CHAPTER VII
WASTE MANAGEMENT COST, OUTPUT AND PROFITABILITY

7.0 Introduction

The economics of waste management lies in the amount of waste generated and the cost of treating the waste materials. The cost of product loss during production process is self-evident however, the cost for treating the waste lies in its specific characteristics. The cost of waste management has a direct link with the productivity and profitability of the product produced. This chapter attempts to analyse the correlation and regression between the waste management cost, output and profitability of small-scale food processing units in the selected districts of Tamil Nadu.

7.1 Waste Management Cost

Waste management is a multidimensional phenomenon. Therefore, the cost associated with waste management programmes are difficult to estimate as it contains different operations namely in-plant control measures, resource recovery and reuse, waste treatment and disposal. It is recommended that the industries should allot a separate budget for waste management in their concerned industries. The waste management cost is related to the effective reduction, control, and disposal of the waste.

7.1.1 Waste Treatment Cost

The cost of waste treatment can be broadly classified into two types, namely (i) capital cost and (ii) operation and maintenance cost.
7.1.1.X Capital Cost

It is very difficult to generalise about capital cost of waste management, because it depends on many factors, such as size of the unit, type of processing, characteristics of waste, space available for treatment, type of design flow, and type of treatment.

In general capital cost takes into account the investment made on the civil, mechanical, electrical piping and contingencies of a treatment plant.

7.1.1.2 Operation and Maintenance Cost

Operation and maintenance cost includes the cost made on electrical consumption, salaries or wages paid to the staff or labourers, cost of chemicals, and cost of maintenance, repairs and depreciation. The operation and maintenance cost can be drastically reduced if the design avoids the use of chemicals and simplifies in operation. In addition, it should not use too much electricity or machinery. Above all, if the unit adopts automation in operation then labour costs can be reduced.

The above mentioned costs, namely capital cost and operation and maintenance cost occur exclusively for those units, which are using waste treatment technology for treating the waste during the production process in that particular unit.

7.1.2 General Waste Management Cost

The industrial units which are engaged in the processing of food products are incurring general waste management cost, namely utilisation cost and disposal cost. The cost involved in utilisation of waste includes collection, transportation, concentration and further processing of waste. The disposal cost includes collection, transportation and labour cost.
Fig. 7.1. Presents the flow chart of utilisation and disposal cost of waste products in small-scale food processing units.

**Figure 7.1: Flow Chart of Utilisation and Disposal Cost of Waste Products**

The flow chart shows the utilisation and disposal cost of waste product from small-scale food processing units. It is concluded from the flow sheet that, if the utilisation cost "U" after deducting the Revenue "R" is lesser than or equal to the Disposal cost "D", then it is profitable for the industry \((U - R \leq D)\). On the other hand if the disposal cost is lesser than the utilisation cost, it will be uneconomical on the part of the industries to go for further processing of the
waste materials. However, on the environmental front it is advisable for all the small-scale food processing units to undertake waste utilisation options to reduce the impact of disposal of waste on the environment.

7.2 Cost Incurred by the Small-Scale Food Processing Units on Waste Management.

It was found that all the selected small-scale food processing units are assigning a separate amount for waste management and waste disposal. Moreover, the purpose for allocation of budget on waste management differs from one unit to the other.

Table 7.1: Purpose for Allocation of Budget for Waste Management by the Selected Units

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of Industrial Units</th>
<th>Purpose for Waste Management Budget</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Utilisation + Treatment</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Grain Milling</td>
<td>30(60)</td>
<td>50(100)</td>
</tr>
<tr>
<td>2</td>
<td>Fruit and Vegetable Processing</td>
<td>15(30)</td>
<td>50(100)</td>
</tr>
<tr>
<td>3</td>
<td>Milk Processing</td>
<td>22(44)</td>
<td>50(100)</td>
</tr>
<tr>
<td>4</td>
<td>Oil Crashing/Extraction</td>
<td>50(100)</td>
<td>50(100)</td>
</tr>
<tr>
<td>5</td>
<td>Soft Drink (Beverages)</td>
<td>13(26)</td>
<td>50(100)</td>
</tr>
<tr>
<td>6</td>
<td>Bakery and Confectionery</td>
<td>12(24)</td>
<td>50(100)</td>
</tr>
<tr>
<td>7</td>
<td>Meat and Poultry</td>
<td>5(10)</td>
<td>50(100)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>147(42)</strong></td>
<td><strong>350(100)</strong></td>
</tr>
</tbody>
</table>

Source: Primary data collected from the field
Note: Figures within the parentheses denote percentage to total.

Of the selected industrial units, 42 per cent of the units are allocating their budget for the dual purpose namely waste utilisation and waste treatment, whereas majority (58 per cent) of the units are pumping their respective budget towards waste disposal, which includes the collection and transportation of the waste products from the unit premises to the disposal site (Table 7.1).
Apart from the waste management budget, the cost also varies from one unit to other. The waste management cost of the selected small-scale food processing units are presented in Table 7.2.

**Table 7.2: Waste Management and Disposal Cost of the Units**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Type of Industrial Units</th>
<th>Waste Management cost (Rs.in thousands)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;25</td>
<td>26-50</td>
</tr>
<tr>
<td>1</td>
<td>Grain Milling</td>
<td>9 (16)</td>
<td>16 (32)</td>
</tr>
<tr>
<td>2</td>
<td>Fruit and Vegetable Processing</td>
<td>5 (10)</td>
<td>22 (44)</td>
</tr>
<tr>
<td>3</td>
<td>Milk Processing</td>
<td>2 (4)</td>
<td>10 (20)</td>
</tr>
<tr>
<td>4</td>
<td>Oil Crushing/Extraction</td>
<td>2 (4)</td>
<td>18 (36)</td>
</tr>
<tr>
<td>5</td>
<td>Soft Drink (Beverages)</td>
<td>11 (22)</td>
<td>9 (18)</td>
</tr>
<tr>
<td>6</td>
<td>Bakery and Confectionery</td>
<td>9 (18)</td>
<td>17 (34)</td>
</tr>
<tr>
<td>7</td>
<td>Meat and Poultry</td>
<td>3 (6)</td>
<td>22 (44)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>41 (12)</td>
<td>112 (32)</td>
</tr>
</tbody>
</table>

Source: Primary data collected from the field

Note: Figures within the parentheses denote percentage to total.

Table 7.2 points out that all the selected small-scale food processing units are using a certain amount of their budget towards waste management and disposal operations. The waste management cost varies from less than Rs. 25,000 to more than Rs. 1,51,000.
Among the units 32 per cent are spending between Rs.51,000 to Rs.1 lakh. Although the selected food processing units are small in nature however, they also allocate and spend more than Rs.1 lakh to the maximum of Rs.3 lakhs for this purpose. 24 per cent of the units spend between Rs.1.01 lakhs to Rs.1.50 lakhs. A few of the units also spend more than 1.51 lakhs per year on waste management and disposal. Among the units 84 per cent of meat and poultry, 58 per cent of bakery and confectionery, 60 per cent of fruit and vegetable processing, 54 per cent of soft drink (beverage) have spend between Rs.26,000 to Rs. 1 lakh. Thus, the selected units are spending huge amount on waste management and waste disposal.

7.3 Output of the Selected Units

Output is one of the important factors, which determines the growth and performance of any enterprise. Output is governed by many vital factors such as input, appropriate technology, adequacy of management in organising inventory, availability of skilled labour and capital.

The selected small-scale food processing units produce a wide range of products. For instance, the fruit and vegetables processing units are producing pickles, jam, chips and fruit juice. The milk processing units are processing fluid milk, ice cream, butter and ghee, cheese and curd. The bakery and confectionery units were manufacturing bread, biscuits, toffee and sugar coated confectionery. Oil units are producing edible oil whereas the solvent extraction units are extracting oil from rich bran and oil cakes. Rice and dhall (Pulses) are processed by the grain milling units. The meat of goat, sheep and poultry is processed by the meat and poultry units. And soft drink units are producing both synthetic and fruit based beverages.
The quantity of output produced by the selected small-scale food processing units is shown in Table 7.3.

### Table 7.3: Output of the Selected Units

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of Industrial Units</th>
<th>Output in Tonnes/ Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt; 100</td>
<td>101-500</td>
</tr>
<tr>
<td>1</td>
<td>Grains Milling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Fruit and Vegetables processing</td>
<td>25 (50)</td>
<td>25 (50)</td>
</tr>
<tr>
<td>3</td>
<td>Milk processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Oil crushing/Extraction</td>
<td>1 (2)</td>
<td>19 (38)</td>
</tr>
<tr>
<td>5</td>
<td>Soft drink (beverages)</td>
<td>16 (32)</td>
<td>13 (26)</td>
</tr>
<tr>
<td>6</td>
<td>Bakery and Confectionery</td>
<td>40 (80)</td>
<td>10 (20)</td>
</tr>
<tr>
<td>7</td>
<td>Meat and Poultry</td>
<td>23 (46)</td>
<td>27 (54)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>113 (32)</td>
<td>131 (38)</td>
</tr>
</tbody>
</table>

**Source:** Primary data collected from the field

**Note:** Figures within the parentheses denote percentage to total.

The output of selected units varies from one to another. It ranges from less than 100 tonnes to more than 2500 tonnes per year. Highest number (38 per cent) of units falls in the range of 101 to 500 tonnes per year. 50 per cent of fruit and vegetable processing, milk processing and meat and poultry units falls under this category. The grain milling units have produced higher output per year (more than 1500 tonnes per year). Bakery and confectionery units are found producing low compared to other units. As grain milling consumes more input it also produce high output. On the contrary the bakery and confectionery consumes low quantity of raw materials hence lower output. If bakery products are occasionally consumed thd output is also found low.
7.4 Profit of the Selected Units

Profit making is one of the important goals of any commercial enterprise. The profitability is the basis of determining the functional and financial efficiency for any business activity. The profitability of the selected small-scale food processing units is presented in table 7.4.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of Industrial Units</th>
<th>Profit / Year (Rs. in lakhs)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;3</td>
<td>4-6</td>
</tr>
<tr>
<td>1</td>
<td>Grain Milling</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Fruit and Vegetable processing</td>
<td>36</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>Milk processing</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>Oil Crushing/Extraction</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Soft drink (beverages)</td>
<td>28</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>Bakery and Confectionery</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>Meat and Poultry</td>
<td>31</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>160</td>
<td>125</td>
</tr>
</tbody>
</table>

Source: Primary data collected from the field
Note: Figures within the parentheses denote percentages.

The profit earned by the selected units ranges from less than Rs.3 lakhs to more than Rs.10 lakhs per year. Majority (46 per cent) of the units earn less than Rs.3 lakhs per year and another 36 per cent of the units earn a profit of Rs.4 lakhs to Rs.6 lakhs in a year. As the grain mill produces the highest output, the profit earned by this units was also found higher. 40 per cent of these industrial owners earn a profit of 7 to 9 lakhs per year. Similarly the milk
processing (32 per cent) and oil crushing / extraction (28 per cent) earn higher profit (7 to 9 lakhs per year). The fruit and vegetable processing (72 per cent) were the least profit earners among the selected small-scale food processing units.

7.5 Correlation and Regression Analysis

The relationship between the independent variables (output, profit, and the quantity of waste) with the dependent variable (waste management cost) in the selected small-scale units was assessed with the help of the following functions:

\[ WMC = f(qi, \pi, wqi) \]  \hspace{1cm} \text{.....(i)}

Model: \[ Y(WMC) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + U_i \] \hspace{1cm} \text{.....(ii)}

Where,

- WMC = Cost of waste management
- qi = Quantity of output
- \pi = Profit of the industry
- wqi = Quantity of waste
- \beta_0 = intercept or constant term
- \beta_1, \beta_2, \beta_3 = Regression coefficients
- Ui = Random variable

Note: One independent variable has been removed from the above function in order to avoid multicollinearity, since profit and output are closely related.
7.5.1 Correlation and Regression Analysis of all the Selected Small-Scale Food Processing Units

A bivariate correlation between the independent variables (output, profit, and the quantity of waste) shows that a significant positive relationship exists between all the variables as $r = 0.673$, 0.563 and 0.628, $p < 0.05$. As quantity of output with $r = 0.673$ was highly significant among the other two variables correlated, it was excluded. The remaining two variables, namely profit and quantity of waste was further carried out for regression with the dependent variable (waste management cost).

The estimated function was

\[
WMC = 15178.496 + 0.09678 \times \pi i + 0.544 \times wqi
\]

\[
(2371.879) \quad (0.006) \quad (0.043)
\]

\[
t^* = 6.399 \quad 14.890 \quad 12.523
\]

(Calculated Value)

$N = 350$, $R^2 = 0.744$, $\overline{R}^2 = 0.743$, $F = 505.392$

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)

The results from the above function show that 74 per cent of variation in waste management cost is accounted for by variation in profit and quantity of waste of the units. The co-efficient representing the quantity of waste and profit of the selected units, as expected, is positive and significant at 5 per cent level of probability. The value of the co-efficient implies that when quantity of waste increases by one kilogram and the profit increases by one rupee, it would lead
to an increase of 54 paise and around 10 paise respectively on the cost of waste management of the selected units in all categories namely grain milling, fruit and vegetable processing, milk processing, oil crushing / extraction, soft drink, and bakery and confectionery and meat and poultry, other things remaining constant. This result suggests that the impact of the quantity of output and profit on the waste management cost is nominal. The F value of 505.392 explains that the variables are highly significant.

An examination of the t-values indicates that the cost of waste management was highly influenced by the profit of the industries and the quantity of the waste as the t-values are 14.890 and 12.523 respectively.

The normal plot of regression standardised residuals for the dependent variable indicates a relatively normal distribution.
From the scatterplot of residuals against predicted values, it was found that there was no clear relationship between the residuals and the predicted values, consistent with the assumption of linearity.

It is concluded from the result that the impact of the quantity of waste on waste management cost is substantial whereas the impact of profit is nominal for all the units selected for the study.

**7.5.2 Correlation and Regression Analysis for the Selected Grain Milling Units**

A bivariate correlation between output, profit, and the quantity of waste shows that a significant positive relationship exists between the variables as r values are 0.989, 0.999 and 0.989, against the p value 0.05. The profit with r value 0.999 was highly significant, among the variables henceforth, it was removed. The other two variables namely output and quantity of waste was
further subjected to regression with the dependent variable, namely waste
management cost.

The estimated function was

\[ WMC = 1009.472 - 0.00371^* q_i + 0.953^* wqi \]

\[ \begin{array}{ccc}
(373.975) & (0.002) & (0.031) \\
\end{array} \]

t* 2.699 
-1.719 
30.314
(Calculated Value)

N = 50, \ R^2 = 0.999, \ \bar{R}^2 = 0.999, \ F = 19542.179

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)

The function shows that 99 per cent of variation in waste management
cost in grain milling units is accounted by variations in quantity of output and
quantity of waste. Contrary to the expectation, the co-efficient value
representing the quantity of output has turned out be negative, which shows
that it is not significant. On the other hand the value of the co-efficient
denoting quantity of waste indicates that one kilogram increase in waste would
raise cost of waste management by around one rupee. The F value of
19542.179 denotes that the variable (quantity of waste) was highly significant.

An investigation of the t-values also shows the same result, which
implies that waste management cost in grain milling units is highly influenced
by the quantity of waste generated by the units (30.314), whereas the quantity
of output (-1.719) is highly non-significant variable.
Normal P-P Plot of R.S.Residual

Dependent Variable: WMC

A relatively normal distribution was evident from the normal plot of regression standardised residuals for the dependent variable.

Scatterplot

Dependent Variable: WMC

Regression Standardized Predicted Value
It is found from the analysis that no clear relationship exists between the residuals and the predicted values, which is consistent with the assumption of linearity.

The result denotes that the impact of quantity of waste on waste management cost in grain milling units is substantial, whereas the impact of quantity of waste is insignificant.

7.5.3 Correlation and Regression Analysis for the Selected Fruit and Vegetable Processing Units

A bivariate correlation between the input variables (output, profit, and the quantity of waste) indicates that a significant positive relationship exists between the variables as \( r = 0.381, \ 0.980 \) and \( 0.368, \ p < 0.05 \). Among the variables, the profit with \( r = 0.980 \) is highly significant, therefore it is excluded. The output and quantity of waste is further subjected to regression with the waste management cost.

The estimated function was

\[
WMC = 1500.480 + 0.479* q_i + 0.002109* wqi
\]

\[
(753.472) \quad (0.006) \quad (0.012)
\]

\[
t^* = 1.991 \quad 77.808 \quad 0.858
\]

(Calculated Value)

\[
N = 50, \ R^2 = 0.993, \ \bar{R}^2 = 0.993, \ F = 3547.532
\]

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)

The results from the above function show that 99 per cent of the variation in waste management cost of the fruit and vegetable processing units is contributed by the quantity of output and waste. All the variables had the expected theoretical signs. The co-efficient of quantity of output and waste,
turned out to be significant at 5 per cent level of probability. The co-efficient denotes that when quantity of output increases by one kilogram the WMC increases by 48 paise, other things being equal. On the other hand, one kilogram increase in quantity of waste contributes to 0.002 paise to WMC, which turns out to be non-significant, thus not contributing to WMC.

The F value of 3547.532 explains that the variables are highly significant.

An examination of the t-values also indicates that the quantity of output (77.808) highly influences the cost of waste management. On the other hand the t-value of quantity of waste was only 0.858 which denotes that it is non-significant variable.

Normal P-P Plot of R.S.Residual

Dependent Variable: WMC

The normal plot of regression standardised residuals for the dependent variable shows a relatively normal distribution.
The scatterplot of residuals against the predicted values shows that there is no clear relationship between the residuals and the predicted values. Hence, it shows the consistency of the assumption of linearity.

The result indicates that the impact of quantity of output on WMC in fruit and vegetable processing units is substantial whereas the impact of quantity of waste is nominal.

7.5.4 Correlation and Regression Analysis for the Selected Milk Processing Units

A correlation results show that the independent variables (output, profit, and the quantity of waste) are having significant positive relationship with each other as the r values are 0.532, 0.410 and 0.464, which are greater than the p value (0.05). Out of three independent variables, the output with r value of 0.532 was highly significant, hence it was excluded. The remaining variables namely profit and quantity of output was further subjected to regressing with the dependent variable (waste management cost).
The estimated function was

\[ WMC = 1395.154 + 0.132* \bar{z} + 0.728* wqi \]
\[ \text{(8077.952)} \quad \text{(0.014)} \quad \text{(0.235)} \]

\[ t^* \quad 0.173 \quad 9.165 \quad 3.097 \]

(Calculated Value)

\[ N = 50, \ R^2 = 0.765, \ \bar{R}^2 = 0.755, \ F = 76.411 \]

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)

The results from the above function show that, in milk processing units 77 per cent of the variation in waste management cost is contributed by the quantity of output and profit of the units. All the variables had the expected theoretical signs. The co-efficient of the variables have turned out to be significant at five per cent level of probability. The co-efficient denoting the quantity of waste and profit indicates that increase in quantity of waste by one kilogram and profit by one rupee would lead to an increase of around 73 paise and 13 paise respectively in terms of cost of waste management. The F value of 76.411 denotes that the variables are highly significant in milk processing units.

An observation of the t-values also indicates that the cost of waste management is highly influenced by both the quantity of the profit and quantity of waste of the units as the t-value are 9.165 and 3.097 respectively.
The normal plot of regression standardised residuals for the dependent variable also indicates a relatively normal distribution.
The scatterplot of residuals against the predicted values shows that there is no clear relationship between the residuals and the predicted values, which is consistent with the assumption of linearity.

The result shows that the impact of quantity of waste on waste management cost is substantial whereas the impact of quantity of waste is nominal under milk processing units.

7.5.5 Correlation and Regression Analysis for the Selected Oil Crushing / Extraction Units

Correlation carried out among the independent variables namely output, profit and quantity of waste indicates that they enjoy a significant positive relationship with $r$ values of 0.958, 0.966 and 0.924, against the $p$ value of 0.05. The profit with $r$ value of 0.966 is highly significant, among the independent variable, therefore it was omitted. Regression is carried out between output and quantity of waste with the waste management cost.

The estimated function was

$$WMC = -1075.158 + 0.101*qi + 0.518*wqi$$

$$\begin{align*}
(633.788) & \quad (0.002) & \quad (0.021) \\

-1.696 & \quad 41.280 & \quad 24.214
\end{align*}$$

(Calculated Value)

$N = 50$, $R^2 = 0.999$, $\bar{R}^2 = 0.999$, $F = 25424.867$

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)
The above function shows that 99 per cent of variation in waste management cost in oil crushing / extraction units is accounted by variations in quantity of output and quantity of waste. The co-efficient of quantity of output has turned significant at five per cent level of probability. The co-efficient denoting quantity of output indicates that an increase in quantity of output by one kilogram would contribute to 10 paisa increase in waste management cost. On the other hand, the co-efficient of quantity of waste indicates that one kilogram increase in waste would make the waste management cost dearer by around 52 paisa. The F value of 25424.867 explains that the variables are highly significant in oil crushing / extraction units.

An investigation of the t-values indicates that waste management cost in oil crushing / extraction units is highly influenced by the quantity of output (41.280) and quantity of waste (24.214).
The normal plot of regression standardised residuals for the dependent variable also indicates a relatively normal distribution.

The assumption of linearity is established as no clear relationship exists between the residuals and the predicted values, which is seen from the scatter plot.

The result denotes that the impact of quantity of waste on WMC was substantial whereas the impact of quantity of output was nominal in oil crushing / extraction units.

7.5.6 Correlation and Regression Analysis for the Selected Soft Drink (Beverages) Units

The correlation results shows that there exists a significant positive relationship between the independent variables (output, profit, and the quantity of waste) as the \( r = 0.732, 0.840 \) and \( 0.680 \), against the \( p < 0.05 \). The profit with \( r = 0.840 \) was highly significant, hence it was dropped. Further regression was carried out between output and quantity of waste with the waste management cost.
The estimated function was

\[ WMC = 271.323 + 0.02312* qi + 1.121* wqi \]

\[ (3402.753) \quad (0.004) \quad (0.122) \]

\[ t^* \; 0.080 \quad 6.574 \quad 9.174 \]

(Calculated Value)

\[ N = 50, \; R^2 = 0.908, \; \bar{R}^2 = 0.904, \; F = 232.537 \]

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)

The results from the above function shows that 90 per cent of the variation in waste management cost in soft drink (beverages) units is explained by the quantity of output and waste. The co-efficient of quantity of output and waste, turned out to be significant at five per cent level of probability. The increase in output by one kilogram contributes to an increase of 23 paise to waste management cost, other things being equal. On the other hand, the coefficient of quantity of waste indicates that one kilogram increase in waste would make the waste management cost costlier by one rupee. The F value of 232.537 indicates that the variables are highly significant.

An observation of the t-values indicates that the cost of waste management is highly influenced by both quantity of waste (9.174) and quantity of output (6.574).
Normal P-P Plot of R.S. Residual

Dependent Variable: WMC

The relatively normal distribution is seen from the normal plot of regression standardised residuals for the dependent variable.

Scatterplot

Dependent Variable: WMC

Regression Standardized Predicted Value
The scatter plot of residuals against predicted values shows that no clear relationship exists between the residuals and the predicted values, which satisfies the assumption of linearity.

The result denotes that the impact of quantity of waste on waste management cost is substantial whereas the impact of quantity of output is relatively nominal or insignificant under the soft drink (beverages) units.

7.5.7 Correlation and Regression Analysis for the Selected Bakery and Confectionery Units

The correlation carried out between the output, profit, and the quantity of waste shows that a significant positive relationship exists between them as the r values are 0.999, 0.807 and 0.810, against the p value of 0.05. The output with r value 0.999 was the most highly significant variable among the independent variables, thus it was left out. With the remaining independent variables of profit and quantity of waste regression was carried out with the waste management cost.

The estimated function was

\[ WMC = -303.640 + 0.102*\bar{m} + 0.648*wqi \]

\[ t^* = -0.273 \quad 25.747 \quad 4.122 \]

(Calculated Value)

\[ N = 50, \quad R^2 = 0.981, \quad \bar{R}^2 = 0.981, \quad F = 1237.041 \]

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)
The value of $R^2$ shows a good fit of the function. The value of $R^2$ implies that 98 per cent of variation in cost of waste management in bakery and confectionery units is explained by the quality of waste and profit of the units. The co-efficient representing the quantity of waste and profit has a positive sign and it is in conformity with the theoretical expectation. The value of the co-efficient implies that one kilogram increase in quantity of waste contributes around 65 paise to WMC. On the other hand one rupee increase in profit will also increase the WMC by 10 paise. The F value of 1237.041 indicates that the variables are highly significant.

An examination of the t-values indicates that profit of the industry (25.747) has highly influenced the cost of waste management where as the t-value of quantity of waste is (4.122) relatively lower.
Here also the normal plot of regression standardised residuals for the dependent variable indicates a normal distribution.

**Scatterplot**

**Dependent Variable: WMC**

The scatter plot of residuals against the predicted values indicates that there exists an unclear relationship between the residuals and the predicted values, which proves the assumption of linearity.

The result indicates that the impact of quantity of waste on cost of waste management is substantial whereas the impact of profit is nominal under the bakery and confectionery units.

7.5.8 Correlation and Regression Analysis for the Selected Meat and Poultry Units

A correlation results show that all the three independent variables enjoy a significant positive relationship as r values are 0.999, 0.896 and 0.899 against the p value 0.05.
The output with \( r = 0.999 \) was the highly significant variable among the independent variables, therefore it was excluded. The remaining two variables (profit and quantity of waste) were taken for regression with the waste management cost.

The estimated function was

\[
WMC = 1319.365 - 0.00154* xi + 3.979* wqi
\]

\[
\begin{align*}
(1141.684) & \quad (-0.0007) & \quad (1.002)
\end{align*}
\]

\[
t^* 1.156 \quad -0.230 \quad 32.326
\]

(Calculated Value)

\[
N = 50, \quad R^2 = 0.991, \quad R^2 = 0.991, \quad F = 2687.770
\]

* Significant at 5 per cent level of probability.

(Figures in parentheses show standard errors)

The above function shows a good fit. The value of \( R^2 \) implies that 99 per cent of the changes in waste management cost in meat and poultry units is explained by the quantity of waste and profit of the above said units. The value of the coefficient of quantity of waste implies that one kilogram increase in the quantity of waste contributes to around 4 rupees increase in the cost of waste management, other things being the same. On the other hand, the co-efficient of profit hass turned out to be in significant. The F value of 2687.770 shows that the variable (quantity of waste) is highly significant.
An observation of the t-values also indicates that the quantity of waste (32.326) highly influences the cost of waste management under meat and poultry units whereas the t value of profit (-0.230) is insignificant.

A relatively normal distribution is seen from the normal plot of regression standardised residuals for the dependent variable.
No clear relationship exists between the residuals and the predicted values. The scatterplot shows the consistency of the assumption of linearity.

The result denotes that the impact of quantity of waste on waste management cost is substantial whereas the impact of quantity of waste is insignificant under the meat and poultry units.

7.6 Conclusion

The result of the above discussion shows that there exists a positive and significant relationship between the dependent variable (waste management cost) and independent variables (output, profit and quantity of waste) in all the selected small-scale food processing units. The regression results shows that the independent variables (output, profit and quantity of waste) have jointly expressed more than 90 per cent or the variations in waste management cost in fruit and vegetable processing units, meat and poultry units, grain milling units, oil crushing / extraction units, bakery and confectionery units and soft drink (beverages) units and also more than 70 per cent in milk processing units.