Structure Matrix

The structure matrix is derived from the pooled within-group correlation matrix, which is computed by averaging the separate covariance matrices for all groups. It presents the pooled within-group correlations between the discriminating variables and the standardized canonical discriminant function variables, arranged by the absolute size of the correlation within each function. (Table 12)

Table 12. Structure matrix for fertilizers

	Function		
	1	2	3
Product quality	.573*	.110	.343
Marketing support	.402*	-.076	-.152
Price	-.459	.569*	.268
Credit availability	-.143	.349*	.156
Brand reputation	-.169	-.085	.819*

The structure matrix analysis reveals the key discriminating variables for each function. Function 1 is most strongly correlated with product quality (0.573) and marketing support (0.402). Function 2 is defined by price (0.569) and credit availability (0.349). Function 3 is highly influenced by brand reputation (0.819). The largest correlations, particularly with product quality, price and brand reputation, highlight these variables as the primary differentiators across functions.

Table 13. Structure matrix for secondary nutrients

	Function		
	1	2	3
Marketing support	.683	-.216	-.482
Price of the product	-.476	.032	.355
Product quality	.273	-.474	.185
Credit availability	.074	.415	.198
Profit margin	.323	.057	.709

Function 1 represents a marketing-oriented dimension, characterized by a strong positive association with marketing support (0.683) and a negative association with price (-0.476). Function 2 captures a trade-off between product quality (-0.474) and credit availability (0.415), whereas Function 3 is defined by a significant positive relationship with profit margin (0.709) and a negative relationship with marketing support (-0.482) (Table 13).

Functions at Group Centroids

Table 14 and 15 presents the means of the canonical variables (discriminant functions) by group, based on unstandardized canonical discriminant functions evaluated at group means. This table is used to plot the brands on the attribute plot.

Analysis and Interpretation of fertilizers

Fig. 1 illustrates the vector representation of key attributes, including product price, product quality, brand reputation, marketing support, profit margin and credit availability.

Table 14. Functions at group centroids for fertilizers

Brand	Function		
	1	2	3
FACT	.882	.900	.093
Coromandel	1.282	.426	-.151
IPL	1.243	-1.123	.240
Linga Chemicals	-1.145	-.360	-.537

Table 15. Functions at group centroids for secondary nutrients

Brand	Function		
	1	2	3
Activa	.682	.728	.177
Chakra Gold	-.881	.092	-.516
SPIC	-1.226	-.284	.399
Biofort	1.425	-.536	-.060

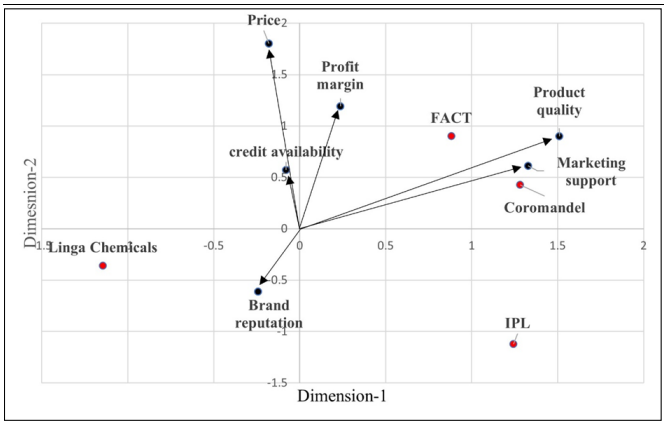

Fig. 1. Perceptual map of fertilizer brands and attributes.

Longer arrows that point closer to specific group centroids indicate a stronger association with that group. Conversely, vectors pointing away from a group centroid suggest weaker affiliation with the respective group. The performance of the brands varied significantly across these attributes.

Notably, the performance was approximately average for both brand reputation and credit availability. As shown in Table 7, the first two dimensions account for most of the variance in the dataset, while the contributions of the third and fourth dimensions are negligible. Therefore, only the first two dimensions were considered for further analysis. Dimension 1 is predominantly characterized by product quality and marketing support, while Dimension 2 is primarily associated with product price, profit margin and credit availability, as indicated by the proximity of their respective vectors to the vertical axis.

The analysis highlights that product price and product quality are the strongest attributes overall. FACT is strongly associated with profit margin and product quality, while Coromandel is characterized by product quality and marketing support. Notably, none of the attribute vectors are aligned with IPL, indicating that IPL does not occupy a distinctive position along either dimension.

Linga Chemicals is represented primarily by brand reputation; however, the opposing direction of other attribute vectors suggests that the overall influence of brand reputation is relatively low. Despite this, Linga Chemicals is perceived to have higher brand reputation than other brands. The short length of the arrow for brand reputation indicates that it is a less significant attribute (Table 16).

Table 16. Comparative analysis of major fertilizer brand attributes

S.no	Major brands	Price	Profit margin	Brand reputation	Credit availability	Product quality	Marketing support
1	FACT		✓			✓	✓
2	Coromandel					✓	✓
3	IPL						
4	Linga Chemicals			✓			

In conclusion, Coromandel and FACT hold strong positions across attributes other than product price and brand reputation, with FACT being particularly notable for its superior product quality.

Analysis and Interpretation of Secondary Nutrients

Dimension 1 primarily encompasses product quality and product price, while Dimension 2 is associated with profit margin and marketing support. Among all attributes, profit margin and product quality emerge as the most influential. Activa is strongly characterized by attributes such as profit margin, product price and product quality (Fig. 2). SPIC is distinctly associated with credit availability and marketing support. In contrast, none of the attribute vectors align with Biofort, indicating that it does not hold a distinct position in either dimension. Chakra Gold is linked to the attribute of credit availability; however, the short arrow representing this attribute suggests it holds relatively lower importance (Table 17).

Conclusion

It can be concluded that Activa is perceived as offering high-quality secondary nutrients but at a premium price with a high profit margin. SPIC is perceived as offering lower prices but with potential trade-offs in quality or marketing support. The agriculture input market is undergoing significant transformation driven by sustainability demands, technological advancements, solubility of fertilizers, secondary plant nutrients and climate-related challenges. While innovation in products and practices is enhancing efficiency and environmental stewardship, factors such as price volatility and product quality continue to influence market dynamics.

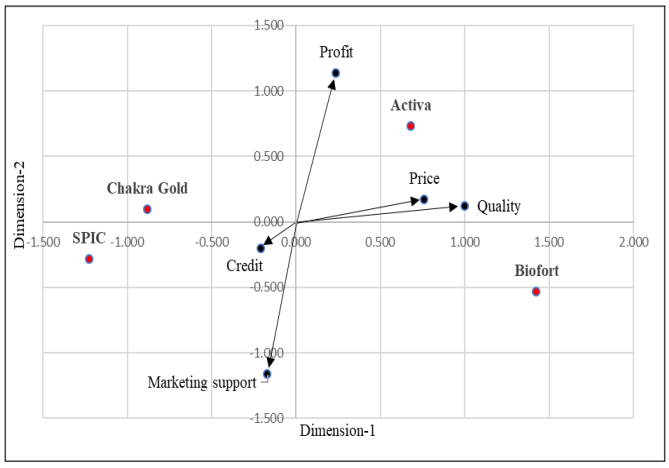

Fig. 2. Perceptual map of Secondary nutrient brands and attributes.

The study effectively employs discriminant analysis to create a perceptual map that illustrates the positioning of various agriculture input companies based on key attributes. This analytical approach allows for a visual representation of how different companies are perceived in relation to one another, particularly in terms of critical factors that influence dealer and farmer choices.

The findings reveal that there are significant differences in product quality and pricing among the companies surveyed. This suggests that these two attributes are pivotal in determining how dealers view and select agricultural inputs. High product quality is likely to enhance a company's reputation and foster farmers' loyalty, while competitive pricing can attract cost-conscious dealers looking to maximize their profit margins.

The future growth of this sector will depend on how effectively the agricultural input companies are able to come up with the new and innovative product designs suitable for the Indian context and shift the perception of Indian farmers.

The results of the study showed that dealers brand preference is influenced by product quality and the price of the product.

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Authors' contributions

RS and MK wrote the manuscript. ML designed the article and helped with revisions of the article. RS analysed the data. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

Table 17. Comparative analysis of secondary nutrients

S.no	Major brands	Price	Profit margin	Credit availability	Product quality	Marketing support
1	Activa	✓	✓		✓	
2	SPIC			✓		✓
3	Chakra Gold					
4	Biofort					

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