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ARTICLE

The Indian Dairy Market: Forecast, Risk and Strategic Roadmap to 2030

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ABSTRACT

The Indian dairy sector is a vital industry experiencing significant transformation due to innovation, increased brand competition, new entrants, and retail evolution. A resource-informed roadmap is crucial for guiding investors, marketers, and policymakers in capitalising on opportunities in this dynamic landscape. In this regard, the current study aims to provide a roadmap for the traditional Indian cooperatives. It utilises comprehensive trend and forecasting analysis of the Indian dairy market. By leveraging data on brand share, company share, retail channels, and product ingredients used, the current study employs multiple models to examine the growth patterns of market leaders and emerging players. The study also includes growth analysis of the emerging hypermarket format in retail and market shares of various products. The best-fitting model is validated using residual analysis and cross-validation techniques. The study reveals that emerging players exhibit unstable yet aggressive growth, indicating their potential for disruption. The hypermarket assessment shows the retail industry's robust linear growth. This study employs the comprehensive GE-Matrix to analyse the strategic positioning of various players. Its novelty lies in integrating different model confidences into the strategic GE Matrix concerning the Indian dairy market. The findings suggest that traditional market players must innovate to maintain their stable growth, while investors must address and understand the challenges posed by the aggressive growth of emerging players. This research provides comprehensive data analysis, predictive insights into future trends, and strategic guidance for traditional

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market players in the Indian dairy industry.

Keywords: Indian Dairy Market; Regression Analysis; Brand Share; Company Share; Hypermarkets; Market Share; GE Matrix Framework

1. Introduction

The Indian dairy industry is a cornerstone of the nation's agricultural landscape, showcasing remarkable growth. In the fiscal year 2022–2023, milk production soared to an impressive Rs. 11.16 lakh crore, outstripping the combined value of major agricultural commodities, such as paddy and wheat. With a staggering 230 million metric tons produced annually, the dairy sector is a driving force in India's economy [1, 2]. This dairy dominance underscores its economic significance, while also creating rural employment opportunities and addressing food security challenges. India, the world's largest milk producer, contributes 24% of global milk production [3]. India's dairy sector comprises 80 million smallholder farmers, representing 2.3 lakh households in cooperatives [4]. As the dairy industry in India transitions to a realm of diversified products and competitive markets beyond the norm, stakeholders involved in the industry, including marketers, investors, policymakers, consumers, and producers, should not be left in the dark about these current trends and market dynamics in the emerging sector. This is a novel development that is yielding a broad range of high-value, high-quality products. This development has sparked increased interest among consumers, leading to a shift in dairy consumption patterns nationwide. The dairy industry continues to evolve in significant ways as new entrants enter the market and innovative products are introduced, utilising various retailing channels. Such a shift opens up growth possibilities, but strains employment within the rural context due to the proliferation of privately held companies. The change is also a threat to the sustainability of cooperatives in the industry. Another example of a cooperative organisation that has achieved large-scale success is the Gujarat Co-operative Milk Marketing Federation (GCMMF). It plays a leading role in the dairy industry, showing the power and organisation of cooperative movements in the country.

The competition, however, is becoming stiff with other emerging business players such as Lactalis Group. Lactalis, through its subsidiary unit Anik, is using robust market expansion strategies. This growth has been studied under the Resource-based view theory, which emphasises resources and capabilities in gaining a competitive advantage [5] These trends drive strategic discussions on market positioning, sustainability and scalability of products and channels through the GE-Matrix framework.

The trends continue to evolve, necessitating critical strategic deliberations on the marketplace, viability, and the scope of numerous products and channels. The Indian dairy industry presents as many opportunities as it does uncertainties. The nexus between Industrial Organisation (IO) Theory, as the originator of the Structure Conduct Performance (SCP) Paradigm, and the Resource-Based View highlights that market process forces alone do not dictate growth [6]. Rather than this, growth is made possible through resources that are valuable, rare, inimitable, and non-substitutable (VRIN), explaining how structural transformation occurs in the Indian dairy industry. IO contrasts the competitive ability provided by changing policies and open markets with the industrial structure in behaviour, such as innovation and pricing strategies of firms [6].

The study presents data-driven projections of the Indian dairy market from 2015 to 2030, utilising quantitative methods such as linear regression, polynomial regression, and scenario analysis. Statistical measures, such as Mean Squared Error and R-squared, verify forecast accuracy and model fit. The study develops a strategic model to assess the positioning of Indian dairy companies using a confidence-enhanced GE Matrix, which determines the required investment based on model sensitivity and forecast stability. The following study evaluates the 2015–2024 data to predict trends related to the dairy industry in India. The results can be utilised strategically by market leaders, challengers, and new retailers. The study may help cooperative milk producers with risk management, resource allocation services, and competitive strategies, which are essential in the face of profit-driven individualists.

1.1. Problem Statement

The traditional Indian Cooperative structure of the dairy industry is facing new pressures, as the consumer demand in the country moves towards value-added products due to urbanisation and innovation by private companies. These companies are adopting aggressive strategies and leveraging hypermarkets to increase their visibility and gain consumer attention.

1.2. Study Gap

There is a scarcity of literature addressing the future challenges and evolving data-driven trends in the Indian cooperative dairy market. This research paper aims to shed light on the dynamic and innovative nature of emerging players and the risks that the traditional cooperative model of this industry must overcome.

1.3. Research Objectives

1. To evaluate the market share of dairy market leaders, assess trends, and examine hypermarket channels by 2030,
2. To investigate the dairy segment's ingredient usage and patterns.
3. To explore possible future market developments through scenario analysis.
4. To review strategic priorities through the GE Matrix framework.

2. Literature Review

The Indian cooperative dairy system is vital for the rural economy and agribusiness, playing a key role in community development. It supports millions of people involved in the dairy business, serving as an important stabiliser for rural households [7]. The industry's characteristics make it vital for economic stability and growth in rural areas [8]. Cooperatives can provide better milk prices by reducing unnecessary intermediaries. Built through community involvement, they promote economic stability and prosperity at the grassroots level [9]. The White Revolution exemplifies cooperative achievement in India [10]. This initiative transformed the nation into the world's largest milk producer [11].

Recent literature on the Indian dairy industry highlights the role of private enterprises and market changes. Lactalis used robust strategies, increasing Anik's market share to 13% between 2015 and 2024 [12, 13]. Shifts in market structure is shown by the conduct of firms, and their performance is demonstrated by industrial organisation theory. The trends reflect the resource-based view (RBV) theory, illustrating how liberalisation and deregulation reshape competition in the agri-food sector [14, 15]. Changes in retailing are becoming an increasingly important research topic, as conventional methods are shifting toward modern approaches [16]. Our data show a hypermarket growth rate of 131% from 2015 to 2024, reflecting evolving consumer preferences, supply chain modernisation, and urbanisation, which creates an invisible challenge for the cooperative structure of the dairy sector [17]. The potential argument arises here that the cooperative structure of the dairy sector could adapt to these changes rather than being challenged by them.

The interplay of production dynamics, policy changes, and demand shifts in the sector is critical. Researchers have investigated polynomial and linear models [18, 19] for projecting market shares, while highlighting concerns related to widening confidence intervals in the context of volatile growth [20, 21]. Our research on Lactalis reveals a broad confidence interval, indicating risks associated with excessive rewards. The demand for milk contributes to increased methane emissions, posing challenges to India's environmental sustainability due to fodder and water scarcity. This can, once again, be compromised by the profit motives of private players [22]. This field of literature has focused on policy interventions addressing such problems through proper feeding habits and breed enhancement [23, 24]. Effective waste management has been identified as a potential means to reduce the carbon footprint of the dairy sector [25].

Product diversification, value addition, and innovation drive new growth in the dairy industry, as supported by the resource-based view theory, posing strategic challenges to the traditional structure [26]. According to a 2023 report from the National Dairy Development Board (NDDB), the probiotic dairy and yoghurt segments are emerging as significant growth areas in the Indian dairy market. As observed through industrial organisation theory, this trend is supported by innovative product development. Our research confirms that yoghurt is experiencing the highest growth, which reflects a rising health consciousness among urban consumers [27].

Research studies criticise the overreliance on single forecasting methods and recommend using diverse approaches for more accurate predictions [28]. Research by scholars like Mugiyo et al. [29] uses multi-scenario modelling to manage risk through four scenarios: base case (stable), optimistic (hopeful), pessimistic (cautious), and disruptive (transformative). This strategy aligns with our research activities, enabling us to explore various possibilities and position ourselves strategically. Changes in policy, regulations, or the emergence of new competitors can reshape growth trajectories, creating both opportunities and challenges that require businesses to be agile.

The research aims to study dairy firms' market structure and growth trends, analyse ingredient usage patterns, predict future market challenges and recommend appropriate strategies for cooperative players based on historical trends by dividing research into five sections, 1st introduction, 2nd Literature review of previous studies, 3rd methodologies adopted for research, 4th into results And findings and 5th as discussion on possible future roadmap for cooperatives to cope with challenges due disruption and transformation of the sector.

Before delving into the subsequent sections, it is essential to highlight a key component of this research: the foundational framework. Our study is anchored in a conceptual framework (**Figure 1**) that integrates two pivotal theories: Industrial Organisation Theory and Resource-Based View Theory. This integration facilitates a comprehensive understanding of our research objectives [6].

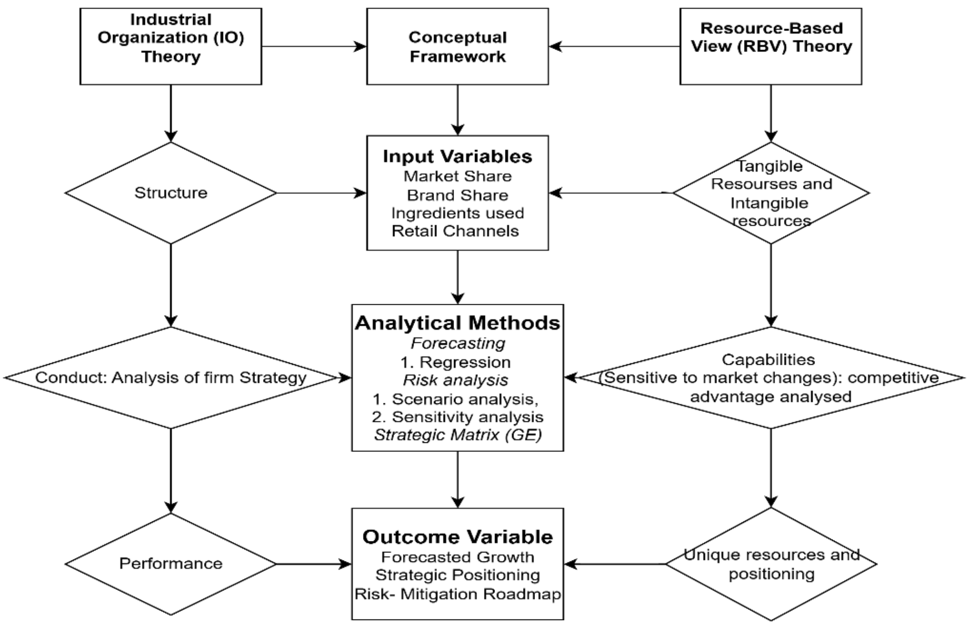

Figure 1. Integrative conceptual framework of the research.

Source: Researcher.

3. Materials and Methods

3.1. Data Source and Scope

This study utilised secondary data from Euromonitor [30–32]. The data includes market share, brand share, company share, and ingredient usage from 2015 to 2024, with retail channel data analysed from 2010 to 2024 [33, 34]. The scope of the study extends to evaluating market trends and growth through 2030. The analysis examines product, company, and distribution levels to understand historical trends and projects for 2030.

3.2. Analytical Framework

Research applied quantitative empirical analysis by using H2O (Python coding) [34–36]. The following statistical procedures were applied:

3.2.1. Regression Analysis

This study employed linear and polynomial regression models to determine the optimal fits for each business, thereby enabling accurate forecasting and trend analysis [37]. Performance metrics, including R^2 and mean squared error (MSE), were used to select the model fit [38]. Regression analysis using historical time series data explored its relationship with market share, with Amul as the dependent variable and time in years as the independent variable. Similar regressions were conducted for Lactalis and Hypermarket.

By the simple regression method, we get,

Market share (%) $= \mathrm{a} + \mathrm{b} \times \mathrm{x}$

Where, $\mathrm{x} = \mathrm{Year} - 2015$

Base year $= 2015$

3.2.2. Scenario Analysis

Several scenarios were applied when analysing uncertain risks to the macroeconomic framework for the dairy market. These include baseline, optimistic, pessimistic, and disruptive scenarios, which are evaluated for their market impact [39, 40]. The different scenarios taken as Base (continuation of the current market trends), optimistic (favourable economic condition of +15% growth), pessimistic (unfavourable economic condition of -15% growth), and disruptive, the disruption year is taken as 2027 (due to regulatory changes or new entrants).

3.2.3. Confidence Interval Estimation

To evaluate the degree of uncertainty present in each business segment, we established a 95% confidence level. This means we aimed to be 95% certain that our estimates accurately reflect the actual values of key performance indicators within each segment. Using this statistical margin, we sought to estimate the various fluctuations and risks that may arise in our business practices, enabling companies to make better decisions and stay informed about market changes [41, 42].

3.2.4. Benchmarking of Growth Rate

Growth projections were made based on past and future analysis, which is composed of three categories: High, Normal, and Anomalous. Normal: Growth rates ≤ 30% reflect market stability, High: Growth between 30% and 100% demonstrates intense expansion with medium confidence, Exceptional: Growth 100%-500% shows significant gains, but confidence may decrease, Anomalous: Growth > 500% is an outlier, raising scepticism and low confidence. The high category expects growth rates significantly higher than average patterns, indicating excellent economic performance or unusual demand. The Normal category summarises general growth expectations, which were based on the stable indicators and precedents. Lastly, the Anomalous category includes projections that lack precision and are defined in terms of uncertain variables, making them difficult to predict. Collectively, these groups ensure an effective approach to exploring possible growth paths [43, 44].

3.3. Validity of Models

- **Cross-validation**

To enhance the reliability of our model, we conducted comprehensive cross-validation using multiple data subsets. Such an evaluation enhances the validity of our results and provides insight into the model's applicability. By examining its advantages and drawbacks, we will be better equipped to produce more credible findings on its effectiveness in various applications.

- **Residual Diagnosis**

To confirm our work, we must see whether the data is normally distributed, as this will show trends. Additionally, it is crucial to examine the linear relationship between the significant variables, as this will influence the interpretation of the results. These checks will ensure the validity of our research findings and support our conclusions.

3.4. Strategic Mapping

The GE Matrix strategic framework executes strategic mapping [32]. To aid decision-making in forecasting strategy and risk, business entities are mapped on a 3×3 Matrix that evaluates their strategic position based on strength and industry attractiveness. A confidence-adjusted resource allocation model provides further support for strategic analysis and future planning.

4. Results and Findings

4.1. Market Share Forecasted by Categories (2024–2030)

GCMMF is projected to maintain the leading market position with a share of 38.02% by 2030, reflecting a slight increase of 0.04%. This stability suggests minimal fluctuations and a high concentration in the dairy products sector (**Figure 2**).

Britannia expects a robust growth rate of 9.06% in its cheese segment, which could surge by 138%, indicating strong growth potential. In contrast, GCMMF is anticipated to face a significant decline of 29.52%, with a projected growth rate of only 10.64% by 2030. KMF is also encountering challenges, with a projected decline of 7.18% with an anticipated growth rate of 7.24% by 2030. The drinking milk category remains the most dynamic area for market redistribution. Although GCMMF is experiencing a declining trend of 8.25%, it is projected to increase by 14.31% by 2030, suggesting a shift in leadership dynamics within the sector. Meanwhile, NDDB is projected to experience moderate growth of 9.81%, but its anticipated growth is expected to be just 1.43% by 2030.

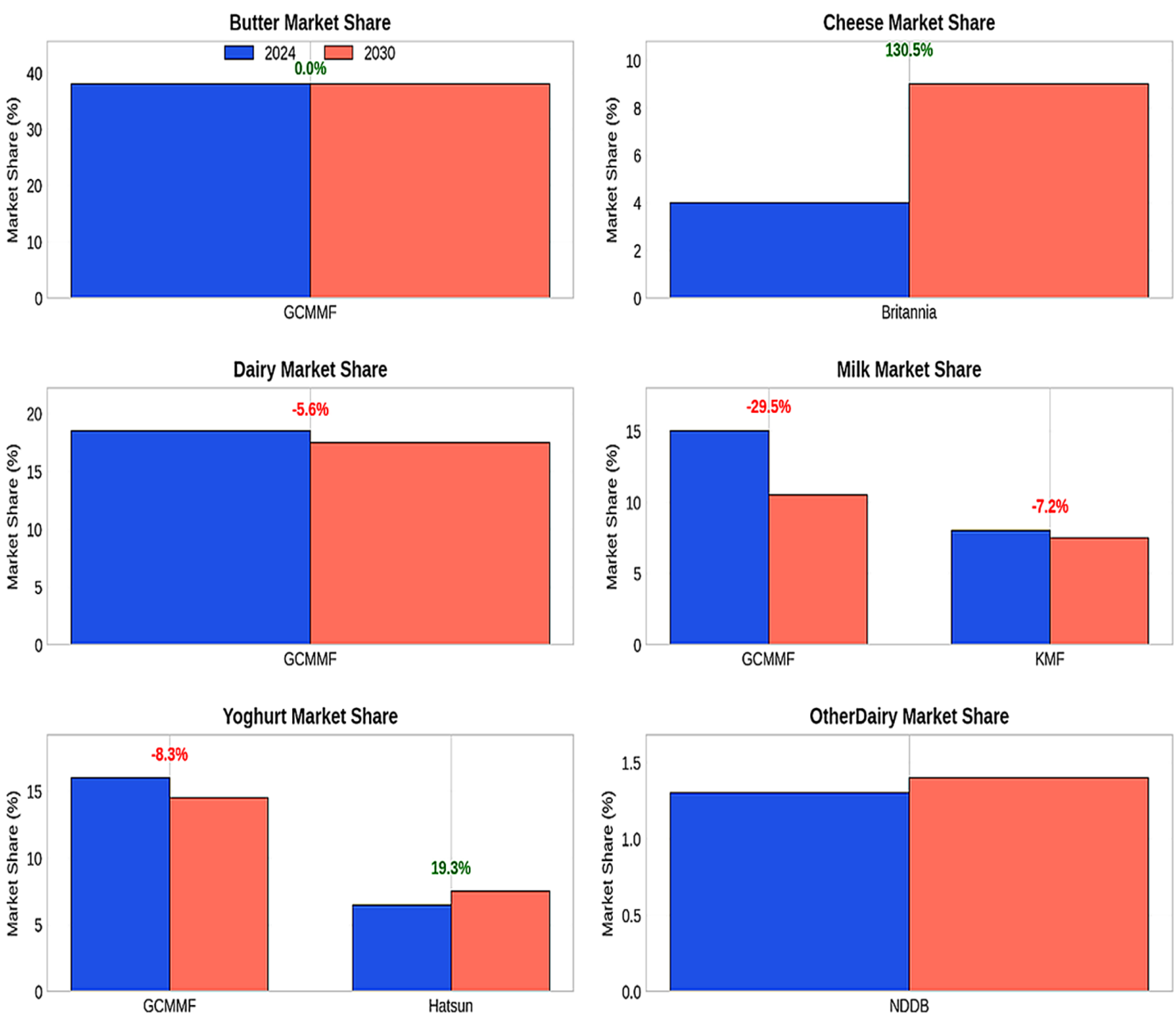

Figure 2. Indian dairy market share forecasted by categories (2024–2030).

Source: Researcher.

4.2. Market Share by Companies

GCMMF (Amul) (**Appendix A, Figure A1**) leads the dairy market, holding an 18.3–19.1% market share from 2015 to 2024. Nestlé SA maintains a 1.6% share, while Lactalis Group shows a 2.5–3.5% share during this period. The "others" category holds a 29.2–40.7% market share from 2015 to 2024.

4.2.1. Regression Analysis

The analysis reveals a significant relationship between Amul's market share and time. Specifically, as time progresses, a noticeable trend in Amul's growth of market presence emerges, indicating that its strategies and brand positioning are resonating well with consumers. Furthermore, a detailed regression analysis was performed for additional companies within the dairy sector to assess their market dynamics and competitive positioning relative to Amul. This comprehensive evaluation provides deeper insights into the factors influencing market share across the industry (**Appendix A, Figure A2**).

4.2.2. Forecasting

The research employed a linear regression model to analyse market share dynamics using data from 2015 to 2024. Amul shows a modest Average Annual Growth Rate (AAGR) of 0.14%, indicating steady progress (**Figure 3**). Nestlé SA has a stagnant AAGR of 0%, reflecting stability without growth, while Groupe Lactalis stands out with a more favourable AAGR of 0.23%, suggesting a positive upward trend.

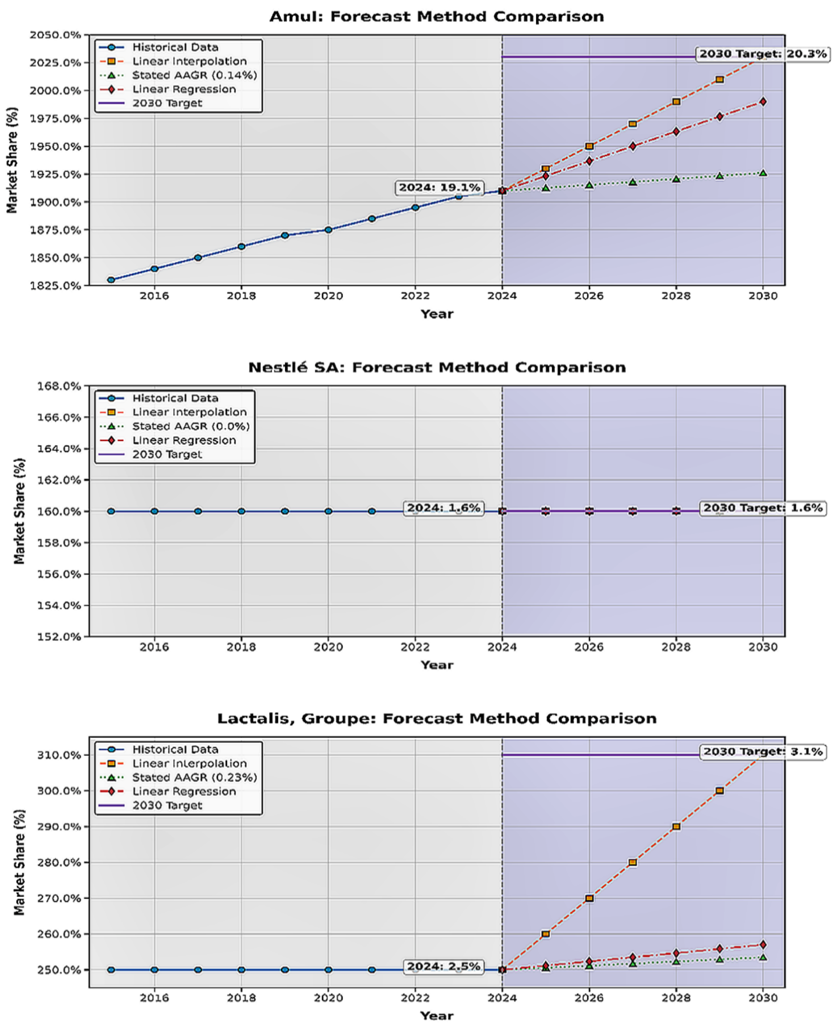

Figure 3. Forecasting methodology comparison by company.

Source: Researcher.

Looking ahead to 2024, Amul is expected to achieve a growth rate of 19.1%, rising to 20.3% by 2030. In contrast, Nestlé SA is projected to maintain a steady market share of 1.6% through 2030. Groupe Lactalis is anticipated to experience growth acceleration, rising to 2.5% in 2024 and 3.1% by 2030. This overview illustrates the competitive landscape and growth potential of each company.

4.3. Market Leadership Dynamic Analysis

4.3.1. Cross-Category Comparison

GCMMF remains the powerhouse in the dairy market, holding an impressive 38% share of the butter category (**Figure 4**). The cheese segment presents significant growth opportunities; however, the entry of strong competitors, such as Lactalis, is intensifying market competition. Despite these challenges, research indicates that GCMMF has the strategies to strengthen its market position. Optimistically, the company is expected to maintain its strong presence across all categories through 2030.

4.3.2. Market Analysis of Leaders

Amul

The polynomial model demonstrates a strong fit, evidenced by an impressive R^2 value of 0.927 and a Mean Squared Error (MSE) of only 0.0402 (**Appendix A, Table A1**). These statistical indicators of cross-validation provide a robust basis for validating the model's accuracy and reliability, suggesting that it effectively captures the underlying trends in the data. The growth projections are optimistic, with an anticipated annual growth rate of 4.60% from 2015 to 2024. Market share estimates (**Figure 5**) include 95% confidence intervals, reinforcing confidence in future trends. Following this, a steady growth rate of 0.16% is expected from 2024 to 2030, indicating a consistent upward trend. The model demonstrates reliability with strong fits and optimistic forecasts, supporting confidence in upcoming developments.

4.3.3. Lactalis Group

The analysis reveals a linear relationship with an R-squared value of 0.359 and a Mean Squared Error (MSE) of 21.3018, confirming the adequacy of the chosen linear model (**Appendix A, Table A1**)[45]. The projected growth rate of Lactalis overall is 56%, and in the other dairy segment, it is impressive at 2066.67%, indicating significant market acquisitions expected between 2015 and 2024, which are likely to reshape the industry (**Figure 5**). The projected growth rate of 91.94% from 2024 to 2030 presents a significant opportunity for stakeholders. However, caution is advised due to the questionable reliability of the data and a poorly fitting model, which may not accurately reflect market dynamics. Additionally, high uncertainty suggests that actual growth could vary widely. Investors should be aware of these limitations to effectively navigate the associated risks and rewards.

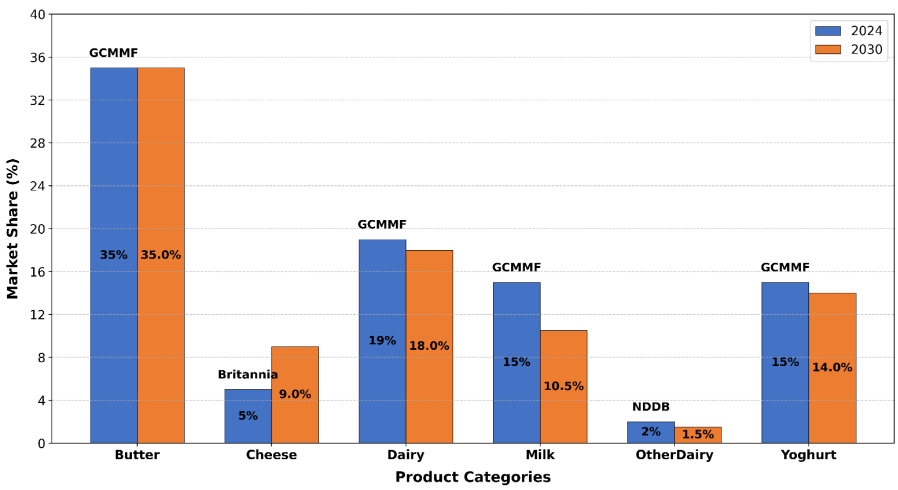

Figure 4. Market leader comparison (2024 versus 2030).

Source: Researcher.

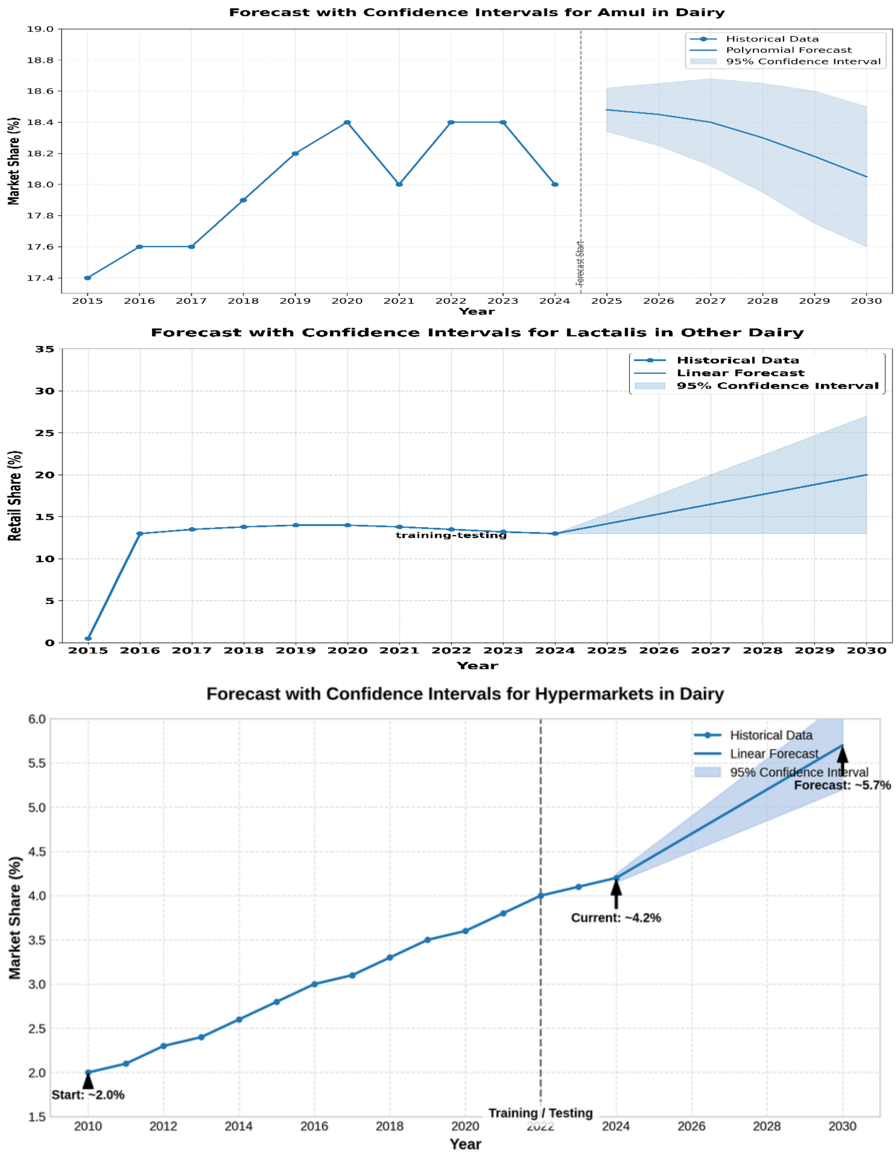

Figure 5. Forecasting of Amul, Lactalis and Hypermarket with confidence interval.

Source: Researcher.

4.3.4. Hypermarket Forecast

Two regression models were thoroughly compared using cross-validation to uncover their effectiveness and performance (see **Appendix A Table A1**) [46]. The Linear Model Forecast shows a strong outlook, projecting over 5% growth through 2030, indicating reliable expansion and opportunities for development. In contrast, the Polynomial Model Forecast suggests market share will stabilise around 4%, indicating potential saturation.

As competition increases and consumer demand levels off, companies will need innovative strategies to differentiate themselves and attract new customers to capitalise on the remaining market opportunities. The analysis selected a linear model with a high coefficient of determination (R^2) of 0.976, indicating a strong fit with the observed data. The Mean Squared Error (MSE) is low at 0.0096, highlighting the model's reliable forecasts. Notably, a growth trend of 131.58% is projected from 2015 to 2024, suggesting a significant shift in market behaviour. Additionally, the market projection includes a confidence interval, which enhances the robustness of the analysis for strategic planning and informed decision-making. A projection of the growth of 23.43% from 2024–2030 and shows medium reliability due to the high model fit and extreme historical growth (**Figure 5**).

4.3.5. Residual and Regression Analysis Outlook

Residual analysis shows whether the residuals are normally distributed along the predicted line (**Figure 6**). This refers to the difference between the actual data and the predicted line, as shown by the time series with a regression line chart. Residuals over time show the behaviour of residuals year after year. A histogram shows the large error versus the small; ideally, for a normal distribution, it should be bell-shaped. The distance from the predicted line for a specific residual represents error. The ideal model, or one that shows normality, should have less error or very little difference between the spread of residuals and the standard predicted line [47, 48].

a. Amul

A thorough residual analysis (**Figure 6**) confirmed the normality of the residuals for the polynomial model, supporting its statistical validity. This reinforces the reliability of the polynomial regression model in capturing the nuances of the data related to Amul's market performance.

b. Lactalis

Unlike Amul and Hypermarket, in the case of Lactalis, normality is not confirmed during residual analysis. The linear regression model indicates significant unpredictability, evidenced by an R^2 value of just 0.359. This suggests that while Lactalis exhibits a linear growth trend, considerable uncertainty surrounds its future trajectory.

c. Hypermarket

Residual analysis (**Figure 6**) confirms data normality, and narrow confidence intervals highlight the reliability in channel planning. This confidence in hypermarket forecasts is bolstered by strategic planning, enhancing their dependability. Over the years, the market share of hypermarkets in the dairy sector has demonstrated a steady upward trajectory. This gradual increase signifies a consistent growth trend, highlighting the expanding presence and influence of hypermarkets in the dairy market (**Figure 7**). This rise reflects changing consumer preferences and the strategic positioning of hypermarkets within the retail landscape, emphasising their role as significant players in the distribution of dairy products.

4.4. Market Scenario

4.4.1. Amul

A thorough analysis of potential market scenarios for Amul was conducted, extending our projections to the year 2030. The assessment assumes that existing market trends will persist. Three distinct scenarios were developed to illustrate this (**Figure 8**). The optimistic scenario depicts strong economic growth for Amul, driven by rising consumer income and demand for dairy products. In contrast, the pessimistic scenario emphasises challenges from increased competition and potential economic downturns, which could reduce consumer spending and harm Amul's market position. Additionally, the disruptive scenario highlights the threat from innovative entrants, changing consumer preferences for plant-based alternatives, and stricter regulations that may alter the traditional dairy market. Together, these scenarios provide a comprehensive framework for understanding the potential pathways Amul might navigate in the coming years.

4.4.2. Lactalis

Lactalis is projected to grow significantly from 0% in 2015 to 13–14% by 2024. The base forecast anticipates an increase from 19% in 2016 to 25% by 2030, unless there are significant market changes. However, during an economic slowdown, market share is expected to fall below this baseline around 2027–2028. A new competitive scenario in 2026 could erode Lactalis's share by 15% by 2030. Conversely, an optimistic outlook suggests that product innovation could boost market share to 40% by 2030, with acceleration in 2026 (**Figure 8**).

4.4.3. Hypermarket

In the hypermarket analysis (**Figure 8**), the blue line indicates stable growth of 3–4% from 2010 to 2024, with a forecast of 5.5% growth for 2030. The red line indicates a slowdown to 2%.

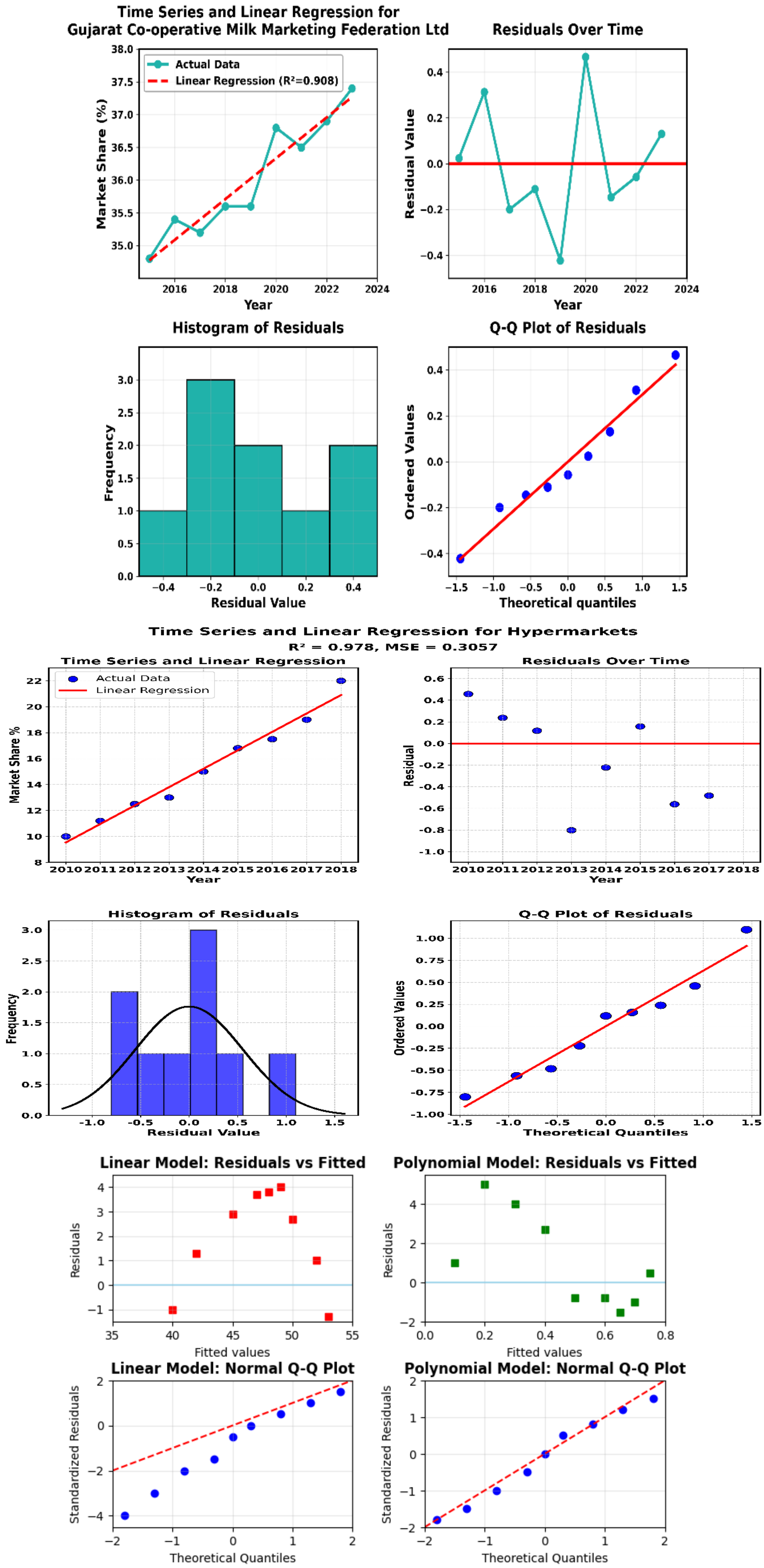

Figure 6. Residual analysis of Amul Hypermarket and Lactalis.

Source: Researcher.

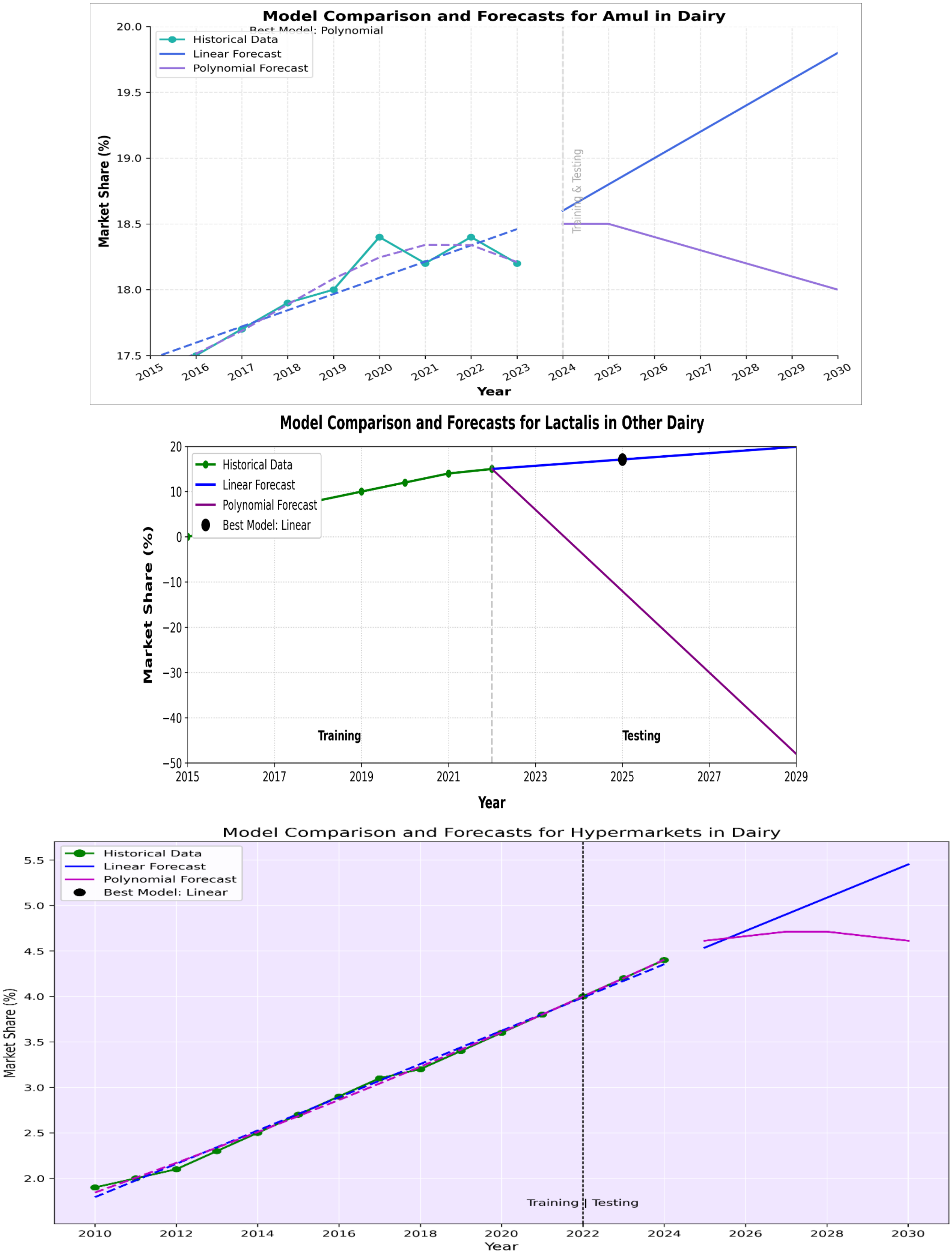

Figure 7. Model fit and forecasting for Amul, Lactalis and Hypermarket.

Source: Researcher.

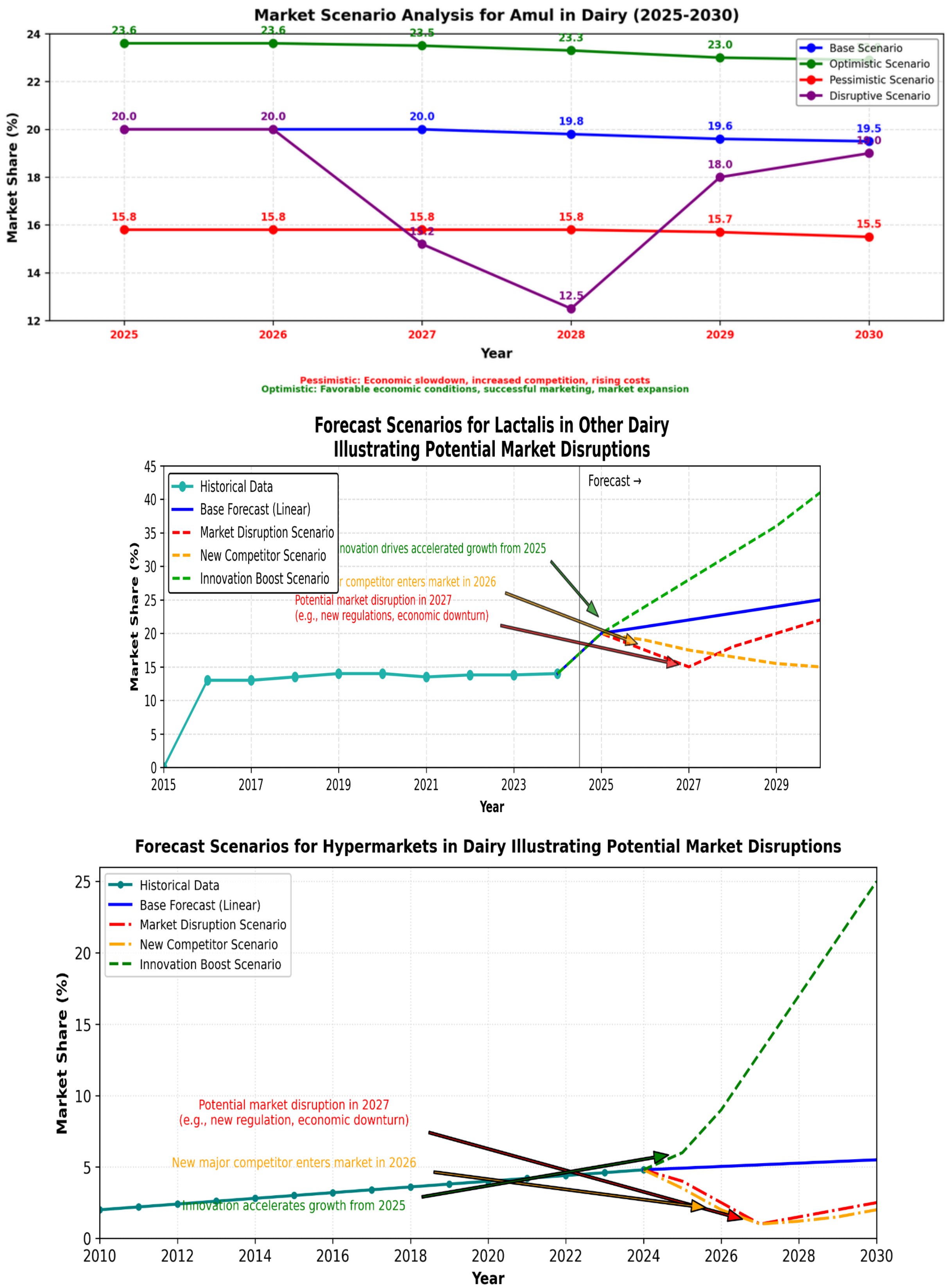

Figure 8. Scenario analysis of Amul, Lactalis and Hypermarket with potential disruption.

Source: Researcher.

4.5. Validation of Growth Rate

4.5.1. High Growth Rates

Lactalis (Anik) is experiencing significant growth, with a 66.67% increase, rising from 0.60% to 13.00%. This suggests the company is either entering the market or pursuing strategic acquisitions. In contrast, several smaller players show signs of artificially inflated growth rates, raising concerns about their sustainability. This dynamic landscape positions Lactalis as a potentially influential player in the industry.

4.5.2. Projections

Amul's growth from 2024 to 2030 is projected at 0.16%, reflecting a stable performance due to its strong market presence, indicating normal, sustainable development (2024–2030). In contrast, Lactalis anticipates a remarkable growth rate of 91.94%, indicating high growth but with medium confidence due to market variability. Hypermarket's outlook is also positive, with a projected increase of 23.43%, categorised as normal growth with high confidence, based on current trends (2024–2030).

4.6. Strategic Outlook

Strategic Market Implications

- **Evolution of the Competitive Landscape**

If Lactalis continues its growth, it may lead the dairy industry by 2027–2028, surpassing competitors. Amul appears to have reached a growth plateau, necessitating innovation or new market exploration for continued expansion. The wide confidence intervals in Lactalis's projections indicate strategic risks and uncertainty in growth forecasts.

- **Channel Strategy Priorities**

The retail environment, particularly in hypermarkets, is experiencing significant growth, presenting opportunities for expansion. Amul demonstrates strong confidence in its market forecasts, which aids in effective long-term planning. In contrast, Lactalis takes a more cautious approach, preparing for uncertainties that could impact operations. A scenario analysis indicates potential market disruptions in 2027, highlighting the need for proactive measures from industry players.

4.7. Product Ingredient

The Indian dairy market utilises both traditional ingredients, such as milk, sugar, and fat, and modern ones, including skimmed milk powder (SMP), enzymes, and stabilisers, to meet market demands.

The heat map (**Figure 9**) illustrates the presence of ingredients across various Indian dairy product varieties using binary codes. The y-axis lists ingredients such as agar, animal fat, and calcium, while the x-axis displays product categories including butter and spread, cheese, and dairy.

- **Dark blue** (value = 1) indicates the presence of the ingredient in the product
- **Light yellow** (value = 0) means the absence of the ingredient in the product.
- **Commonly used ingredients**: Ingredients like Skimmed Milk, Milk Proteins, Probiotic Cultures, and Sweeteners are most commonly used in many products.

While some ingredients are category-specific:

- In *Yoghurt and Sour Milk Products, Other Dairy* Acesulfame K appears to be present as a sweetener.
- Butter spread and cheese appear to have animal fat.
- Yoghurt and sour milk products have probiotic cultures.

The heat map shows that additives such as emulsifiers, Flavours, Vitamins, and stabilisers are used in product processing. This analysis helps identify common versus niche ingredients and understand the complexity of product formulation.

4.7.1. Growth Rate of Key Ingredients

The dairy market is experiencing notable growth, led by skimmed milk with a CAGR of 10.7% (**Appendix A**, **Figure A3**). This trend highlights a strong consumer preference for low-fat dairy, with products such as skim milk and powdered skim milk experiencing growth rates of 8% to 11%, indicating a shift towards healthier options. Sweeteners, milk powders, and sugar are experiencing moderate growth, with CAGRs of 6% to 7%.

In contrast, whole milk products and hydrogenated oils have slower growth rates of just 3% to 4%. This difference highlights the rising demand for nutritious, low-fat options as health-conscious consumers seek healthier dietary choices.

4.7.2. Correlation Between Market Share and Ingredient Volume

The correlation between market share and ingredient volume (2015–2024) (**Appendix A**, **Figure A4**) shows a weak negative correlation. Drinking milk products have a low market share but high ingredient usage, while other dairy products dominate market size with minimal ingredients, suggesting limited processing requirements. Dairy ingredients are projected to grow at a CAGR of 5.5% from 2023 to 2029 (**Figure 10**), with R^2 values above 0.97. However, fats and oils exhibit lower growth, with an R^2 of 0.759, reflecting market saturation.

4.8. Confidence-Enhanced GE Matrix Strategic Framework for the Indian Dairy Market

The GE matrix analyses India's dairy market (**Figure 11**), guiding resource allocation by business strength and industry attractiveness. Our study shows differences in strategic position reliability, leading to a confidence-enhanced implementation. The strategic position of each business category, as shown in **Figure 11**, is further detailed in **Appendix A Table A2**. The GE matrix shows positioning related to resource allocation, but we need to validate these positions before implementing them as provided.

4.8.1. Confidence Assessment

Confidence assessment reveals a significant variation in confidence levels across various businesses (**Figure 12**).

The confidence assessment is done by taking three crucial factors:

(1) Validity of Growth Rate: The rapid expansion of Lactalis and Anik has negatively impacted their competitive standing. Their aggressive growth strategies have altered consumer perceptions and intensified competition, making it harder for both brands to maintain their unique positioning and customer loyalty in a crowded market.

(2) Stability of Position: Many industries show vulnerability to changes in categorisation. The following Sensitivity Analysis highlights how redefined categories impact business outcomes differently across sectors, underscoring the need to understand these dynamics for effective strategy adaptation.

Sensitivity Analysis

Reducing industry attractiveness or business strength can shift positions by nearly 7 points, indicating high sensitivity to negative changes. A +1 favourable change only shifts positions by 6 points, showing lower reactivity to improvements. Businesses should closely monitor risks due to this downside sensitivity (**Figure 13**).

(3) Framework-related Alignment: Framework-related alignment indicates that only 37.5% of business units report a requirement for cross-verification through strategic cross-validation (**Appendix A Table A3**).

Confidence score is a form of a weighted average linear combination method. Equal weights are assigned to ensure a balanced approach that does not favour one dimension of confidence over another[49, 50]. Mathematically, it is done by using the formula[51],

$$Confidence\ Score = W_1(GRC) \\ + W_2(PSC)_5 + W_3(FAC)$$

GRC = Growth Rate Component

PSC = Position Stability Component

FAC = Framework alignment component

4.8.2. Confidence-Adjusted Resource Allocation

To enhance our positioning reliability, we adjusted resource allocation based on our confidence assessment (**Appendix A**, **Table A4**, and **Figure 14**). Amul (yoghurt) and Hypermarket have high confidence, so minimal adjustments are required for them. In contrast, low-confidence segments, such as Lactalis/Anik (yoghurt), require significant reductions for adjustments.

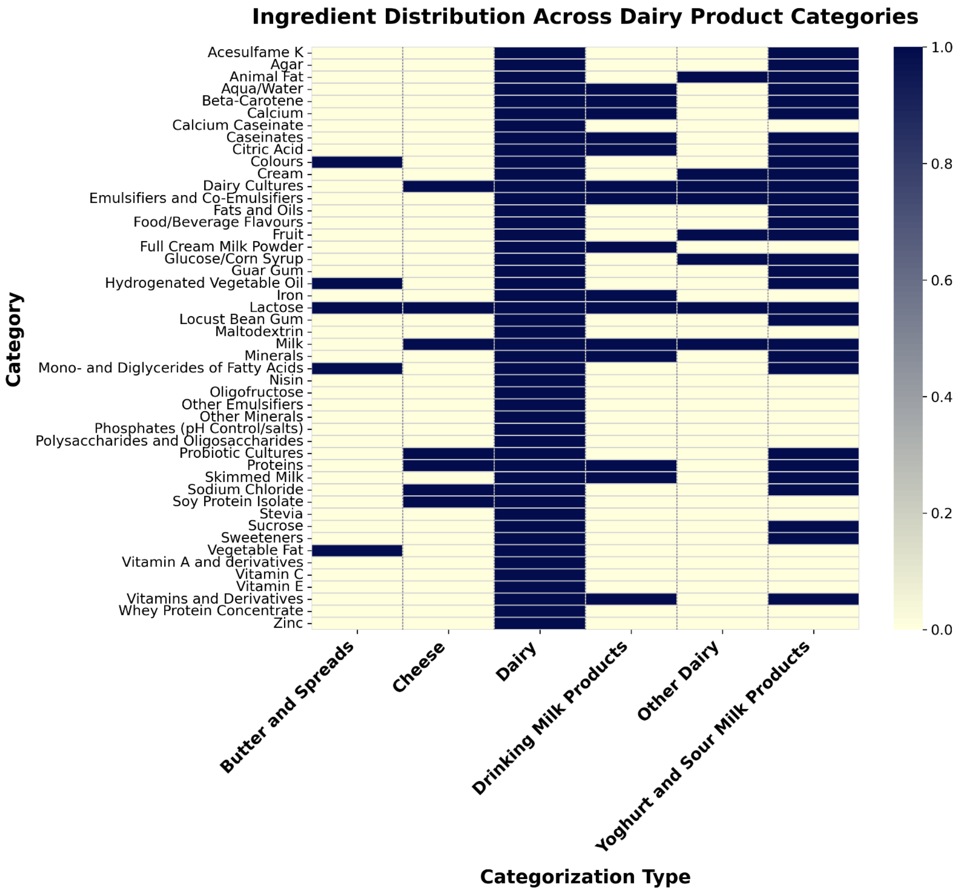

Figure 9. Heat map of ingredient usage across Indian dairy.

Source: Researcher.

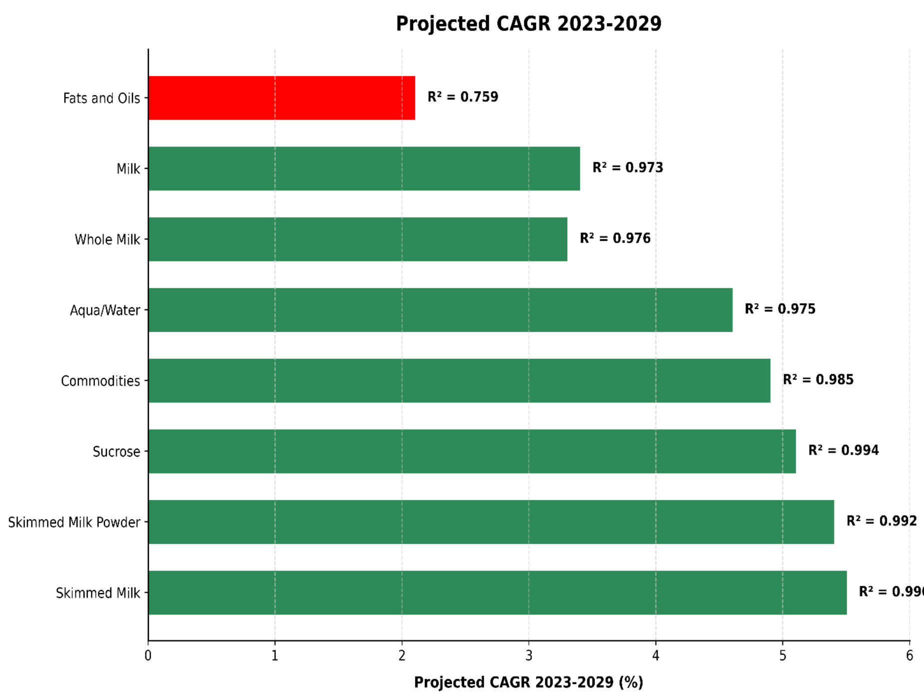

Figure 10. Projected CAGR for ingredients (2023–2029).

Source: Researcher.

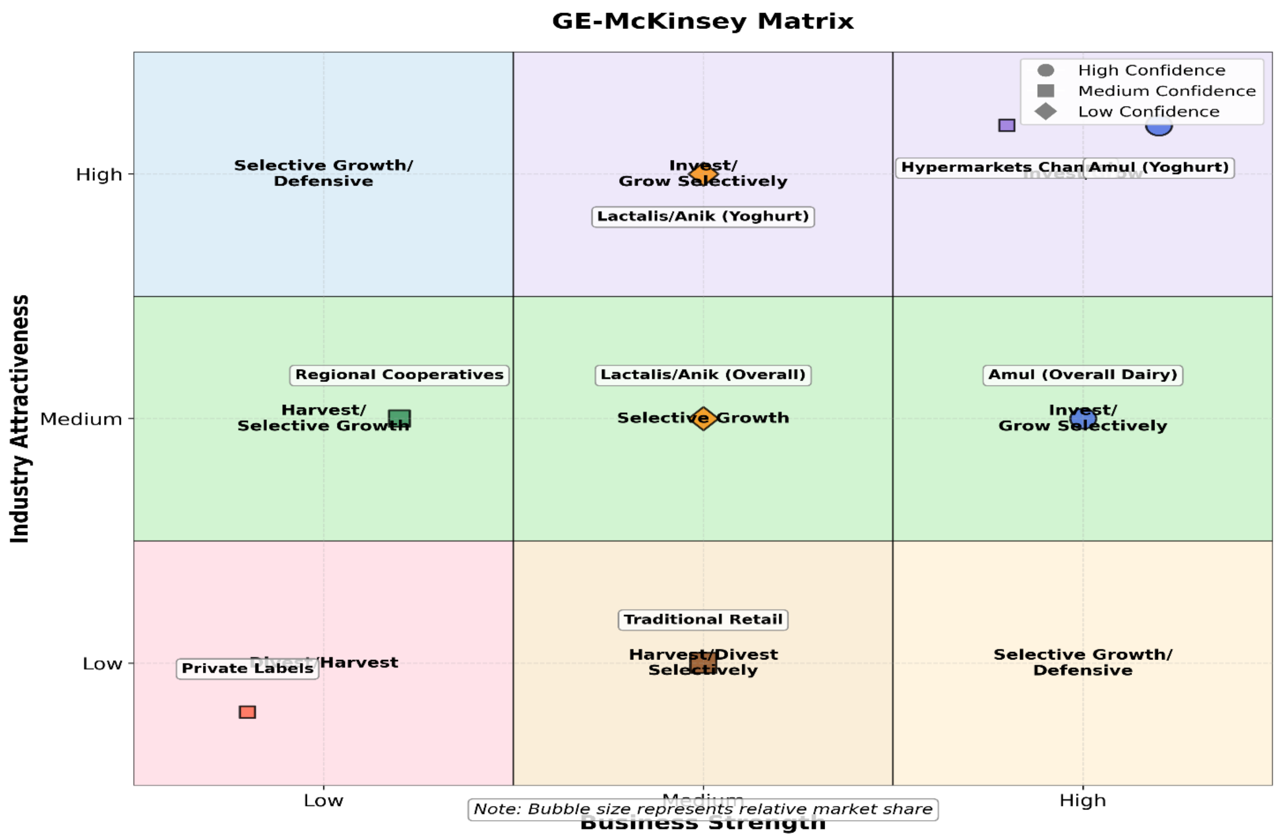

Figure 11. GE matrix strategic analysis.

Source: Researcher.

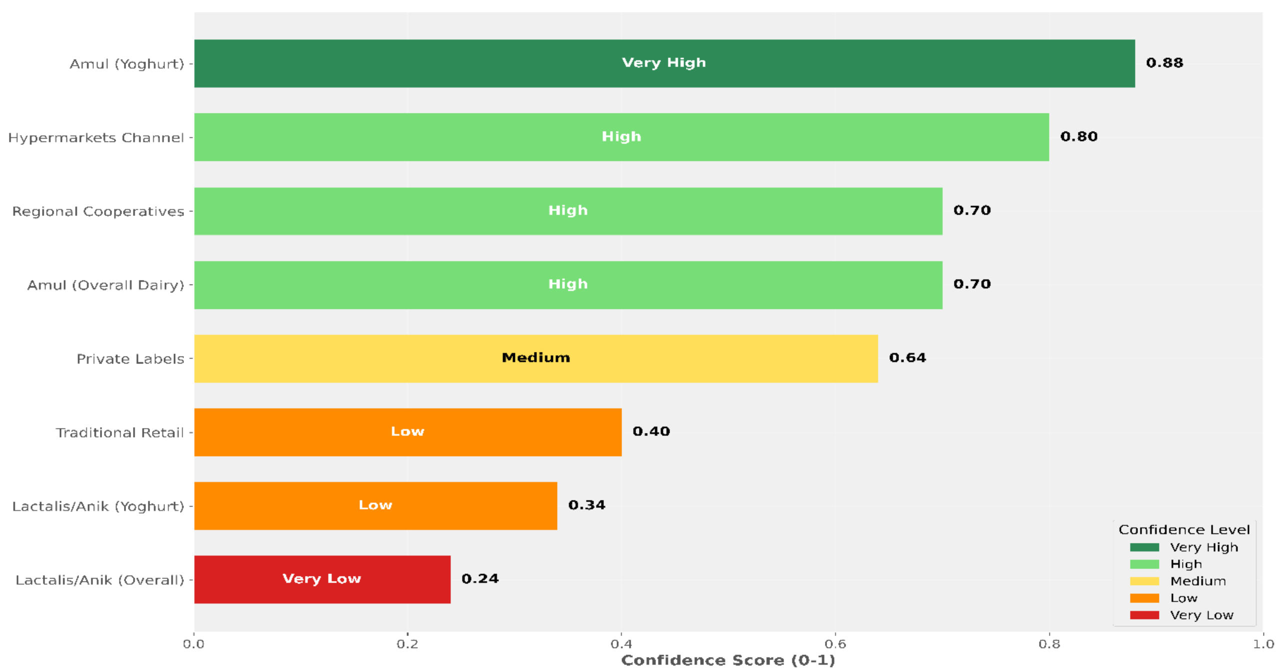

Figure 12. Confidence assessment graph.

Source: Researcher.

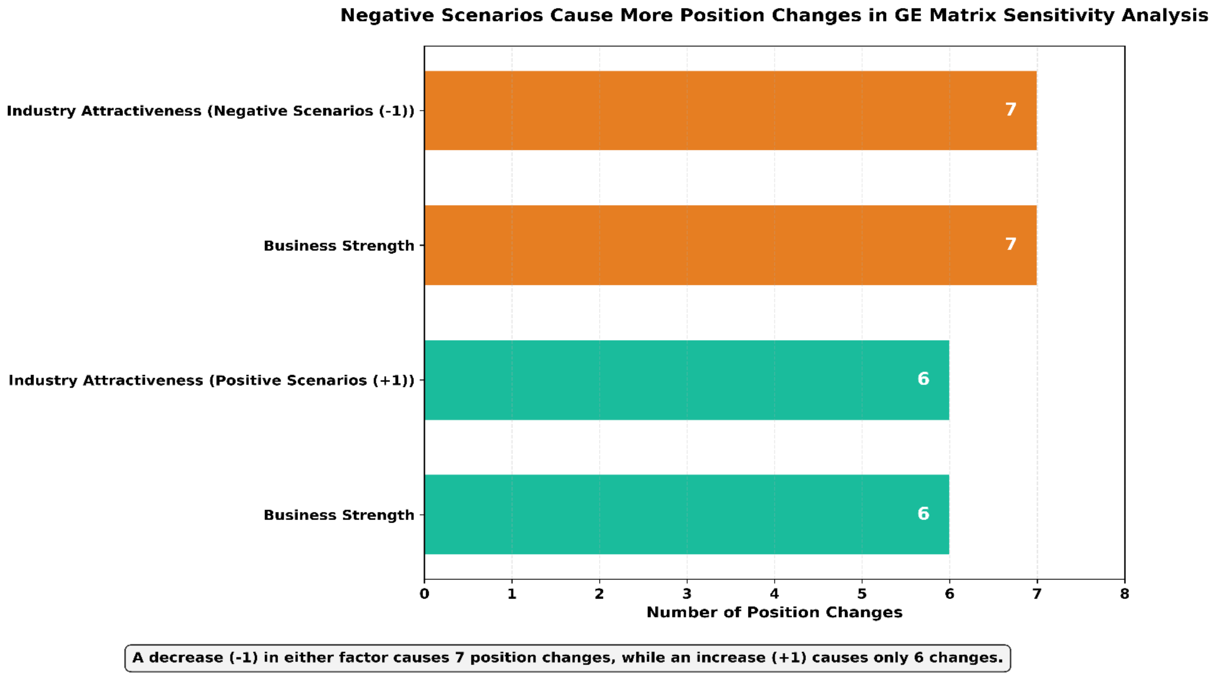

Figure 13. Sensitivity analysis.

Source: Researcher.

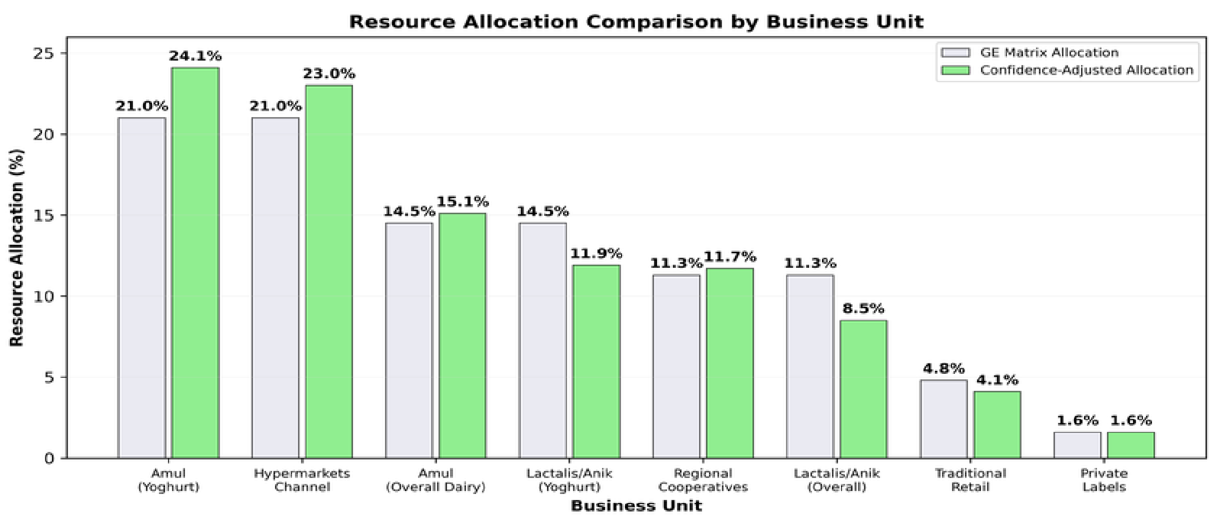

Figure 14. Base versus confidence-adjusted resource allocation.

Source: Researcher.

4.8.3. Strategic Implementation

Strategic implementation based on the time frame, based on the GE Matrix, is analysed based on the following criteria (**Figure 15**):

1 **High Confidence**: Focus on products with confidence levels over 0.70, such as Amul (Yoghurt), Amul (Overall), hypermarket channels, and regional cooperatives. Fully implement the GE Matrix and monitor during semi-annual reviews. A long-term investment is essential.

2 **Medium Confidence:** Segments with confidence levels of 0.50–0.70, like Private Labels, require careful review. The GE Matrix shows limited planning and uncertainty. Monitoring quarterly reviews and short-term investments using the phase-gate methodology is advisable.

3 **Low Confidence**: Segments with low confidence

(below 0.50) are Lactalis (Yoghurt), Lactalis (Overall), and Traditional Retail. Extensive contingency planning is required, with minimal execution of the GE Matrix. Conduct quarterly reviews and adopt a short-term investment strategy using a phase-gate approach.

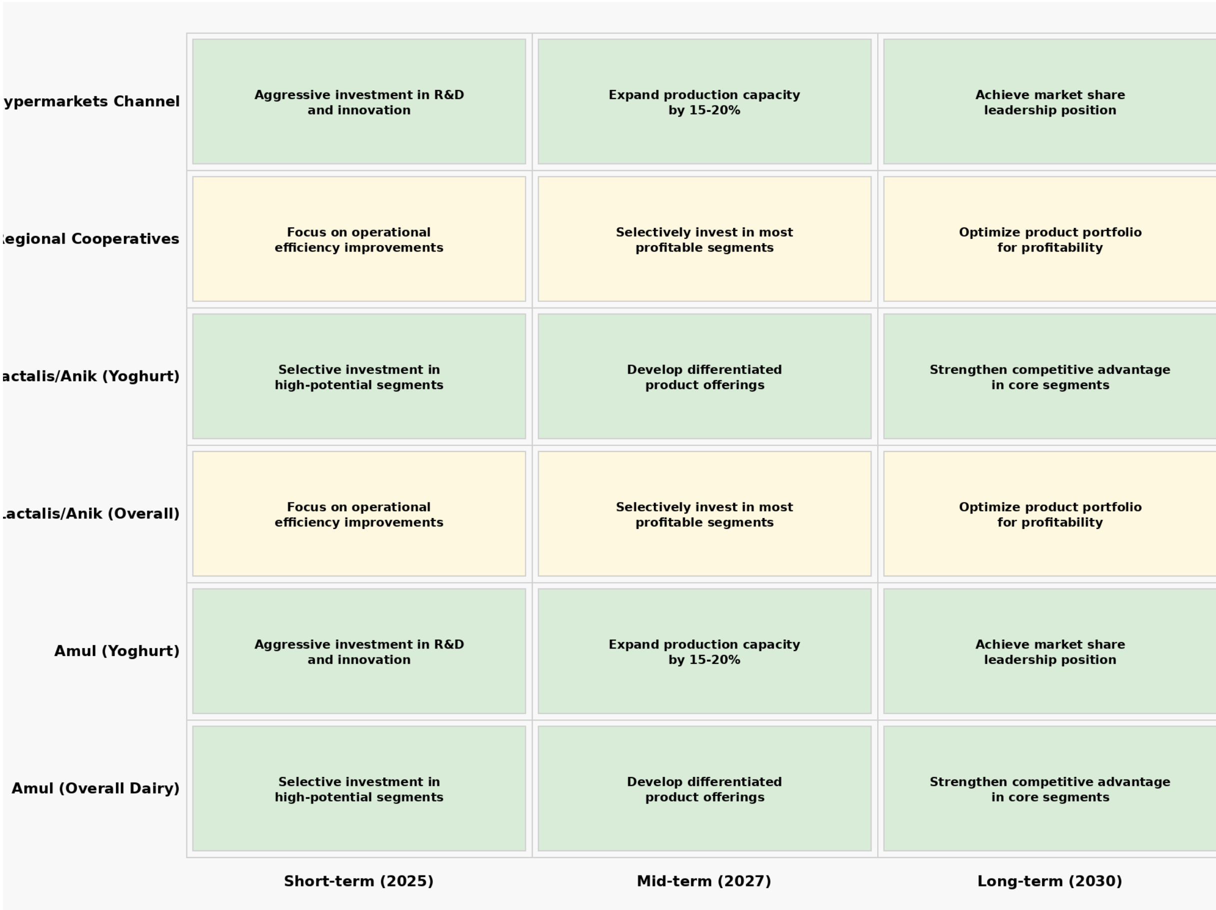

Figure 15. Implementation timeline based on the GE Matrix.

Source: Researcher.

5. Discussion

The Indian dairy market, one of the largest globally, is undergoing significant changes due to shifting consumer preferences, technological advancements, and policy reforms. Our forecasts indicate strong but uneven growth in the dairy sector through 2030. This analysis examines key trends, evaluates specific risks, and suggests strategies for sustainable development, utilising a dual methodology with quantitative forecasting and linear regression models [52]. To investigate the dynamics of the Indian dairy market, this paper focuses on market share, retail channels, and the strategic knowledge required up to 2030 for the traditional cooperative structure of the Indian dairy industry to cope with existing and future challenges.

5.1. Growth Trends and Market Dynamics

The regression analysis revealed different growth trends, including saturated, transformative, and emergent stages, which require varied forecasting models and interpretations. Linear and polynomial models facilitate forecasting and market trend analysis using R^2 and Mean Squared Error (MSE). The Amul polynomial model demonstrated strong performance, with an R^2 of 0.927, indicating stable growth and a low MSE of 0.0402, facilitated by a non-linear saturation term [53]. The linear model for the Lactalis Group had a poor fit (R^2 of 0.359, MSE of 21.3018), indicating significant uncertainty in long-term projections. In contrast, the hypermarket model showed a much better fit (R^2 of 0.976, MSE of 0.0402), underscoring the importance of model fit assessment for accurate growth interpretation [54]. Urbanisation, rising disposable incomes, and growing health consciousness contribute to the increasing demand for processed and functional dairy products. The organised sector is gaining a larger portion of the market, and cooperative federations need to upgrade their cold chain logistics and improve their presence in retail. Differentiation in yoghurt and processed products occurs due to additives like stabilisers, flavours, emulsifiers, and sweeteners. Some ingredients, like animal fat and Acesulfame K, are used selectively in specific products. While some ingredients remain common, others create value-added products through additive innovation.

5.2. Risk Landscape

Despite a positive growth outlook, several risks threaten sectoral stability:

- Price Volatility: Variations in feed costs, milk procurement prices, and global skimmed milk powder (SMP) markets can significantly impact profit margins [55].
- Climate Risk: Rising temperatures, lack of water, and unpredictable monsoons may cause supply problems, especially in areas that rely on rain-fed fodder [56].
- Regulatory Challenges: Unexpected government actions like price caps, subsidies, or export bans can wrench market strategies and disrupt the planning flow [57].

The involvement of private companies that prioritise profit can lead to environmental harm and inefficient resource utilisation. These companies often employ strategies aimed at maximising profits, such as scale intensification, utilising high-yield hybrid cattle breeds, engaging in contract farming to ensure a steady supply of raw materials, and establishing industrial processing farms to maintain a continuous milk supply.

Scale intensification increases the demand for fodder and contributes to higher methane (CH_4) emissions. Traditionally, cow dung is used as organic manure; however, large industries often dispose of it in pits due to issues with manure management, which further contributes to methane emissions. Additionally, utilising cold chains and large warehouses releases more carbon into the environment due to the energy consumption associated with refrigeration.

5.3. Scenario Analysis and Strategic Planning

Scenario and sensitivity analysis enhance trend analysis by incorporating macroeconomic risks, such as market entrants, economic changes, and regulatory changes. A 2027 disruptive scenario forecasting Amul's market share decline demonstrates the impact of nonlinear shocks and justifies contingency-based strategic models. Furthermore, the implementation of the GE Framework. Complemented by sensitivity testing, it provides evidence of business positions and their variations with input changes, particularly for low-confidence businesses like Lactalis. This analysis confirms instability in historical growth patterns, characterised by volatile trends, which supports confidence-enhanced strategic models.

5.4. Strategic Implications for Stakeholders

For policymakers, the study underscores the need for climate-smart dairy policies and streamlined subsidy frameworks. Cooperatives must leverage their grassroots reach to expand into value-added products and e-commerce. For farmers, training in animal welfare and feed efficiency will be crucial for scaling operations sustainably.

5.5. Practical Implications

Structured resource allocation (Resource-based View) strategies and effective innovative products for maintaining market share (Industrial Organisation Theory) are needed for Dairy cooperatives. The Resource-Based View reveals that firms with intangible assets, such as innovation and brand loyalty, possess a competitive edge over others. Supply chain optimisation, risk and contingency planning, and research and development for cooperatives are practically required in dynamic market situations.

5.6. Limitations

This research utilises ten years of secondary data; therefore, the model's explanatory power is limited by the absence of certain macroeconomic and policy variables.

5.7. Future Research Scope

Future research could focus on advanced machine learning models, particularly Long Short-Term Memory (LSTM) networks, by integrating real-time consumer sentiment analysis. This would capture consumer emotions about products and services, combining sentiment data with nonlinear time series data for better insights into consumer behaviour. Furthermore, examining the macroeconomic landscape and policy implications could help researchers understand the interactions between consumer sentiment and market dynamics. This approach may lead to improved predictive models that can help policymakers and businesses navigate economic changes more effectively.

6. Conclusion

This research focuses on the dominance of businesses in the dairy industry. The Indian dairy industry is structured and segmented, with market leadership held by Amul, emerging players such as Lactalis (Anik), and the development of urban retail channels, including hypermarkets. Amul has consistently maintained its status as a pioneer in the dairy industry, reporting stable yet progressive trends over the last few years, which reflect its robustness. Conversely, Lactalis, whose brand name is Anik, has a striking growth potential, but a lot of risk accompanies it. Innovativeness is being demonstrated in the yoghurt and value-added dairy industry, especially in terms of the ingredients used and how they are utilised to make the product incredibly appealing and something that consumers would resort to. Moreover, hypermarkets are becoming increasingly critical in the distribution field, as they cater to consumer preferences for a convenient shopping experience. This trend indicates that hypermarkets will continue to play a significant role in dairy product sales in the future. While core players like Amul can plan with confidence, Lactalis requires flexibility in strategic planning due to the challenges of volatile growth projections. In conclusion, the market is mature in dominant segments, but some areas with high innovation and retail transformation need careful investment by the cooperative federations, while still recognising emerging market trends and players like Lactalis.

Author Contributions

Conceptualization, N.P.; methodology, C.R.; software, N.P.; validation, C.R. and A.C.; formal analysis, C.R.; resources, N.P.; writing—original draft preparation, C.R. and A.C.; writing—review and editing, N.P., C.R., and A.C.; supervision, N.P.; project administration, N.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

Not applicable.

Data Availability Statement

Data is made available as per demand.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

Abbreviations

IO: Industrial Organisation Theory

RBV: Resource-based View theory

MSE: MEAN Squared Error

GCMMF: Gujarat Co-operative Milk Marketing Federation Ltd.

KMF: Karnataka Milk Federation

NDDB: National Dairy Development Board

AAGR: Average Annual Growth Rate

SMP: Skimmed Milk Powder

CAGR: Compound Annual Growth Rate

LSTM: Long Short-Term Memory

Definitions of Terminologies

Euromonitor: Euromonitor is a global market research company that provides data insights on industries, companies, and consumer trends worldwide.

Retail Channels: Retail channels transfer finished products from manufacturers to consumers.

Empirical Analysis: Empirical analysis involves collecting data and applying statistical models to analyse it.

Regression Analysis: Regression analysis examines the relationship between a dependent variable and one or more independent variables.

Coefficient of Determination: A statistical measure showing how well a model explains dependent variable variation.

MEAN Square Error: Any regression model's average squared differences between actual and predicted values.

Scenario Analysis: It is a technique to predict future outcomes by modelling different probabilities.

Confidence Interval Estimation: The statistical method for calculating the range of values within which the actual value is likely to fall, at a certain confidence level.

Cross-validation: This statistical technique divides data into training and testing datasets to evaluate model prediction on unseen data.

Residual Diagnosis: It checks model accuracy by analysing residuals between observed and predicted regression values.

Heat Map: A Heat map is a data visualisation technique using colour patterns to show the presence and intensity of data across dimensions, and through binary codes, helps understand patterns and relationships.

GE Matrix strategic framework: GE Matrix evaluates business units and product positions based on business strength and industry attractiveness.

Sensitivity analysis: Shows how business positions on the GE Matrix shift when model variables change.

Appendix

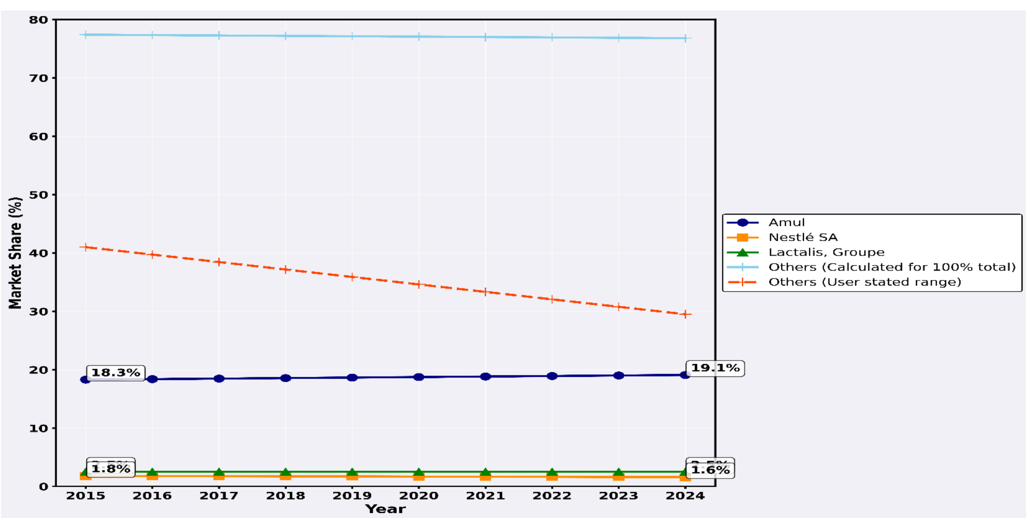

Figure A1. Dairy market share trends historical (2015–2024).

Source: Researcher.

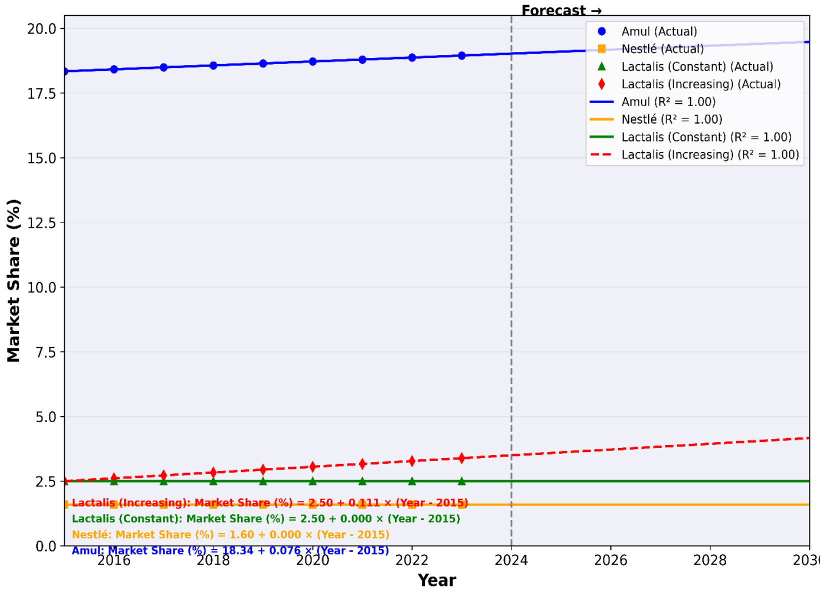

Figure A2. Combined regression analysis of Indian dairy market (2015–2030).

Source: Researcher.

Table A1. Cross-validation of different models.

Business Unit	Model Type	Training Metrics	Test Metrics	Selected Model	Residual Analysis
Amul	Linear	$R^2 = 0.906$	$MSE = 0.1714$		
Amul	Polynomial	$R^2 = 0.927$	$MSE = 0.0402$	Polynomial	Normality confirmed
Lactalis	Linear*	$R^2 = 0.359$	$MSE = 21.301$	Linear	
Hypermarket	Linear**	$R^2 = 0.976$	$MSE = 0.0096$	Linear	Normality confirmed
Hypermarket	Polynomial	$R^2 = 0.991$	$MSE = 0.0049$		

Note:
* *For Lactalis, the linear model shows high uncertainty ($R^2 = 0.359$), suggesting a poor fit. However, no alternative model performance shows a better fit, as the dataset is showing extreme values of an anomalous growth pattern, with uncertainty, creating a need to focus on uncertainty qualification rather than model selection. Again, extreme values of the dataset fundamentally challenge the adoption of the polynomial model.*
** *A linear model is chosen for the Hypermarket by following the principle of parsimony.*

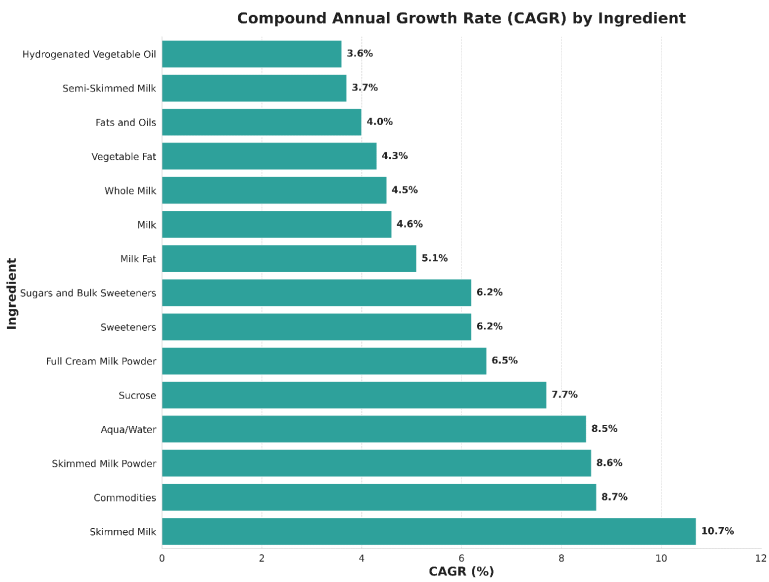

Figure A3. Historical CAGR for ingredients (2015–2023).

Source: Researcher.

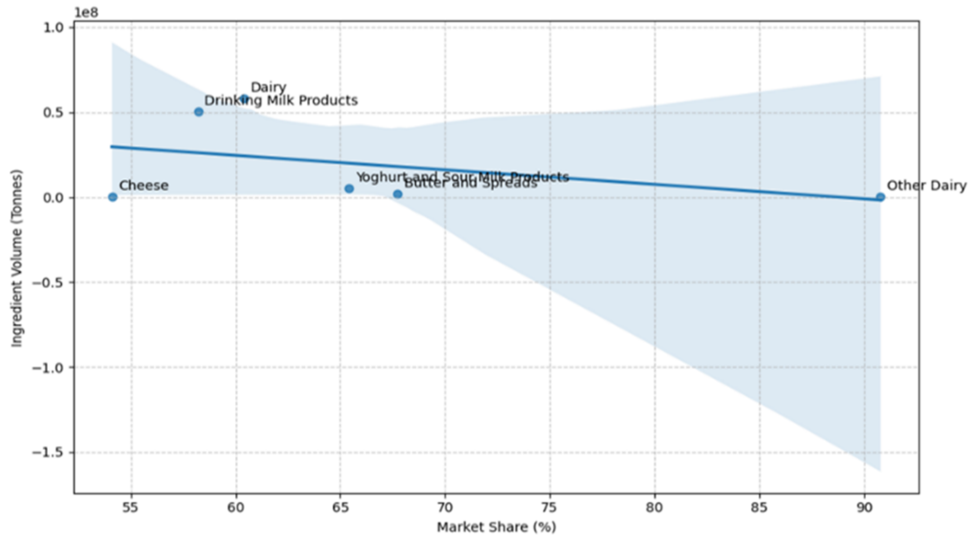

Figure A4. Correlation between market share and ingredient volume (2015–2023).

Source: Researcher.

Table A2. GE matrix: strategic position of each business.

Business Units	GE Matrix Position	Strategic Directions
Amul (Yoghurt)	High-High	Invest/Grow
Hypermarkets Channel	High-High	Invest/Grow
Amul (Overall)	Medium-High	Invest/Grow Selectively
Lactalis/Anik (Yoghurt)	High-Medium	Invest/Grow Selectively
Lactalis/Anik (Overall)	Medium-Medium	Selective Growth
Regional Cooperatives	Medium-Medium	Selective Growth
Traditional Retail	Low-Medium	Harvest/Divest Selectively
Private Labels	Low-Low	Divest/Harvest

Table A3. Confidence adjustment-based resource allocation.

Business Units	GE Matrix Position	Strategic Directions	Confidence Score
Amul (Yoghurt)	High-High	Very High	0.88
Hypermarket channels	High-High	High	0.80
Regional Cooperatives	Medium-Medium	High	0.70
Amul (Overall)	Medium-High	High	0.70
Private Labels	Low-Low	Medium	0.64
Traditional Retails	Low-Medium	Low	0.40
Lactilis/Anik (Yoghurt)	High-Medium	Low	0.34
Lactilis/Anik (Overall)	Medium-Medium	Very-Low	0.24

Table A4. Confidence assessment of different businesses.

Business Units	GE Matrix Position	Base Allocation	Adjusted Allocation	Adjustments
Amul (Yoghurt)	High-High	25.3%	23.8%	−6.0%
Hypermarket channels	High-High	25.3%	22.8%	−10.0%
Amul (Overall)	Medium-High	17.6%	14.9%	−15.0%
Regional Cooperatives	Medium-Medium	13.7%	11.6%	−15.0%
Lactalis/Anik (Yoghurt)	High-Medium	17.6%	11.8%	−33.0%
Lactalis/Anik (Overall)	Medium-Medium	13.7%	8.5%	−38.0%
Traditional Retails	Low-Medium	5.9%	4.1%	−30.0%
Private Labels	Low-Low	2.0%	1.6%	−18.0%

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