

# Optimal Solution for Establishment of Disposal Units Using Goal Programming Model

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**ABSTRACT:** In spite of varieties of expenditures in disposal unit there will be lot of benefits from establishment of disposal unit. In present scenario if we prove the disposal units yield more and more profit for the business, then people may be encouraged for the establishment of many such disposal units. Such disposal units benefit the society by keeping environment clean. Enhancing the profit from the waste disposal units by goal programming model by observing the deviations from the goal is the main aim of the study. Study involves with many goals such as minimizing the expenses of electricity, suppressing the general expenses, enhancing the profit of the unit, decreasing the storage cost, minimizing the missed sales, controlling the transportation cost, boosting the return on sales, minimizing the salary expenses of employees. Formulation of goal programming model and identifying the deviations from the goals and taking corrective measures for the betterment of the unit is the main aim of the study. This helps in achieving the overall profit of the unit. The profit based disposal unit encourages the people to take up the establishment of disposal unit.

**KEYWORDS:** Goal programming, deviation, underachievement, overachievement

## I. INTRODUCTION

Minimizing the air pollution is one of the very important needs in the present situation. Improper disposal of waste is mainly responsible for air pollution. Waste minimization can be done by establishing waste disposal units and involvement of proper methods in the unit. By categorizing the wastes into 3 main categories like wet wastes, dry wastes and medical wastes, selling the waste to vendors of waste management companies with the profit is the main activity of the garbage disposal unit. Vendors of different waste management companies buy the wastes/Recycled material from disposal unit and unit may run with profit. This profit may be increased by our study which involves mathematical technique, namely goal programming.

Goal programming model is developed for establishment of profit based disposal unit. Optimal solution is found using this model. Goals are considered by fixing the targets. Goals considered in this study are discussed in detail. Current study involves different types of wastes are collected from different locations each month

## II. RELATED WORK

In [7] Goal programming model is developed for rubber plantation planning. Solid waste management challenges in cities is explained in [4]. [9] Explains Goal Programming approach for food products distribution. [10] Refers goal programming model for paper recycling system. Formulation of model using goal programming for rubber wood door manufacturing factory explained in [5].

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## IV. GOAL PROGRAMMING MODEL

Goal Programming model is developed for the current problem by considering several goals. Considered goals are as follows

### Goal 1: To control the electricity charges

Electricity expenses of the unit are one of the main expenditures in the disposal unit. Expenses need to control as much as possible. Recycling of wastes need more electricity since machine operations consume lot of electricity.

$$\sum_{j=1}^5 \sum_{t=1}^{12} E_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} E_{ijt} D_{ijt} \leq E_T \quad i \text{ represents the type of waste, } j \text{ represents the 5 different locations,}$$

$t$  represents the months of the year,  $D_{ij}$  represents  $i$ th type of dry waste from  $j$ th locations,

$W_{ij}$  represents wet waste from  $j$ th location in  $t$ th month

$E_T$  Electricity charges target,  $E_{ijt}$  represents electricity charges of  $i$ th waste from  $j$ th location in  $t$ th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 E_{jt} D_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} E_{ijt} D_{ijt} + d_1^- - d_1^+ = E_T$$

### Goal 2: To suppress the general expenses

General expenses include water expenses, maintenance of machines, development charges, stationary expenses etc.

$$\sum_{j=1}^5 \sum_{t=1}^{12} G_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} G_{ijt} D_{ijt} \leq G_T \quad i \text{ represents the type of waste, } j \text{ represents the 5 different locations,}$$

$t$  represents the months of the year,  $D_{ij}$  represents  $i$ th type of dry waste from  $j$ th locations,

$W_{ij}$  represents wet waste from  $j$ th location in  $t$ th month

$G_T$  general expenditure target,  $G_{ijt}$  represents general expenditure of  $i$ th waste from  $j$ th location in  $t$ th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 G_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} G_{ijt} D_{ijt} + d_2^- - d_2^+ = G_T$$

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### Goal 3: To accelerate the profit

Ultimately profit is very essential for every unit. Profit target is fixed to P

$$\sum_{j=1}^5 \sum_{t=1}^{12} P_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} P_{ijt} D_{ijt} \geq P$$

*i* represents the type of waste, *j* represents the 5 different locations, *t* represents the months of the year,  $D_{ij}$  represents *i*th type of dry waste from *j*th locations,  $W_{ij}$  represents wet waste from *j*th location in *t*th month  
*P* is profit target,  $P_{ijt}$  represents general expenditure of *i*th waste from *j*th location in *t*th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 P_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} P_{ijt} D_{ijt} + d_3^- - d_3^+ = P$$

### Goal 4: To decrease the storage cost

Sometimes demand level of by-products produced is less than what we expected. In that case disposal plant need to store the materials produced from recycling. Storage cost of by-products will increase if we don't sell the products in time and some items may spoil. Minimization of storage cost is essential

$$\sum_{j=1}^5 \sum_{t=1}^{12} ST_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} ST_{ijt} D_{ijt} \leq ST$$

*i* represents the type of waste, *j* represents the 5 different locations, *t* represents the months of the year,  $D_{ij}$  represents *i*th type of dry waste from *j*th locations,  $W_{ij}$  represents wet waste from *j*th location in *t*th month  
*ST* is storage cost target,  $ST_{ijt}$  represents storage cost of *i*th waste from *j*th location in *t*th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 ST_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} ST_{ijt} D_{ijt} + d_4^- - d_4^+ = ST$$

### Goal 5: To decrease the missed sales:

100% of recycled material may not be possible in all the time. In that case marketing plan need to be done by the manager and he should fix the target.

$$\sum_{j=1}^5 \sum_{t=1}^{12} M_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} M_{ijt} D_{ijt} \leq M_T$$

*i* represents the type of waste, *j* represents the 5 different locations, *t* represents the months of the year,  $D_{ij}$  represents *i*th type of dry waste from *j*th locations,  $W_{ij}$  represents wet waste from *j*th location in *t*th month  
 $M_T$  is Missed sale target,  $M_{ijt}$  represents missed sales of *i*th waste from *j*th location in *t*th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 M_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} M_{ijt} D_{ijt} + d_5^- - d_5^+ = M_T$$

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### Goal 6: To control the transportation charges

Controlling the transportation charge is very difficult task and it is the main expenditure involved in waste collection. Different types of wastes are collected from different areas and different sections like houses, party halls, hostels, hotels, temples, hospitals, clinics, departments etc

$$\sum_{j=1}^5 \sum_{t=1}^{12} T_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} T_{ijt} D_{ijt} \leq T_T \quad i \text{ represents the type of waste, } j \text{ represents the 5 different locations,}$$

$t$  represents the months of the year,  $D_{ij}$  represents  $i$ th type of dry waste from  $j$ th locations,

$W_{ij}$  represents wet waste from  $j$ th location in  $t$ th month

$T_T$  is Transportation cost target,  $T_{ijt}$  represents transportation cost of  $i$ th waste from  $j$ th location in  $t$ th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 T_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} T_{ijt} D_{ijt} + d_6^- - d_6^+ = T_T$$

### Goal 7: To boost the sales income

Increase in sales income gives more profit to the unit. This can be achieved by selling more and more recycled item. Return on sales of wet, dry and medical wastes are taken into consideration

$$\sum_{j=1}^5 \sum_{t=1}^{12} I_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} I_{ijt} D_{ijt} \geq I_T \quad i \text{ represents the type of waste, } j \text{ represents the 5 different locations,}$$

$t$  represents the months of the year,  $D_{ij}$  represents the type of dry waste from  $j$ th locations,

$W_{ij}$  represents wet waste from  $j$ th location in  $t$ th month

$I_T$  is Sales Income target,  $I_{ijt}$  represents sales income of  $i$ th waste from  $j$ th location in  $t$ th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 I_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} I_{ijt} D_{ijt} + d_7^- - d_7^+ = I_T$$

**Goal 8: To minimize the salary expenses: Salary of the employees of the garbage disposal unit plays a major role in the unit. By minimizing this expenses unit may achieve more profit.**

$$\sum_{j=1}^5 \sum_{t=1}^{12} s_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} s_{ijt} D_{ijt} \leq s_T \quad i \text{ represents the type of waste, } j \text{ represents the 5 different locations,}$$

$t$  represents the months of the year,  $D_{ij}$  represents  $i$ th type of dry waste from  $j$ th locations,

$W_{ij}$  represents wet waste from  $j$ th location in  $t$ th month

$s_T$  is salary expenses target,  $s_{ijt}$  represents salary expenses of  $i$ th waste from  $j$ th location in  $t$ th month of the unit

$$\sum_{i=1}^6 \sum_{j=1}^5 s_{jt} W_{jt} + \sum_{i=1}^6 \sum_{j=1}^5 \sum_{t=1}^{12} s_{ijt} D_{ijt} + d_6^- - d_6^+ = s_T$$

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Priority levels:

Priorities	goals
$P_1$	Profit
$P_2$	Sales Income
$P_3$	Transportation charges
$P_4$	General expenses
$P_5$	Electricity expenses
$P_6$	Salary expenses
$P_7$	Storages cost
$P_8$	Missed sales

Achievement function:  $MinZ = P_1d_3^- + P_2d_7^- + P_3d_6^+ + P_4d_2^+ + P_5d_1^+ + P_6d_8^+ + P_7d_4^+ + P_8d_5^+$

## V. CONCLUSION

Developed general goal programming model may be solved using software's like tora, matlab, excel solver etc. Values of underachievement and overachievement may help the manager to take decision towards the improvement of the unit. The profit based garbage disposal system encourages the other people to take up the business of wastes which helps in keeping the environment clean. The waste management companies take up the work of recycling and selling the products. Deviation values helps in taking up the decisions in the unit.

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