CHAPTER 3
RESEARCH METHODOLOGY

The study was planned to collect information and data from various sectors of cotton textile industry starting from cotton to garment and home furnishing. A proper research methodology was formulated in order to execute the issues related to the research and its objectives.

3.1 Research Design

Study was designed to be conducted by collecting both primary and secondary data. Primary data were collected from the opinion of respondents and the secondary data were collected from various reports and journals. The data were collected on quantitative scales.

3.2 Methods and Materials

Various methods were adopted to collect primary and secondary data. The data were collected personally and through field assistants by interaction, interrogation, interviews and mail based on structured questionnaire. In-depth telephonic interview was conducted with various organisations. Some data were generated from primary data.

3.2.1 Secondary Data

The purpose of collecting secondary data is to reveal the growth and trend of cotton textile industry in India and to forecast the future production and marketing of the industry. Data were collected from Cotton Advisory Board, Ministry of Textiles, United Stated Department of Agriculture, Directorate of Cotton Development, Mumbai, National Centre for Integrated Pest Management, New Delhi, India Trade Statistics and India Export Import Statistics, Central Institute of Cotton Research, Ministry of Textile, Office of the Textile Commissioner, GOI, Ministry of Textile, Economic Survey 2011-12, GOI, Monthly Statistics of Foreign Trade, India, DGCI and S, Kolkata, Press Information Bureau, GOI (1993-94 to 1997-98 value of export), Economic and Industrial Publication (1992-93 to 1997-98 quantity of export), National
3.3 Research Hypotheses

In this section, various relationships assumed for carrying out the investigation are presented.

3.3.1 Cotton (A)

$H_{A1}$: With time (year) there is a significant increase in growth rate of cotton area.

$H_{A2}$: With time (year) there is a significant increase in growth rate of cotton production.

$H_{A3}$: With time (year) there is a significant increase in growth rate of cotton productivity.

$H_{A4}$: With time (year) there is a significant increase of cotton consumption.

$H_{A5}$: With time (year) there is a significant increase of cotton export.

$H_{A6}$: Production of cotton has a significant positive relationship with cotton consumption.

$H_{A7}$: Production of cotton has significant positive relationship with cotton export.

$H_{A8}$: With time (year) there is significant increase of cotton production and consumption.

$H_{A9}$: With time (year) there is significant increase of cotton production and its export quantity.

$H_{A10}$: With time (year) there is significant increase of cotton export and its value.

$H_{A11}$: Sample of cotton productivity is the true representative of average productivity of cotton within the states and among group of states in India.

3.3.2 Spinning (B)

$H_{B1}$: With time (year) there is significant increase in cotton yarn production.

$H_{B2}$: With time (year) there is significant increase in cotton and cotton yarn production.

$H_{B3}$: With time (year) there is significant increase in cotton yarn production and consumption.
H₈₄: With time (year) there is significant increase in cotton yarn consumption and its export quantity.

H₈₅: With time (year) there is significant increase in exchange rate and cotton yarn export quantity.

H₈₆: With time (year) there is significant increase in cotton yarn production and its export quantity.

H₈₇: With time (year) there is significant increase in cotton yarn production and its export value.

H₈₈: With time (year) there is significant increase in export quantity of cotton yarn and its export value.

H₈₉: With time (year) there is significant increase in exchange rate and export value of cotton yarn.

H₉₀: Export quantity of cotton yarn has significant positive relationship with cotton yarn production and exchange rate.

H₉₁: Export quantity of cotton yarn has significant positive relationship with cotton yarn consumption and exchange rate.

H₉₂: Export quantity of cotton yarn has significant positive relationship with cotton yarn production and its consumption.

H₉₃: Value of cotton yarn export has significant positive relationship with cotton yarn production and its export quantity.

H₉₄: Value of cotton yarn export has significant positive relationship with export quantity of cotton yarn and exchange rate.

H₉₅: Spinning capacity of cotton yarn has significant positive relationship with its cost and profit.

3.3.3 Weaving (C)

H₉₆: With time (year) there is significant increase in cotton fabric production.

H₉₇: With time (year) there is significant increase in blended fabric production.

H₉₈: With time (year) there is significant increase in others fabric production.

H₉₉: With time (year) there is significant increase in total fabric production.

H₁₀₀: Production of cotton fabric has significant positive relationship with production of blended fabric.

H₁₀₁: Production of cotton fabric has significant positive relationship with production of others fabric.
\( H_{C7} \): Production of cotton fabric has significant positive relationship with production of total fabric.

\( H_{C8} \): Production of blended fabric has significant positive relationship with production of others fabric.

\( H_{C9} \): Production of blended fabric has significant positive relationship with production of total fabric.

\( H_{C10} \): With time (year) there is significant increase in export quantity of cotton woven fabric.

\( H_{C11} \): With time (year) there is significant increase in export value of cotton woven fabric.

\( H_{C12} \): With time (year) there is significant increase in import quantity of cotton woven fabric.

\( H_{C13} \): With time (year) there is significant increase in import value of cotton woven fabric.

\( H_{C14} \): Export quantity of cotton woven fabric has positive relationship with export value.

\( H_{C15} \): Import quantity of cotton woven fabric has positive relationship with import value.

3.3.4 Processing (D)

\( H_{D1} \): There is no significant difference exists for estimated and observed capacity in processing companies.

\( H_{D2} \): There is no significant difference exists for estimated and observed cost in processing companies.

\( H_{D3} \): There is no significant difference exists for estimated and observed price in processing companies.

\( H_{D4} \): There is no significant difference exists for estimated and observed profit in processing companies.

\( H_{D5} \): There is no significant cost difference exists for factor of production between large and small processing companies.

3.3.5 Apparel and Garment (E)

\( H_{E1} \): With time (year) there is significant increase in export quantity of readymade goods.
$H_{E2}$: With time (year) there is significant increase in export value of readymade goods.

$H_{E3}$: Export quantity of readymade goods has significant positive relationship with export value.

$H_{E4}$: With time (year) there is significant increase in export quantity of made-ups.

$H_{E5}$: With time (year) there is significant increase in export value of made-ups.

$H_{E6}$: Export quantity of made-ups has significant positive relationship with export value.

$H_{E7}$: With time (year) there is significant increase in import quantity of readymade goods.

$H_{E8}$: With time (year) there is significant increase in import value of readymade goods.

$H_{E9}$: Import quantity of readymade goods has significant positive relationship with import value.

$H_{E10}$: With time (year) there is significant increase in import quantity of made-ups.

$H_{E11}$: With time (year) there is significant increase in import value of made-ups.

$H_{E12}$: Import quantity of made-ups has significant positive relationship with import value.

3.3.6 Home Furnishing (F)

$H_{F1}$: There is no significant cost and profit difference exists for product varieties within the companies and between the companies in home furnishing.

3.3.7 Value Addition (G)

$H_{G1}$: There is no significant difference exists for productivity, cost of cultivation and profit between Bt and organic cotton.

$H_{G2}$: There is no significant difference exists for profit between Bt and organic cotton.
3.4 Analytical Tools

To fulfill the objectives of study following different statistical tools are used.

3.4.1 Coefficient of Variation

To analyze the instability coefficient of variation has been used by the formula

\[
CV = \frac{\sigma}{\mu} \times 100 \quad \ldots (3.1)
\]

Where CV is the coefficient of variation, \(\sigma\) = standard deviation and \(\mu\) = mean

3.4.2 Compound Growth Rate

To show the growth trend compound growth rate is calculated and shown below. For this purpose, two different models are considered.

Model- I

\[
Z_t = a + bT \quad \ldots (3.2)
\]

Where \(Z_t\) = area, production or productivity, \(a\) = parameter, \(b\) = regression coefficient and \(T\) = time element.

Model- II

\[
X_a = mn^a
\]

\[
\log X_a = \log m + a \log n \quad \ldots (3.3)
\]

\[n = 1 + r/100\]

where \(X_a\) = area, production and productivity, \(a\) = time element, \(m\) = intercept and \(r\) = regression coefficient.

\[
\text{CGR} (r) = (\text{antilog} n - 1) \times 100
\]

where \(n = 1 + r/100\)

3.4.3 t-test for Significance Level

Student’s t test is used to test the significance of the CGR. Test statistics can be calculated by using t-test as:

\[
t = r \sqrt{\frac{n-2}{1-r^2}} \quad \ldots (3.4)
\]

where \((n - 2)\) is the degree of freedom and \(r\) is the correlation coefficient.

3.4.4 Correlation Coefficient

To show the relationship between two variables Karl Pearson’s correlation coefficient is calculated using the formula

\[
r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][\Sigma n\Sigma y^2 - (\Sigma y)^2]}} \quad \ldots (3.5)
\]
where \( n \) = number of pairs of scores, \( \sum xy \) = sum of the products of paired scores, \( \sum x \) = sum of x scores, \( \sum y \) = sum of y scores, \( \sum x^2 \) = sum of squared x scores, \( \sum y^2 \) = sum of squared y scores.

### 3.4.5 Multiple Correlation Coefficient

To show the relationship between the dependent variable and those independent variables multiple correlation has been used. The formula for multiple correlation is denoted by

\[
R_{z, xy} = \sqrt{\frac{r_{zx}^2 + r_{zy}^2 - 2r_{zx}r_{zy}r_{xy}}{1 - r_{xy}^2}} \quad \ldots (3.6)
\]

where \( x \) and \( y \) are independent variable and \( z \) is dependent variable, \( r \) is correlation coefficient.

### 3.4.6 Fisher’s F test for Significance Level

Fisher’s F test is used to test significance level of multiple correlation coefficient. Formula used for F-test is given as below:

\[
F = \frac{R_{z, xy}^2 / k}{(1 - R_{z, xy}^2) / (N - k - 1)} \quad df = k, N - k - 1 \quad \ldots (3.7)
\]

### 3.4.7 Combined Coefficient of Variation

\[
COV_{123} = \frac{\sigma_{123}}{\bar{X}_{123}} \quad \ldots (3.8)
\]

Where \( COV_{123} \) is combined coefficient of variation, \( \sigma_{123} \) is combined standard deviation and \( \bar{X}_{123} \) is combined mean.

### 3.4.8 Z test

It is used to compare the population mean with the sample mean for large sample size

\[
Z = \frac{\bar{X} - \mu_{H_0}}{\sigma_p / \sqrt{n}} \quad \ldots (3.9)
\]

where \( \bar{X} \) = sample mean, \( \mu_{H_0} \) = population mean, \( \sigma_p \) = Standard deviation of population, \( n \) = number of sample size.

### 3.4.9 Return on Investment

To find out return on investment following formula is used

\[
\left( \frac{\text{Price/unit}}{\text{Cost/unit}} \right) \times 100 \quad \ldots (3.10)
\]
3.4.10 Production Utilization

To find out production utilization, formula used is
\[
\frac{\text{Observed capacity}}{\text{Estimated capacity}} \times 100 \quad \ldots (3.11)
\]

3.4.11 Cost Share

To calculate the cost share (%) of production factors the formula is
\[
\frac{\text{Cost of factor of production}}{\text{Total cost for all factor of production}} \times 100 \quad \ldots (3.12)
\]

3.4.12 Coefficient of Determination

To show the relationship between two variables coefficient of determination is calculated using the formula
\[
r^2 = \frac{\{n(\Sigma xy) - (\Sigma x)(\Sigma y)\}^2}{[n\Sigma x^2 - (\Sigma x)^2] \times [n\Sigma y^2 - (\Sigma y)^2]} \quad \ldots (3.13)
\]

where \( n \) = number of pairs of scores, \( \Sigma xy \) = sum of the products of paired scores, \( \Sigma x \) = sum of \( x \) scores, \( \Sigma y \) = sum of \( y \) scores, \( \Sigma x^2 \) = sum of squared \( x \) scores, \( \Sigma y^2 \) = sum of squared \( y \) scores.

3.4.13 Coefficient of Alienation

To show the non-relationship between two variables coefficient of alienation is calculated using the formula
\[
K = 1 - \frac{\{n(\Sigma xy) - (\Sigma x)(\Sigma y)\}^2}{[n\Sigma x^2 - (\Sigma x)^2] \times [n\Sigma y^2 - (\Sigma y)^2]} \quad \ldots (3.14)
\]

where \( n \) = number of pairs of scores, \( \Sigma xy \) = sum of the products of paired scores, \( \Sigma x \) = sum of \( x \) scores, \( \Sigma y \) = sum of \( y \) scores, \( \Sigma x^2 \) = sum of squared \( x \) scores, \( \Sigma y^2 \) = sum of squared \( y \) scores

3.4.14 Net Return

\[\text{N.R} = \frac{\text{Profit}}{\text{Cost}} \times 100 \quad \ldots (3.15)\]

3.4.15 Paired Test

For comparing two related samples involving small values of \( n \) that does not require the variances of two populations to be equal, paired test is used by the formula
\[
\sigma_{\text{diff}} = \frac{\Sigma d^2 - (\overline{d})^2 \times n}{n-1} \quad \ldots (3.16)
\]

where \( \overline{d} \) = mean of differences, \( \sigma_{\text{diff}} \) = standard deviation of differences, \( n \) = number of matched pairs with \( n - 1 \) degree of freedom
3.4.16 Hypothesis Testing
To show the cost comparison between small and big companies following testing is used

\[
t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - 1)s_{1}^2 + (n_2 - 1)s_{2}^2}{(n_1 + n_2 - 2)}} \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}
\]  \quad (3.17)

where \(X_1\), \(n_1\) and \(\sigma_{S_1}\) represents different cost factors, number of sample and standard deviation respectively of large companies and \(X_2\), \(n_2\) and \(\sigma_{S_2}\) signifies cost factors, number of sample and standard deviation of small companies respectively in processing industries.

3.4.17 Linear Programming Problem
This method is used to optimize the resources in order to achieve objective of the organization

Maximize or minimize \[Z = \sum_{j=1}^{n} c_j x_j\]  \quad (3.18)

subject to \[Z = \sum_{j=1}^{n} a_{ij} x_j \ (\leq, = \geq) b_i \quad i = 1, 2, \ldots, m\]

and \[x_j \geq 0, j = 1, 2, \ldots, n\]

where variables \(x_j\) (\(j = 1, 2, \ldots, n\)) are called decision variables, \(c_i\), \(a_{ij}\) and \(b_i\) (\(i = 1, 2, \ldots, m\); \(j = 1, 2, \ldots, n\)) are constants determined from the statement of the problem. The constants \(c_i\) represent the net unit contribution of decision variables \(x_j\) to the value of the objective function and are called objective function coefficients, constants \(b_i\) denote the total availability of the \(i\)th resource and are called stipulations and constants \(a_{ij}\) stand for the amount of resource, say \(i\) consumed per unit of variable (activity) \(x_j\) and are called structural coefficients.

3.4.18 One Way Anova
For determining variance of cost/profit between the product varieties by companies, one-way Anova is used.
### Source of variation           Sum of square (SS)          Degree of freedom(d.f.)           Mean square (MS)        F-ratio

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of square (SS)</th>
<th>Degree of freedom(d.f.)</th>
<th>Mean square (MS)</th>
<th>F-ratio</th>
</tr>
</thead>
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<tr>
<td>Between samples</td>
<td>$n_1(X_1 - \bar{X})^2 + \ldots + n_k(X_k - \bar{X})^2$</td>
<td>(k-1)</td>
<td>$SS_{between}$</td>
<td>(k-1)</td>
</tr>
<tr>
<td>Within samples</td>
<td>$\sum(X_{1i} - \bar{X}<em>1)^2 + \ldots + \sum(X</em>{ki} - \bar{X}_k)^2$</td>
<td>(n-k)</td>
<td>$SS_{within}$</td>
<td>(n-k)</td>
</tr>
<tr>
<td>Total</td>
<td>$\sum(X_{ij} - \bar{X})^2$</td>
<td>(n-1)</td>
<td></td>
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</tbody>
</table>

### 3.4.19 Time Series Analysis

To find out the future trend for various sector in cotton textile industry following trend equations have been used.

(a) **Linear Equation**

$$y = a + bx$$  \hspace{1cm} \ldots (3.20)

(b) **Quadratic Equation**

$$y = a + bx + cx^2$$  \hspace{1cm} \ldots (3.21)

where $y$ is demand data and $x$ is time data (no of years), $a$ and $b$ are constant.

(c) **Exponential Function**

$$P = Ar^t$$  \hspace{1cm} \ldots (3.22)

where $A$ and $r$ are parameters and $t$ is the time period.

### 3.4.20 Multiple Regression Model

Multiple regression model establishes the relationship between a dependent or criterion variable of interest (call it $Y$) and a set of $k$ independent variables or potential predictor variables (call them $X_1$, $X_2$, $X_3$, ..., $X_k$), where the scores on all variables are measured for $N$ cases. For predicting the performance on yarn export ($Y$), yarn production ($X_1$), domestic consumption of yarn ($X_2$), exchange rate ($X_3$) and random factor ($U$) have been used. A multiple regression equation for predicting $Y$ can be expressed as follows:

$$Y = b_1X_1 + b_2X_2 + b_3X_3 + u$$  \hspace{1cm} \ldots (3.23)
3.4.21 Moving Average

It is used in measurement of trend by smoothing out the fluctuations of the data. The time series values $Y_1, Y_2, Y_3, \ldots Y_k$, for different time periods, the moving average of period 'k' is given by:

1st value of moving average $= 1/k (Y_1 + Y_2 + \ldots Y_k)$

2nd value of moving average $= 1/k (Y_2 + Y_3 + \ldots Y_{k+1})$

3rd value of moving average $= 1/k (Y_2 + Y_4 + \ldots Y_{k+2})$

(3.24)

3.4.22 Testing the Equality of Variance of Two Normal Population

To test the equality of variances of two normal populations, F test has been used based on F distribution. The null hypothesis is $H_0: \sigma^2_o = \sigma^2_B$ where $\sigma^2_o$ and $\sigma^2_B$ represents the variances of various factors of organic and Bt cotton respectively. This hypothesis is tested on the basis of sample data and the test statistic $F$ is found using $\sigma^2_o$ and $\sigma^2_B$ the sample estimated for $\sigma^2_o$ and $\sigma^2_B$ respectively as stated below:

$$F = \frac{\sigma^2_o}{\sigma^2_B} \quad \text{... (3.25)}$$

Where

$$\sigma^2_o = \frac{\sum(x_{oi} - \bar{x}_o)^2}{(n_1 - 1)}$$

$$\sigma^2_B = \frac{\sum(x_{bi} - \bar{x}_b)^2}{(n_2 - 1)}$$

where $\sigma^2_o$ is treated $>\sigma^2_B$ which means that numerator is always the greater variance.

3.4.23 Estimation of Difference between Profit Means by Confidence Interval

If $\bar{x}_1, \bar{x}_2, s_1$ and $s_2$ are the values of the means and the standard deviations of independent random samples of size $n_1$ and $n_2$ from normal populations with equal variances, then

$$(\bar{x}_1 - \bar{x}_2) - t_{\alpha/2, n_1 + n_2 - 2} . S_p \left( \frac{1}{n_1} + \frac{1}{n_2} \right) < \mu_1 - \mu_2 < (\bar{x}_1 - \bar{x}_2) + t_{\alpha/2, n_1 + n_2 - 2} . S_p \left( \frac{1}{n_1} + \frac{1}{n_2} \right) \quad \text{... (3.26)}$$

is a $(1-\alpha)$ 100% confidence interval for the difference between the two population means and $S_p = \frac{(n_1 - 1)s^2_o + (n_2 - 1)s^2_B}{n_1 + n_2 - 1}$ is an unbiased estimator of $\sigma^2$
This confidence interval is used mainly when \( n_1 \) and/or \( n_2 \) are small, less than 30, we refer to it as a small sample confidence interval for \( \mu_1 - \mu_2 \)

### 3.4.24 Cost-Benefit

**a)** \( \frac{P}{C} \times 100 \) … (3.27)

where \( P \) and \( C \) are value added profit and value added cost respectively and \( P \) and \( C \) increases

**b)** \( (1+\frac{P}{C}) \times 100 \) … (3.28)

where \( P \) and \( C \) are value added profit and value added cost respectively and \( P \) increases and \( C \) decreases

**c)** \( (1-\frac{P}{C}) \times 100 \) … (3.29)

where \( P \) and \( C \) are value added profit and value added cost respectively and \( P \) decreases and \( C \) decreases

### 3.4.25 Graph (Bar diagram, Pie Chart and Line Chart)

To show the cotton export and import in India from 2000-01 to 2010-11 line diagram has been used. For the same period balance of trade of raw cotton has been shown using bar diagram. Line diagram has been used to depict the growth trend of cotton production, consumption and export during 1980-81 to 2010-11. Total production, average cost and net return (\%) for weaving companies have been shown. Net return ratio for processed fabric in different companies is shown.