

A Case Study on Goal Programming Optimization Model in Bread Production Planning

Juli Antasari Br Sinaga¹, Loso Judijanto², Enos Lolang³, Anggreini D. N. Rupidara⁴,
Novia Purnamasari⁵, Herman Herman⁶, Nanda Saputra⁷

^{1,6}Universitas HKBP Nommensen Pematangsiantar, Indonesia

²IPOSS Jakarta, Indonesia

³Universitas Kristen Indonesia Toraja, Indonesia

⁴Universitas Kristen Artha Wacana, Indonesia

⁵STIT Nurul Hikmah Cianjur, Indonesia

⁷Sekolah Tinggi Ilmu Tarbiyah Al-Hilal Sigli, Indonesia

*Corresponding author: juli.sinaga@uhnp.ac.id

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Abstract: Planning bread production is crucial because each stage affects various aspects of the product quality. However, this process is challenging because of the subtle taste and rapid deterioration of bread, necessitating frequent replenishment. A key issue in crafting high-quality bread is the timing of delivery and adaptation of current technologies. By ensuring prompt bread delivery, companies can capitalize on market shifts and fluctuations. Therefore, multiple objectives must be considered when developing production plans. Roti Sultan Meriah, a small to medium-sized bread manufacturing enterprise, aims to satisfy market demand while optimizing production costs to maximize profits. This study employed the goal programming method to address these multiple objectives, which linear programming cannot address. The specific approach used was a model with goal priority, enabling Roti Sultan Meriah to simultaneously optimize various production aspects such as meeting market demand, minimizing expenses, and maximizing profits. This method allows the company to prioritize these objectives, leading to improved decision-making in production planning. By implementing this approach, Roti Sultan Meriah could enhance its operational efficiency and market competitiveness in the bread industry. The findings reveal an optimal solution that achieves the sales volume target and maintains production costs within the target limit of Rp. 27,511,230, and reaches the profit goal of Rp. 98,764,373 over a one-year period.

Keywords: Bread, goal programming, linear program, production planning

Introduction

Bread production planning is a highly important phase because every stage affects different product qualities, such as raw and auxiliary material selection, production and control processes, and stock levels, which in turn affect quality according to consumer demand and certain standards (Mardar et al., 2022). However, it is rather difficult to plan production because of the mild flavor and low quality of bread, which must be renewed every day or every few days. Additionally, the process usually involves low-skilled workers with a high turnover rate. Production cost fluctuations caused by changes in the prices of wheat, one of the most

important raw materials, and the distribution of funds or capital between operations or divisions require applied mathematics to efficiently plan resource allocation. Hannan et al (2020) explained that production development and distribution need to be better than simple intuition. Therefore, advanced optimization techniques, such as goal programming, can be used to reduce wasted production (Jia et al., 2020).

This study has two objectives: to improve production efficiency in terms of different objectives and sources, and to noticeably reduce production defects and releases. The R&T industry continues to face significant challenges in bread production planning. Costs, starting with labor, are always rising. Excessive raw ingredients should not be overused or stored for long periods. Variable capacity and fixed purchase inspiration are required, and must be prepared before the purchasing and planning periods (Aday & Aday, 2020). Currently, most companies use material requirement planning approaches through enterprise resource planning in the market, but only for existing products that have been produced in large quantities. Products with low profit margins are not wasted.

Goryńska-Goldmann et al (2020) stated that bread is known as a staple food in many cultures, is prepared on a daily basis, and has a short shelf life when touched. In the bread-making business, increasing consumer expectations and product variations are the main limitations owing to high capital turnover. Aljohani (2023) explained that several factors create the need for bread production planning. First, demand for bread can fluctuate because of events and market controls. Second, consistency in each batch production is required because of the nutritional value and taste of bread. Third, the variety of bread with many flavor variants requires careful planning for several weeks. Fourth, poor-quality ingredients can produce bread that is not in demand. Finally, bread is a new product that consumers must experience before providing feedback for production (Rozi et al., 2023).

Virginio et al (2022) explained about one of the problems in making quality bread is the time of delivery and adjustment of existing technologies. Timely delivery of bread enables companies to take advantage of market fluctuations. Furthermore, this technology can be used both high-speed processing and baking equipment. This means that when one process begins, it cannot be readily stopped or changed until the current batch is complete. Therefore, it is important that strategic planning is maintained to ensure smooth operation, because the production decision cannot be changed in the short term. Bakery companies and fast-food chains can take advantage of this high-speed line. Disturbances in planning this section also affect the strategic performance of the entire delivery route (Cappelli & Cini, 2021). This is common in the bread industry, such as in extrusion lines that produce both simple and fermented sandwiches. It is clear that instability in this section requires regular adjustments, which slow down the production flow of extruded products (Zinina et al., 2020; Goryńska-Goldmann et al., 2020).

Tirkolaee et al (2021) defined Goal Programming (GP) as an optimization method and extension of traditional linear programming. A goal programming model can handle more than one goal in a given time. The assigned goals can be minimized or maximized at different levels. A GP optimization model has n levels and can achieve x number of goals at the first level and y number of goals at the second or other level (Karasu et al., 2020).

The proposed GP model can consider bread production or changing the capacity level of bread production (Yousefi-Babadi et al., 2023). This makes the budget more realistic. This model is used by the bread company to minimize the cost of promotional campaigns while also maximizing the output proportion of bread to be produced, changing the capacity level of the oven and bread cabinet in the production process. The model has the flexibility to add achieved goals and constraints. The method used in this study is mixed-integer linear programming. The benefits of using GP models are flexibility and applicability for several larger problems that have multiple goals and limitations (Subiria-Cueto et al., 2025)

Goal programming is a methodology for handling multiple objectives that are generally conflicting and addressed at any level based on the priority given. It handles real and difficult world problems, starting from the formulation and the weight of each goal, target, and norm. In addition, their handling can be long, rigid, and inefficient. The group technique used in GP is still data-intensive, and it helps to see and obtain the target value accurately on average. GP can also determine the true alternative decision. The implementation of GP in similar industries is still relatively rare; therefore, considering the application of more than two goals to be pursued simultaneously, the practicality and accuracy of the method can be tested when the multiplicity of the required objectives is present.

Sazvar et al (2021) stated that the application of goal programming in an optimization model has commenced since it was developed for handling multiple objectives and the adversity of certainty present in real-world problems. Several formulations and developments in goal programming have been conducted since its purposive reforms, many of which were directed to the study of optimum solutions from which the decision makers' concerns about the objectives in question can be deduced. In conventional optimization techniques, the approaches involve converting multiple objectives into a single objective by aggregating the objectives through equations or inequalities (Yadav et al., 2022). Unfortunately, with position constraints, assumptions to consider, and weighting, these methods could leave room for unsatisfied decision makers by showing solutions that do not work in real practical applications. Thus, approaching linear weighting in non-linear circumstances would involve an in-depth assessment of the weights to cater to the shortcomings and limitations of weights.

The goal programming method overcomes the limitations of the weighted-sum. It enables linear weighting, lexicography, and a priori choice models to be extended to non-linear values, non-linear time, etc., and takes care of the intertwined trade-offs of several conflicting objectives simultaneously. The function of goal programming is the duality of the constraints as a negligible situation, where one function constitutes the objective function and allows the solution to find the degree of satisfaction between targets, reasonable effort, and residuals (Thirunavukkarasu et al., 2022). These commitments are referred to with these terms, but the actual limit retains a hidden formula in which no quantities must exceed a predetermined value (greater than zero) called goals. A realistic limit represents parameters that can be changed according to real-life empirical observations. Goal programming serves as a decision support system applicable to agriculture and metals.

Research Method

This study employs a descriptive research methodology using a quantitative approach. According to Rony et al (2024), descriptive research aims to determine the value of one or more independent variables without connecting them to other variables (Purba et al., 2024). The research was conducted in Toba Raja Hombang, Hutabayu Raja sub-district, from October 14 to October 19, 2024.

The research process involved the following steps:

1. Data collection

Information was gathered through interviews with the owner of Roti Sultan Meriah.

2. Variable identification

Variables were defined as any elements selected by the researcher for the study, from which information could be obtained and conclusions drawn.

3. Descriptive analysis

This method involves collecting, organizing, processing, and analyzing actual data to provide insights into existing issues.

4. The data processing steps were as follows:

- 1) Identifying production cost volumes for goal programming.
- 2) Formulating goal programming by:
 - a) Establishing the objective function
 - b) Defining constraint functions
 - c) Developing linear programming
 - d) Creating a goal programming model
 - e) Determining the optimal solution

5. Conclusion formulation

The goal programming model was used to process the data, enabling the determination of the minimum production costs and maximum profit potential.

Data analysis techniques involve processing information to extract valuable insights into problem-solving and decision-making. Based on interviews with business owners, the following approach can be employed to optimize production costs and profits:

The data processing steps used in this study were as follows:

1. Developing sales projections to establish sales volume targets, production cost limits, and profit objectives for goal programming models. The forecasting method was selected based on the data pattern, which was visualized using the Minitab 18 software. For stationary data, one equation was used; for trend patterns, another equation was applied; and for seasonal patterns, a third equation was utilized in sales forecasting.

2. Formulating Goal Programming models

a) Identifying decision variables: These are the outputs requiring optimization to meet the goal and constraint criteria. For Sutan Meriah bread, the decision variables were the production quantities for each product type:

Decision variable x_j where $j = 1, 2, 3, 4, 5, 6$ (bread varieties)

X1 = Chicken thigh bread production quantity

X2 = Peanut donut production quantity

X3 = Coconut bread production quantity

X_4 = Seres donut production quantity

X_5 = Jam bread production quantity

X_6 = Green bean bread production quantity

b) Establishing and articulating the objective constraint functions:

- 1) Maximizing production volume in line with market demand
- 2) Minimizing production costs
- 3) Maximizing sales profits

c) Setting priorities:

Priority 1: Production volume maximization

Priority 2: Production cost minimization

Priority 3: Sales profit maximization

d) Determining the objective function:

The objective function will be tailored to the priority-based objective function model, as this study employs a prior approach.

Results And Discussion

A. Data Collection

At sultan ceria bread, the goal is to maximize production volume in order to meet market demand (stalls), minimize production costs and maximize profits. Therefore, the following data is estimated:

Bread sales data in 2023

Production cost data on bread making

Sales price data for each type of bread

1. Sultan Meriah Sales Data

Decision variable x with $j = 1, 2, 3, 4, 5, 6$ (types of bread)

X_1 = Number of chicken thigh production

X_2 = Number of peanut donut production

X_3 = Number of coconut bread production

X_4 = Number of seres donut production

X_5 = number of jam bread production

X_6 = number of green bean bread production

Table 1. Sultan Meriah Bread Sales Data

No	Months	Types of Bread						Total
		x_1	x_2	x_3	x_4	x_5	x_6	
1	January	1.050	1.620	1.820	980	1.200	1.040	7.710
2	February	1.220	1.460	1.240	1.620	1.760	1.830	9.130
3	March	1.320	1.520	1.420	1.820	1.340	1.240	8.660

No	Months	Types of Bread						Total
		x_1	x_2	x_3	x_4	x_5	x_6	
4	April	1.260	1.760	1.320	1.680	1.820	1.120	8.960
5	May	1.460	1.230	1.420	1.920	1.320	600	7.950
6	June	1.320	1.420	1.920	1.620	1.740	720	8.740
7	July	1.720	1.820	1.760	1.320	1.840	1.160	9.620
8	August	1.280	1.420	1.220	1.720	1.800	1.120	8.560
9	September	1.240	1.620	1.320	1.520	1.820	1.600	9.120
10	October	1.480	1.620	1.880	1.720	1.340	1.700	9.740
11	November	980	1.800	1.240	1.300	2.020	1.920	9.260
12	December	1.200	1.700	1.620	1.400	1.840	1.800	9.560
	Total	15.530	18.990	18.180	18.620	19.840	15.850	107.010

Source : Roti Sultan Meriah

2. Production Cost Data

The production cost data are the costs used during the production process. The costs in question are the costs of raw materials and labor costs and delivery costs. The following table shows the cost of expenditure for the production process where the production costs are calculated for all types of bread.

Table 2. Production cost data in 1 loaf of bread (in Rupiah)

No	Types of Bread	Raw material costs	Labor costs	Delivery Fee	Total production costs
1	x_1	150	80	20	250
2	x_2	180	80	20	280
3	x_3	160	80	20	260
4	x_4	200	80	20	300
5	x_5	190	80	20	290
6	x_6	220	80	20	320

Source: Roti Sultan Meriah

3. Bread Type Selling Price Data

Decision variable x with $j = 1, 2, 3, 4, 5, 6$ (bread types)

X_1 = Number of chicken thigh production

X_2 = Number of peanut donut production

X_3 = Number of coconut bread production

X_4 = Number of seres donut production

X_5 = Number of jam bread production

X_6 = Number of green bean bread production

Table 3. Bread Type Selling Price Data

Types of Bread	Bread Selling Price
x_1	800
x_2	800
x_3	800
x_4	800
x_5	800
x_6	800

B. Data processing

In 2024, the goal programming method was used to optimize production planning. Before using the data obtained from Sultan Meriah Bakery for programming purposes, researchers must conduct sales forecasting. The purpose of this forecasting is to set target limits in accordance with market demand, production costs, and profit targets in 2024. In the process of developing the program objectives, these three limits were applied.

1. Sales Forecasting

The data to be estimated come from sales data for one year, namely 2023. Because there are six types of bread that are the subject of this study, sales forecasting in 2024 is not based on a particular type of product, but only on the percentage of monthly sales in that year. The results of the total forecast for each type in 2024 will be re-determined by examining the trader's assessment. The goal was to reduce the number of errors that occur during the forecasting process.

a) Forecasting Results

Based on calculations using the forecasting formula described in previous point, the results of the sales forecast in 2024 are as follows:

With the formula:

$$\text{for } x_1 = (0,3 \times 1220) + (0,7 \times 1050) = 1101$$

$$x_2 = (0,3 \times 1460) + (0,7 \times 1620) = 1572$$

$$x_3 = (0,3 \times 1240) + (0,7 \times 1820) = 1646$$

$$x_4 = (0,3 \times 1620) + (0,7 \times 980) = 1172$$

$$x_5 = (0,3 \times 1760) + (0,7 \times 1200) = 1368$$

$$x_6 = (0,3 \times 1830) + (0,7 \times 1040) = 1277$$

So the forecast for February is the sum of the results of the addition of x_1 to $x_6 = 8136$.

For the calculation of the forecast for March to December, it can be calculated using the help of Microsoft Excel as follows:

Table 4. Sales Forecast Results in 2024

No	Months	Sales Forecast Result Amount
1	January	7710
2	February	8136
3	March	8292
4	April	8495
5	May	8332
6	June	8454
7	July	8334
8	August	8751
9	September	8862
10	October	9127
11	November	9167
12	December	9284
Total		102.944

2. Production Cost Limits

Production costs can be determined based on the number of products to be produced multiplied by each product price such as:

Table 5. Production Cost Limits in 2024

No	Months	Production Cost Limit (Rupiah)
1	January	7.729.158
2	February	7.822.011
3	March	7.908.874
4	April	8.001.727
5	May	8.091.584
6	June	8.184.437
7	July	8.274.295
8	August	8.367.148
9	September	8.460.001
10	October	8.549.858
11	November	8.642.711
12	December	8.732.569
Total		98.76.4373

3) Sales Profit Target

The profit generated from the production of each type of product is reduced by the costs incurred, which then produces sales profit. Based on the production cost data and the selling price of each product type, the sales profit is as follows:

Table 6. Profit for Each Type of Product

Types of Product	Profit (Rupiah)
X_1	550
X_2	520
X_3	540
X_4	500
X_5	510
X_6	480

The following are the results of the calculation of the sales profit target in 2024:

Table 7. Sales Profit Targets in 2024

No	Months	Sales Forecast Result Amount
1	January	7.729.158
2	February	7.822.011
3	March	7.908.874
4	April	8.001.727
5	May	8.091.584
6	June	8.184.437
7	July	8.274.295
8	August	8.367.148
9	September	8.460.001
10	October	8.549.858
11	November	8.642.711
12	December	8.732.569
Total		98.76.4373

C. Goal Programming Formulation

The following are the steps for implementing the goal programming method:

1. Determination of Variables and Parameters

The variables and parameters used in the formulation of goal programming are as follows:

X_j = amount of production of type j bread ($j=1,2,3,4,5,6$)

a_{jk} = amount of sales of type j product in month k

b_k = cost of bread production in month k

c_k = total profit from sales expected in month k

d_i^+ = target achievement that exceeds the target set in the i -th equation

d_i^- = failure to achieve the target set in the i -th equation

P_k = k -th priority

b_i = RHS value (target to be achieved)

2. Determination and Formulation of Model Constraint Functions

There are 3 constraints in this study has three constraints: meeting market demand, minimizing production costs and minimizing the failure to achieve the specified profit target. The formulation for each constraint is as follows:

- a) Constraint Maximizing production volume. The objective was to maximize the production volume. The constraint function of the model is:

$$X_1 + d_1^- - d_1^+ = a_1k$$

$$X_2 + d_2^- - d_2^+ = a_2k$$

$$X_3 + d_3^- - d_3^+ = a_3k$$

$$X_4 + d_4^- - d_4^+ = a_4k$$

$$X_5 + d_5^- - d_5^+ = a_5k$$

$$X_6 + d_6^- - d_6^+ = a_6k$$

The objective function is

$$\text{Min } Z = P_1 \sum_{i=1}^6 (d_i^- + d_i^+)$$

- b) Minimizing production costs.

The aim is to minimize the costs used during production, so what is minimized is the positive or excessive deviation value. The constraint function of the model is formulated as follows:

$$250X_1 + 280X_2 + 250X_3 + 300X_4 + 290X_5 + 320X_6 + d_7^- - d_7^+ = b_k$$

The objective function is:

$$\text{Min } Z = d_7^+$$

- c) Maximizing the profit target from sales

Sultan Meritah Bakery aims to obtain maximum profit so that the profit target below the target or negative deviation value will be minimized which can be formulated as follows:

$$550X_1 + 520X_2 + 540X_3 + 500X_4 + 510X_5 + 480X_6 + d_8^- - d_8^+ = c_k$$

The objective function is:

$$\text{Min } Z = d_8^-$$

3. Priority Determination

Priority Determination is divided into three, the objectives of this study are to meet three constraints: sales volume to meet market demand, reduce production costs, and maximize total profit to meet these constraints. This problem can be solved using priority scale groups. The programming objectives were applied in the following order:

Priority 1

The amount of bread production expected to meet the target

Priority 2

Production costs incurred each month do not exceed the production limit

Priority 3

The total profit each month is expected to reach the existing limits

4. Objective Function of the Model

Based on the constraint function and determination of the priority scale, the objective function of the goal programming model of the problem above is to use pre-emptive goal programming, namely by using the equation. The objective function that can be applied to planning optimization is as follows:

$$\text{Min } Z = P_1 \sum_{i=1}^6 (d_i^- + d_i^+) + P_{2d7+} + P_{3d8-}$$

D. Model Analysis

Based on the results of the data analysis carried out using Microsoft Excel, ideal solution results were obtained. The optimal value can be calculated by calculating the deviation or deviation variables from the previous target, namely the limits of production volume, production costs, and profits, at+ or at-. The deviation values between the target limits from January to December 2024 were as follows.

Table 8. Deviation Between Production Target and Optimal Solution

No	Months	Production Quantity			
		Target	di-	di+	Optimal Solution
1	January	9661	0	0	7,952
2	February	9778	0	0	8008
3	March	9886	0	0	8060
4	April	10002	0	0	8115
5	May	10114	0	0	8169
6	June	10231	0	0	8225
7	July	10343	0	0	8279
8	August	10459	0	0	8336
9	September	10575	0	0	8391
10	October	10687	0	0	8444
11	November	10803	0	0	8500
12	December	10916	0	0	8553
Total		12,3455			99,032

Table 9. Deviation Between Cost Constraints and Optimal Solution

No	Months	Production Cost (Rupiah)			
		Target	di-	di+	Optimal Solution
1	January	7.729.158	0	0	2.206.840
2	February	7.822.011	0	0	2.222.820

3	March	7.908.874	0	0	2.237.630
4	April	8.001.727	0	0	2.253.350
5	May	8.091.584	0	0	2.268.740
6	June	8.184.437	0	0	2.284.720
7	July	8.274.295	0	0	2.300.110
8	August	8.367.148	0	0	2.316.370
9	September	8.460.001	0	0	2.332.050
10	October	8.549.858	0	0	2.347.180
11	November	8.642.711	0	0	2.363.160
12	December	8.732.569	0	0	2.378.260
Total		98.764.373			27.511.230

Table 10. Deviation Between Profit and Optimal Solution

No	Months	Profit			Optimal Solution
		Target	di-	di+	
1	January	7.729.158	0	0	4.154.760
2	February	7.822.011	0	0	4.183.580
3	March	7.908.874	0	0	4.210.370
4	April	8.001.727	0	0	4.238.650
5	May	8.091.584	0	0	4.266.460
6	June	8.184.437	0	0	4.295.280
7	July	8.274.295	0	0	4.323.090
8	August	8.367.148	0	0	4.352.430
9	September	8.460.001	0	0	4.380.750
10	October	8.549.858	0	0	4.408.020
11	November	8.642.711	0	0	4.436.840
12	December	8.732.569	0	0	4.464.140
Total		98.764.373			51.714.370

The goal programming method helps determine the optimal solution for the deviation value or goal deviation. The value at-G0 indicates that the target is still lacking and can be added again to be optimal using the deviation value. The value at+G0 indicates that the target is in excess and can still be reduced. This ensures that the resulting solution is optimal and does not harm the decision maker.

Model analysis was performed to determine whether the created model was optimal. This was performed based on the calculation results described above. The value for each month is at-, at+ = 0 (i = 1,2,3,4,5,6) as shown in the calculation results. As a result of the zero deviation value indicating that there is no excess or shortage in the number of products, Sultan Meriah Bakery will be able to meet the market demand in 2024.

The calculation shows that $d7+ = 0$ every month, which means that the goal of minimizing production costs above the target is achieved. Thus, the company will not experience excess

production costs that have been targeted for one year, which is IDR 98,764,373, -. In addition, the analysis results show that the value of $d8^- = 0$ means that the goal of minimizing profits below the previously set target is achieved. In addition, the achievement of the three objectives of Sultan Meriah Bakery shows that the application of priority scale order in the objective function is effective.

Then the model:

$$\text{Min } Z = P_1 \sum_{i=1}^6 (d_i^- + d_i^+) + P_{2d7+} + P_{3d8-}$$

is the right production planning optimization model to obtain optimal solutions that can be applied to the Sultan Meriah Bakery.

Conclusion

The previous analysis and discussion leads to the conclusion that three key constraints guide production planning: monthly sales volume to meet market demand and annual production costs not exceeding Rp. 27,511,230, -, and a profit goal of Rp. 98,764,373, -. These objective constraints are considered when formulating the production plan. These constraints form the foundation for the development of an effective and efficient production strategy. By carefully balancing sales targets, cost limitations, and profit objectives, a company can optimize its resource allocation and operational decisions. The resulting production plan aims to maximize output while remaining within the defined financial parameters, ensuring sustainable growth and profitability. This comprehensive approach to production planning allows for a more nuanced understanding of a company's capabilities and limitations. By incorporating these constraints into the decision-making process, managers can make more informed choices regarding resource allocation, production schedules, and inventory management. Furthermore, this method enables the organization to adapt quickly to changing market conditions and customer demands while maintaining a competitive edge in the industry.

References

- [1] Aday, S. & Aday, M. S. (2020). Impact of COVID-19 on the food supply chain. *Food quality and safety*, 4(4), 167-180. <https://doi.org/10.1093/fqsafe/fyaa024>
- [2] Aljohani, K. (2023). Optimizing the distribution network of a bakery facility: a reduced travelled distance and food-waste minimization perspective. *Sustainability*, 15(4), 3654. <https://doi.org/10.3390/su15043654>
- [3] Cappelli, A. & Cini, E. (2021). Challenges and opportunities in wheat flour, pasta, bread, and bakery product production chains: A systematic review of innovations and improvement strategies to increase sustainability, productivity, and product quality. *Sustainability*, 13(5), 2608. <https://doi.org/10.3390/su13052608>
- [4] Goryńska-Goldmann, E., Gazdecki, M., & Rejman..., K. (2020). How to prevent bread losses in the baking and confectionery industry?—measurement, causes, management and prevention. *Agriculture*, 11(1), 19. <https://doi.org/10.3390/agriculture11010019>
- [5] Hannan, M. A., Lipu, M. H., Akhtar, M., Begum, R. A., Al Mamun, M. A., Hussain, A., ... & Basri, H. (2020). Solid waste collection optimization objectives, constraints, modeling approaches, and their challenges toward achieving sustainable development

- goals. *Journal of cleaner production*, 277, 123557. <https://doi.org/10.1016/j.jclepro.2020.123557>
- [6] Jia, R., Liu, Y., & Bai, X. (2020). Sustainable supplier selection and order allocation: Distributionally robust goal programming model and tractable approximation. *Computers & Industrial Engineering*. <https://doi.org/10.1016/j.cie.2020.106267>
- [7] Karasu, S., Altan, A., Bekiros, S., & Ahmad, W. (2020). A new forecasting model with wrapper-based feature selection approach using multi-objective optimization technique for chaotic crude oil time series. *Energy*, 212, Article 118750. <https://doi.org/10.1016/j.energy.2020.118750>
- [8] Mardar, M., Solonytska, I., & Pambuk, S. (2022). Development of a new kind of bread produced by the deferred baking technology on the basis of modern methods of quality management. *Food Science & Technology (2073-8684)*, 16(2). <https://doi.org/10.15673/fst.v16i2.2355>
- [10] Purba, W. T. P., Br Sinaga, J. A., & Sianturi, R. (2024). Model Optimasi Goal Programming Pada Perencanaan Produksi Roti. *Jurnal Indragiri Penelitian Multidisiplin*, 4(3), 71–77. Retrieved from <https://ejournal.indrainstitute.id/index.php/jipm/article/view/1066>
- [11] Rony, Z. T., Wijaya, I. M. S., Nababan, D., Julyanthry, J., Silalahi, M., Ganiem, L. M., Judijanto, L., Herman, H., and Saputra, N. (2024). Analyzing the Impact of Human Resources Competence and Work Motivation on Employee Performance: A Statistical Perspective. *Journal of Statistics Applications & Probability*, 13(2), 787-793. DOI: 10.18576/jsap/130216
- [12] Rozi, F., Santoso, A. B., Mahendri, I. G. A. P., Hutapea, R. T. P., Wamaer, D., Siagian, V., ... & Syam, A. (2023). Indonesian market demand patterns for food commodity sources of carbohydrates in facing the global food crisis. *Heliyon*, 9(6), e16809. <https://doi.org/10.1016/j.heliyon.2023.e16809>
- [13] Sazvar, Z., Tafakkori, K., Oladzaad, N., & Nayeri, S. (2021). A capacity planning approach for sustainable-resilient supply chain network design under uncertainty: A case study of vaccine supply chain. *Computers & industrial engineering*, 159, 107406. <https://doi.org/10.1016/j.cie.2021.107406>
- [14] Subiria-Cueto, R., Reyes-Blas, H., Olivas-Armendáriz, I., Wall-Medrano, A., González-Aguilar, G. A., de la Rosa, L. A., ... & Alvarez-Parrilla, E. (2025). Grape pomace and pecan shell fortified bread: The effect of dietary fiber-phenolic compounds interaction on the in vitro accessibility of phenolic compounds and in vitro glycemic index. *Food Chemistry*, 462, 140925. <https://doi.org/10.1016/j.foodchem.2024.140925>
- [15] Thirunavukkarasu, G. S., Seyedmahmoudian, M., Jamei, E., Horan, B., Mekhilef, S., & Stojcevski, A. (2022). Role of optimization techniques in microgrid energy management systems—A review. *Energy Strategy Reviews*, 43, 100899. <https://doi.org/10.1016/j.esr.2022.100899>
- [16] Tirkolaei, E. B., Abbasian, P., & Weber, G. W. (2021). Sustainable fuzzy multi-trip location-routing problem for medical waste management during the COVID-19 outbreak. *Science of the Total Environment*, 20;756:143607. doi: 10.1016/j.scitotenv.2020.143607
- [17] Virginio, C. D., Garcia, C., Cruz, A., Galon, A., Hizon, J. S., Garcia-Vigonte, F., & Malang, B. (2022). *Overcoming Challenges in the Quality Service and Production of a*

- Bakery Business: A Literature Review.* Available at SSRN: <https://ssrn.com/abstract=4031633> or <http://dx.doi.org/10.2139/ssrn.4031633>
- [18] Yadav, V. S., Singh, A. R., Gunasekaran, A., Raut, R. D., & Narkhede, B. E. (2022). A systematic literature review of the agro-food supply chain: Challenges, network design, and performance measurement perspectives. *Sustainable Production and Consumption*, 29, 685-704. <https://doi.org/10.1016/j.spc.2021.11.019>
- [19] Yousefi-Babadi, A., Bozorgi-Amiri, A., Tavakkoli-Moghaddam, R., & Govindan, K. (2023). Redesign of the sustainable wheat-flour-bread supply chain network under uncertainty: An improved robust optimization. *Transportation Research Part E: Logistics and Transportation Review*, 176, 103215. <https://doi.org/10.1016/j.tre.2023.103215>
- [20] Zinina, O. V., Dalisova, N. A., & Olentsova, J. A. (2020). Dynamics and structure of manufacturing bread and bakery products in the Krasnoyarsk region. *IOP Conference Series: Earth and Environmental Science (Vol. 548, No. 2, p. 022028)*. <https://doi.org/10.1088/1755-1315/548/2/022028>