CHAPTER IX
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STRATEGIC PLANNING FOR AGROPROCESSING INDUSTRIES: A CASE STUDY FOR FLOUR MILL

9.1 INTRODUCTION

Most of the work carried out on perishable commodity does not reflect the situation in which the value added product is constituted from the perishable nature of the commodity. Normally this kind of situation is prevailing in some of the agroprocessing industries. In such case, the value added product has the fixed life time and its raw commodity has negligible rate of perishability.

Thus for such agroprocessing units, processing has to be done as per the existing requirement or else it leads to the loss that is equivalent to the cost of perished units (in case of higher production rate only). To manage such situation, the entrepreneur has to process the limited quantity of agricultural crop which is less than the actual demand. This does not curtail profit only but also generates artificial shortage of the value added product.

To understand such kind of situation, consider the case of a flour mill unit. The flour mill unit consumes grain as a raw commodity to make value added product which is recognised as
Atta. Atta, the value added product has fixed life time which is generally represented in terms of a week (and for some of the cases in days also) whereas the life time for the raw commodity is generally represented in terms of months (and for some of the cases in years also).

Thus in such kind of situation, the value added product has very little life time as compared to the raw commodity. This situation highlights the need for the determination of processing quantity or production rate of the production unit.

In this chapter, with the help of simulation technique, an attempt is made to determine the reproduction level as well as the maximum stock level considering probabilistic nature of demand for the value added product.

This approach might be useful to the decision makers who are associated with the strategic planning for the production process of such kind of agroprocessing industries.
9.2 ASSUMPTIONS

The assumptions made for the strategic planning of the production process are as under:

1. Demand is probabilistic in nature.
2. Shortages are allowed to occur with backorder policy approach.
3. The value added units which are produced in the earlier week (before 7 days) are considered as the disposed units.
4. Carrying cost of the value added product is given by \( C_1 \) Rs. per unit per day.
5. Shortage cost of the value added product is given by \( C_2 \) Rs. per unit per day.
6. Setup cost for the production run is given by a functional form of the number of units produced viz, \( C_3 = a + b \cdot PU \)
   where PU is the number of units to be produced.
7. At initial stage, there is no stock of the value added product. Due to this reason, the production process starts immediately.
8. Feasible production level is given by FPL and it is assumed to be known.
3 PRODUCTION STRATEGIES

The strategies adopted for the production process are as under:

1. At the most 10 days requirement of the value added product should be stored at a time.

2. Requirement of number of units to be produced must exceed the Feasible Production Level. This condition is known as Production Feasibility Condition.

3. Production process is operated to produce the value added units in multiple of five.

4. The value added product is supplied in multiple of five units.

5. Once the production process starts, it continues till the stock of the value added product attains its maximum level.

6. If production process is required to continue on the next day, then it is treated as single production run only but production process is continued provided it satisfies the Production Feasibility Condition.

7. As soon as the stock of value added product drops to its reproduction level, production process is going to restart.
The following are the notations used in this chapter.

\[ P \] = Purchase price per unit of raw commodity
\[ N \] = Number of production runs
\[ TUP \] = Total number of units produced
\[ THU \] = Total number of holding units
\[ TSU \] = Total number of shortage units
\[ TDU \] = Total number of disposed units
\[ LU \] = Number of left out units on last day
\[ I_1(Q) \] = Expected holding cost
\[ I_2(Q) \] = Expected shortage cost
\[ I_3(Q) \] = Expected production run cost
\[ I_4(Q) \] = Expected loss occurred due to disposed units
\[ TC(Q) \] = Total cost
9.5 PROBLEM FORMULATION AND ITS SOLVING TECHNIQUE

In practice, we find that there are many commodities which are of perishable nature. Such commodities are classified under two categories viz:

(1) Commodities having perishability at natural stage and

(2) Commodities having perishability in its value added stage.

Here the situation is examined for the commodities that fall under the second category viz perishability in their value added stage.

For one flour mill unit, the demand of flour (Wheat atta) is distributed as under.

<table>
<thead>
<tr>
<th>Demand (Kg)</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>500-550</td>
<td>0.10</td>
</tr>
<tr>
<td>555-600</td>
<td>0.18</td>
</tr>
<tr>
<td>605-650</td>
<td>0.20</td>
</tr>
<tr>
<td>655-700</td>
<td>0.15</td>
</tr>
<tr>
<td>705-750</td>
<td>0.12</td>
</tr>
<tr>
<td>755-800</td>
<td>0.10</td>
</tr>
<tr>
<td>805-850</td>
<td>0.08</td>
</tr>
<tr>
<td>855-900</td>
<td>0.04</td>
</tr>
<tr>
<td>905-950</td>
<td>0.02</td>
</tr>
<tr>
<td>955-1000</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The problem for the flour mill unit is to determine the maximum stock level as well as reproduction level which minimises the cost associated with the production process.
The associated parameters for the above flour mill are as under:

\[ a = 750 \text{ Rs. per run} \]
\[ b = 1 \text{ Rs. per unit} \]

Production capacity = 2000 units per day
Feasible production level = 1000 units within a day

\[ C_1 = 0.40 \text{ Rs. per unit per day} \]
\[ C_2 = 0.75 \text{ Rs per unit per day} \]

\[ P = 11 \text{ Rs. purchase price per unit} \]

Simulation technique is utilised to forecast demand for the value added product on the basis of given probability distribution. The monthly production plan (for 25 days) is prepared in such a way that the following results are summarised from the plan.

- Number of production run
- Number of units produced
- Total number of units demanded
- Total number of units supplied
- Total number of left out units
- Number of left out units on last day
- Total number of shortage units
- Total number of disposed units

These results are required to calculate the cost associated with the production process.
9.6 COST FUNCTION

Cost associated with the production process system comprises of the setup cost, expected holding cost, expected shortage cost and expected cost due to the disposed units. In the development of cost function, variable production cost of the number of left out units on the last day is also taken into account.

Thus the cost function $TC(Q)$ is given by the following relationship:

$$TC(Q) = Na + b(TUP) + (THU) C_1 + (TSU) C_2 + (TDU) P$$

$$- (LU) b$$

The above cost function is a real discrete convex function with the maximum stock level and reproduction level as the decision variables.

The strategic planning for the production process of the above flour mill unit and values of associated indicators obtained through simulation technique are given in the following table.
### TABLE 9.6.1

**STRATEGIC PLAN FOR THE PRODUCTION PROCESS AND ITS ASSOCIATED INDICATORS**

<table>
<thead>
<tr>
<th>STRATEGIC PLAN</th>
<th>DEMAND SERIES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Reproduction level</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maximum stock level</td>
<td>2000</td>
<td>1500</td>
<td>2000</td>
</tr>
</tbody>
</table>

#### INDICATORS

<table>
<thead>
<tr>
<th>Indicator</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of production run</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Number of units produced</td>
<td>18000</td>
<td>17025</td>
<td>18000</td>
</tr>
<tr>
<td>Number of unit demanded</td>
<td>17230</td>
<td>16870</td>
<td>17410</td>
</tr>
<tr>
<td>Number of units supplied</td>
<td>17230</td>
<td>16870</td>
<td>17410</td>
</tr>
<tr>
<td>Number of units leftout on last day</td>
<td>770</td>
<td>155</td>
<td>590</td>
</tr>
<tr>
<td>Number of disposed units</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### ASSOCIATED COST (in Rs.)

<table>
<thead>
<tr>
<th>Cost</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production cost</td>
<td>18750</td>
<td>19275</td>
<td>18750</td>
</tr>
<tr>
<td>Inventory holding cost</td>
<td>10514</td>
<td>8380</td>
<td>10960</td>
</tr>
<tr>
<td>Expected shortage cost</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Expected loss occurred due to disposed units</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total cost (in Rs.)</td>
<td>28494</td>
<td>27500</td>
<td>29126</td>
</tr>
</tbody>
</table>
9.7 COMMENTS

The Table 9.6.1 highlights the strategic plan for the production process and associated indicators for three different demand series generated with the help of the simulation technique and the given probability distribution. Simulation technique indicates the possible values of the decision variables which yield nearby value of the optimum of the objective function. Thus it is likely to get different strategic plans for different demand series, but as the number of demand series increases, associated strategic plans give the clear indication of the decision variables which yield better result. Based on strategic planning of the production process, strategic planning for the procurement of raw commodity (agricultural crop) can be made accordingly.

9.8 ON LINE APPLICATION FOR THE STRATEGIC PLANNING

On line application for the Strategic Planning is highly beneficial to the decision makers who are associated with the production process of FAST MOVING ITEMS.

For online application to the production process, the demand function of the value added product is recalculated at a regular interval of time (say one week) and thereafter the whole process is repeated to formulate the Strategic Planning of the production process.
Thus simulation technique provides various alternatives. On the basis of these alternatives, decision makers can choose one of the alternatives which suit them most appropriate one in the prevailing circumstances for the production houses.