Optimization Of Chicken Feed Production Using Goal Programming Method At Pt. Japfa Comfeed Indonesia Tbk Unit Makassar

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ABSTRACT
PT Japfa Comfeed Indonesia Tbk is one of the largest and most integrated agri-food companies in Indonesia. The company’s main business units are the manufacture of animal feed, chicken breeding, poultry processing, and agricultural cultivation. This company will automatically continue to increase its production results both in terms of quantity and in terms of quality to be able to compete in the market so that it can expand market share and offer products at affordable costs for consumers. At present, business progress is strongly influenced by fluctuations and variations in consumer demand. This also has an impact on the production of chicken feed carried out by PT Japfa Comfeed Indonesia Tbk Makassar unit. With the increasing demand for chicken feed, an effort is needed so that the production process runs according to available and profitable resources. This research aims to determine the optimal amount of production to generate optimal company profits. The method used in this study is the goal programming method because it can solve problems optimally with more than one goal. The results of this research show that the product of goal programming optimization is more profitable than the companies. The results obtained from this research are the optimal number of products is 4,967,155 kg, and the minimum production cost is Rp. 1,382,685,942,075, and the sales profit is Rp. 314,569,267,925 for a period of one year.

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1. INTRODUCTION
PT Japfa Comfeed Indonesia Tbk is one of the largest and most integrated agri-food companies in Indonesia. The company's main business units are the manufacture of animal feed, chicken breeding, poultry processing, and agricultural cultivation. This company will automatically continue to increase its production results both in terms of quantity and in terms of quality to be able to compete in the market so that it can expand market share and offer products at affordable costs for consumers[1][2]. At present, business progress is strongly influenced by fluctuations and variations in consumer demand. This has an impact on the production of poultry feed by PT Japfa Comfeed Indonesia Tbk Makassar unit. With the increasing demand for chicken feed, an effort is needed so that the production process runs according to available resources and is profitable[3][4].

Production is the end result of a process of economic activity that utilizes several inputs. Production activities are defined as activities in producing output by using certain production techniques to process or process inputs in such a way. Production activities are defined as activities in producing output using certain production techniques to process or process input in such a way[5][6].

Production is the process of making raw materials into finished materials that have a selling value and can be used in everyday life by consumers. With the development of the era and the rapid development of science, there are more and more products sold in the market, so every company must think about production planning carefully. Production is a method or technical method of how resources (labor, machines, and funds) are empowered to create or increase the use of an object so that it can meet human needs [7][8].

Planning is one of the main functions of the production management of a company. Production management is work related to the creation of goods and services through converting inputs (factors of production) into outputs or production results [9].

Production planning (production planning) is planning what and how many products will be produced by the company in one period to come. In production planning, companies not only pay attention to consumer demand but also need to pay attention to three elements, namely consumers, products, and manufacturing processes [10][11].

The purpose of production planning is a plan that aims to minimize risks that will occur in the future. Including minimizing various costs that are considered inefficient that may arise during the work process, a plan must be based on the targets or priorities to be built, a well-conceived and properly executed plan can give confidence to the company, and good planning can give strength to events that occur [12][13].

According to Y. A Titilias, production optimization is a way to plan or regulate the use of company resources such as raw materials, labor, working capital, and production facilities to meet consumer demand, optimize existing raw materials and so that the production process can run smoothly, effective and efficient. Optimizing production can be done by improving the quality of production, optimizing resources, or making production plans [14][15].

In solving optimization there are several methods to solve it, including linear programming and goal programming methods. Linear Programming is a mathematical method of allocating limited resources to achieve a goal such as maximizing profits and minimizing costs [6]. Goal programming or (target program) is a decision-making problem in a settlement technique that involves more than one objective/objective function, by solving the problem to minimize it so that it gets the optimum solution [16].

2. RESEARCH METHODS
2.1 Time and Place of Research.
This research will be conducted at PT. Japfa Comfed Indonesia Tbk Makassar Unit on Jl. Prof. Dr. Ir Sutami No. KM. 17, Pai, Kec. Biringkaaya, Makassar City, South Sulawesi which will be carried out for approximately one month.

2.2 Data Collection.
2.2.1 Primary Data
Primary Data is the data obtained by conducting interviews with the company related to information on production process data, sales data, and sales price data in 2021.

2.2.2 Secondary Data
Secondary data is obtained through literature studies, reports related to the object of research, and documentation.

2.3 Data Processing
Data processing carried out in this study is
as follows:
1. Collecting production planning data
At this stage, the initial steps to be taken are to collect production demand data, production cost data, sales data, and sales price data in 2021.
2. Make a demand forecast.
After collecting data, sales forecasting is carried out for the following year.
3. Formulation of goal programming method.
Formulation of the goal programming model is a problem that will be solved to determine the optimal product combination. Thus, the steps to be taken in the completion of goal programming are as follows.
   a. Determining the decision variable
   b. Define target constraints
   c. Determine the objective function
4. Solve goal programming problems using the simplex algorithm method.
In solving goal programming problems, there are several steps that must be taken, namely.
   a. Changing the objective function and constraints
   b. Arrange the equations in the table
   c. Select key column
   d. Select key row
   e. Changing key row values
   f. Changing row values other than the row key
   g. Continuing improvements or changes

3. RESULTS AND DISCUSSION
3.1 Data on sales of poultry feed in 2021
Data on sales of poultry feed in 2021 in January – December 2021.

Table 1. Production sales data for the year 2021

| No | Month    | PB I  | PB II | Amount    |
|----|----------|-------|-------|-----------|
| 1  | January  | 221.804 | 181.530 | 403.334  |
| 2  | February | 218.768 | 181.710 | 400.478  |
| 3  | March    | 224.730 | 186.876 | 411.606  |
| 4  | April    | 226.446 | 185.220 | 411.666  |
| 5  | May      | 219.247 | 178.020 | 397.267  |
| 6  | June     | 227.370 | 183.204 | 410.574  |
| 7  | July     | 229.350 | 187.884 | 417.234  |
| 8  | August   | 228.380 | 189.485 | 417.865  |
| 9  | September| 228.162 | 186.300 | 414.462  |
| 10 | October  | 230.890 | 188.892 | 419.782  |
| 11 | November | 219.536 | 179.010 | 398.546  |
| 12 | December | 224.224 | 180.792 | 405.016  |

Amount 2,698,907,237.720 4,907.83

Source: 2022 secondary data

3.2 Production quantity data
Table 2. Data on the amount of production

| No | Month      | PB I  | PB II | Amount   |
|----|------------|-------|-------|----------|
| 1  | January    | 222.800 | 182.900 | 405.700  |
| 2  | February   | 220.987 | 183.000 | 403.987  |
| 3  | March      | 225.700 | 187.942 | 413.642  |
| 4  | April      | 227.964 | 186.577 | 414.541  |
| 5  | May        | 220.259 | 179.756 | 400.015  |
| 6  | June       | 228.912 | 184.200 | 413.112  |
| 7  | July       | 230.549 | 188.569 | 419.118  |
| 8  | August     | 229.764 | 190.789 | 420.553  |
| 9  | September  | 229.876 | 187.521 | 417.397  |
| 10 | October    | 231.098 | 189.670 | 420.768  |
| 11 | November   | 220.765 | 180.000 | 400.765  |
| 12 | December   | 225.653 | 181.340 | 406.993  |

Amount 2,714.32 2,222.264 4,936.59

Source: 2022 secondary data

3.3 Raw material data
Table 3. Raw material data

| No | Bahan Baku | Jenis Produk |
|----|------------|--------------|
| PB I | IB | PB II |
| 1  | Corn      | 30 | 25 |
| 2  | bran      | 7  | 3.5 |
| 3  | Gaplek Flour | 1 | 2.5 |
| 4  | Fish flour | 7  | 1.5 |
| 5  | Blood Flour | 1.5 | 1.5 |
| 6  | Soya bean | 3.5 | 4.5 |
| 7  | Coconut Meal | 2.5 | 2.5 |
| 8  | Papaya Leaf Flour | 1 | 1.25 |
| 9  | Kapok Seed Meal | 0.5 | 0.25 |
| 10 | Poultry Feather Flour | 2 | 1.25 |
| 11 | premix    | 0.25 | 0.25 |
| 12 | Sorghum   | 5  | 0.5 |
| 13 | Coconut oil | 0.5 | 0.5 |

Source: 2022 secondary data

3.4 Data on cost of production
Table 4. Data on the cost of production

| No | Raw Material | Bank Interest | Marketing Cost | Cost | Amount |
|----|--------------|---------------|----------------|------|--------|
| PB I | PB II |
| 1  | 246.000 | 11.070 | 3.690 | 3.690 | 264.450 |
| 2  | 275.000 | 12.375 | 4.125 | 4.125 | 295.625 |

Source: 2022 secondary data

3.5 Selling price data
Table 5. Sales price data

| No | Produk   |
|----|----------|
| PB I | PB II |
| 1 | Rp 335,000 | Rp 350,000 |
3.6 Forecasting

Graph 1. Graph of Total Sales of Chicken Feed in 2021

Based on the data pattern above, it shows that the graph is in a horizontal or stationary pattern. Then the processing of data requests using the method of the single moving average, single exponential smoothing, and additive decomposition.

Table 6. Forecasting results for each type of product in 2022

| Month     | PB I | PB II | Amount |
|-----------|------|-------|--------|
| January   | 226.108 | 183.644 | 409.752 |
| February  | 228.671 | 185.316 | 413.987 |
| March     | 226.817 | 183.760 | 410.577 |
| April     | 229.379 | 185.431 | 414.810 |
| May       | 227.526 | 183.875 | 411.401 |
| June      | 230.088 | 185.546 | 415.634 |
| July      | 228.234 | 183.990 | 412.224 |
| August    | 230.797 | 185.662 | 416.459 |
| September | 228.943 | 184.105 | 413.048 |
| October   | 231.506 | 185.777 | 417.283 |
| November  | 229.652 | 184.221 | 413.873 |
| December  | 232.215 | 185.892 | 418.107 |
| Amount    | 2,749.9 | 2,217.219 | 4,967.155 |

Source: 2022 data processing

Table 7. Target Limits for Each Type of Chicken Feed Products

| Month     | PB I   | PB II   | Amount          |
|-----------|--------|---------|-----------------|
| January   | 59,794.260.600 | 54,269.757.500 | 114,084,018.100 |
| February  | 60,472.045.950 | 54,784.042.500 | 115,256,088.450 |
| March     | 59,981.755.650 | 54,324.050.000 | 114,305,805.650 |
| April     | 60,659.276.550 | 54,818.039.375 | 115,477,315.925 |
| May       | 60,169.250.700 | 54,358.046.875 | 114,527,297.575 |
| June      | 60,846.771.600 | 54,852.036.250 | 115,698,807.850 |
| July      | 60,356.481.300 | 54,392.043.750 | 114,748,525.050 |
| August    | 61,034.266.650 | 54,886.328.750 | 115,920,595.400 |
| September | 60,543.976.350 | 54,426.040.625 | 114,970,016.975 |

Source: 2022 data processing

Table 8. Benefits of Each Type of Product

| Product Type Advantage | x1 | x2 |
|------------------------|----|----|
| x1                     | 70.550 |
| x2                     | 54.375 |

Source: 2022 data processing

The advantages of each type of product are obtained from the selling price of each type of product multiplied by the target number of products per month.

Table 9. Sales Profit Target

| Month  | PB I | PB II | Amount          |
|--------|------|-------|-----------------|
| January | 15,951,919.400 | 9,985,642.500 | 23,937,561.900 |
| February | 16,132,739.050 | 10,076,557.500 | 26,209,296.550 |
| March   | 16,001,939.350 | 9,991,950.000 | 25,993,889.350 |
| April   | 16,182,688.450 | 10,082,810.625 | 26,265,499.075 |
| May     | 16,051,959.300 | 9,998,203.125 | 26,050,162.425 |
| June    | 16,232,708.400 | 10,089,063.750 | 26,321,772.150 |
| July    | 16,101,908.700 | 10,004,456.250 | 26,106,364.950 |
| August  | 16,282,728.350 | 10,095,371.250 | 26,378,099.600 |
| September | 16,151,928.650 | 10,010,709.375 | 26,162,638.025 |
| October | 16,332,748.300 | 10,101,624.375 | 26,434,372.675 |
| November | 16,201,948.600 | 10,017,016.875 | 26,218,965.475 |
| December | 16,382,768.250 | 10,107,877.500 | 26,490,645.750 |
| Amount  | 194,007,984.800 | 120,561,283.125 | 314,569,267.925 |

Source: 2022 data processing

The profit target from the sale of animal feed is obtained from the product of the forecast for the amount of production per month with the profit per sack of chicken fodder.

3.7 Model formulation

1. Determine the objective function

\[ \min Z = P_1 \sum (d_i^+ + d_i^-) + P_2 d_1^+ + P_3 d_4 \]

2. Define the limiting function

a. Limiting target market demand

\[ X_1 + d_1^+ - d_1^- = 2,749.936 \]

\[ X_2 + d_2^+ - d_2^- = 2,217.219 \]

b. Production cost limiter

\[ 264.450 X_1 + 295.625 X_2 + d_3^- - d_3^+ = 1,382,685.942.075 \]
c. Sales profit limiter
    \[70.550X1 + 54.375X2 + d4 - d4^+ = 314.569.267.925\]

### 3.8 Model completion

After formulating the production problem into a goal programming model, the next step is to solve the model using the simplex algorithm.

**Table 10. Simplex iteration 1**

| G   | Basis    | Basis | Basis | Quantity | Ratio |
|-----|----------|-------|-------|----------|-------|
| 0   | X2       | 2,360,950 | 0     | 1        | 2,24  |
| 0   | X2       | 2,360,950 | 0     | 1        | 2,24  |
| 0   | X2       | 2,360,950 | 0     | 1        | 2,24  |
| 0   | X2       | 2,360,950 | 0     | 1        | 2,24  |

Source: 2022 data processing

In table 4.12, the results for S1 quantity are 4,967,155 with a ratio of 2.24, S2 is 1,382,685,942,075 with a ratio of 2.11, and S3 is 314,569,925 with a ratio of 2.61.

**Table 11. Simplex iteration 2**

| G   | Basis    | Basis | Basis | Quantity | Ratio |
|-----|----------|-------|-------|----------|-------|
| 0   | X2       | 3,12,741 | 0     | 1        | 2,1095 |
| 0   | X2       | 3,12,741 | 0     | 1        | 2,1095 |
| 1   | X2       | 3,12,741 | 0     | 1        | 2,1095 |
| 1   | X2       | 3,12,741 | 0     | 1        | 2,1095 |

Source: 2022 data processing

In table 4.13, the optimal solution for X1 is 289,993 and X2 is 21,095.

**Table 12. Simplex iteration 3**

| G   | Basis    | Basis | Basis | Quantity | Ratio |
|-----|----------|-------|-------|----------|-------|
| 0   | X2       | 3,12,741 | 0     | 1        | 2,1095 |
| 0   | X2       | 3,12,741 | 0     | 1        | 2,1095 |
| 0   | X2       | 3,12,741 | 0     | 1        | 2,1095 |

Source: 2022 data processing

In table 4.23, the optimal solution is obtained because the entire value of Cj-Zj = 0. Thus, the profit to be obtained in the sale of chicken feed is 709,292.

### 4. CONCLUSIONS

After processing and analyzing the production of poultry feed, it can be concluded that the optimal amount of product is 4,967,155 kg, and the minimum production cost is Rp. 1,382,685,942,075, and the sales profit is Rp. 314,569,267,925 for the period of one year. The results of production planning using the goal programming method get a maximum profit of 709,292.

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