CHAPTER VI

FIELD MANAGEMENT PRACTICES AND AGRO–CLIMATIC FACTORS AFFECTING PRODUCTION OF QUALITY TEA IN ASSAM

The quality of tea as measured in colour, taste and flavour, depends upon appropriate combination of four liquor characters—colour, strength, brightness and briskness. The quality of CTC or orthodox black teas is mainly associated with briskness. The second flush Assam tea is unique and is considered unsubstitutable in the world.

The conventional method of monitoring quality of tea liquor in the laboratory is to analyse the theaflavin (TF) and thearubigin (TR) contents of made tea along with taster's organoleptic tasting and commercially it is generally reflected in per unit price realized in sale. Higher TF/TR ratio meant better quality. During black tea manufacture the catechins through enzymic oxidation and condensation produce TF. Some catechin derivatives directly or through TF get polymerized to TR. Theaflavins are responsible for brightness, briskness and quality of tea and TR contribute towards body of tea liquor.

An extensive study was undertaken in the districts of Dibrugarh and Cachar with the aim of determining the climatic parameters e.g. rainfall, temperature, day length, etc.; agronomic factors e.g., pruning, plucking, etc. and other factors responsible for production of quality tea in Assam.

6.1 Taxonomy and classification of tea

The botanical name for tea plant has been accepted as *Camellia sinensis* (L) O. Kuntze. The genus Camellia belongs to the family Theaceae under tribe Gordonieae along with eight other genera, of which Camellia is the largest. Wight (1962)\(^1\) gave a concise description of the China and the Assam.

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varieties of tea and Barua and others accepted and described the three races of tea as *Camellia sinesis* L. or the China tea plant, *Camellia assamica* (Masters) or the Assam tea plant and *Camellia assamica* Sub sp. insiocalyx (Planch. M S) or the Cambodiensis or Southern form of tea.\(^2\)

6.2 Climate and soil for tea

Tea grows in a diverse range of climatic conditions of tropical and sub-tropical nature like tropical rain forest, tropical savannah and summer rain areas. It grows at latitudes from \(27^\circ\) S (Argentina) to \(43^\circ\) N (Georgia) and from sea level up to an altitude of 2,500 m.\(^3\)

The tea growing soils also vary widely from alluvial in Assam and Malawi; podzol in Russia; volcanic ash in Japan; andosols in Indonesia; red-yellow podzols in Taiwan; red soils in China; lateritic in South India, Sri Lanka and East Africa; peaty in Cachar and sedimentary in Darjeeling.\(^4\) However, tea grows best on a medium or light soil which is deep, friable and rich in organic matter having ph in acid range varying between four and seven and which is free from excess water up to a depth of about 90 cm at all times of the year.

Assam's climate is characterized by high rainfall and humidity, the state being situated in humid sub-tropical region. The mean annual maximum temperature (July- August) in different districts of Assam lies between 30\(^0\) to 33\(^0\) C while the minimum temperature (December – January) ranges from 6\(^0\) C to 12\(^0\) C.

The average annual rainfall is around 2300 mm. On an average, winter (December to


4. Ibid
February) receives about 60 mm, summer (March to May) about 640 mm, monsoon (June to September) about 1460 mm and post-monsoon period (October to November) about 140 mm.

The average annual relative humidity ranges from 74.0 percent to 87.0 percent. 5

The major soil groups found in the state are new alluvial soil, old alluvial soil, old mountain valley alluvial soil, non-laterised red soil (mixed red and black soils) and laterised red soils, where majority of the tea growing areas are located were formed from the material deposits by the river Brahmaputra and its tributaries and it falls in the Brahmaputra valley. The best tea in the world is found on the alluvium of the Brahmaputra valley and on soils formed from the wash of old sandstone on the North bank. 6

The most important characteristics of the soils of Assam is its acidity ideal for growth of tea which grows best in the soils with pH range of 4.5 to 5.5. The soils of the Brahmaputra valley are mostly sandy loam; their available and total potash contents are fairly good; the P₂O₅ content is good and the percentages of the organic matter and nitrogen in them are fairly moderate. 7

Cachar is a distant area from the main tea districts of Assam. Distribution of rainfall in Cachar district is highly uneven. Date collected from different tea gardens, covering the entire district shows that North Cachar Circle receives highest rainfall in the district, whereas Longai circle in the Southern Cachar, receives the lowest. Intensity of rain during monsoon period is also higher than Assam Valley. Recurrence of hail is also another phenomena in the Central region during


March/April. Soil moisture deficit is aggravated by ambient and soil temperature, which is highest in Cachar than other parts of North-East India.

6.3 Materials and Methodology

Agro-climatic and primary data with specifically prepared questionnaires by direct contact method and mailing were collected in the study. The meteorological/climatic data were collected from Margherita and Dikom meteorological observatories in Upper Assam and Silcoori meteorological observatory in Cachar of Tea Research Association for the period 1990-2000. The parameters studied were rainfall, maximum and minimum temperature, average sunshine hours and relative humidity. Soil texture and fertility status of Dibrugarh and Cachar district were analysed based on compilations of soil testing analysis routinely carried out at Dikom (Upper Assam) and Silcoori (Cachar) Branches of Tea Research Association and from the reports of field studies conducted by Tea Research Association.

The agronomic and other factors affecting the production of quality tea were ascertained rankwise from the sample tea estates of Dibrugarh and Cachar districts through structured interviews and mailing of questionnaires.

The whole volume of data so generated were analysed by simple comparison, percentage and Garrett’s ranking technique etc.. These were presented in details in Chapter I earlier.

6.4 Tea quality – price index value in Auction market

Price realization in auction sale may be taken as the indicator of tea quality. In course of auction sale, the quality is judged by the brokers and buyers based on physical and organoleptic characteristics that govern the price realized for the particular type and lot of tea sold.
It can be observed from Table 35 that Assam tea of Assam Valley normally fetched better price than Cachar tea due to its inherent superior quality. Within Assam, the largest number of high quality producers obtaining higher prices are concentrated in Upper Assam, particularly in Dibrugarh district. The tea quality and price also varied within the season and the second flush tea available during mid April-June is considered to be premium tea and fetches highest prices.

The study was made in the two districts of Dibrugarh and Cachar analyzing the soil, climate and agronomic practices responsible for quality in tea.

It is found from Table 35 that Assam tea is always fetching higher price than Cachar tea both in Guwahati and Kolkata auctions since the period of reference (1975-76 to 2000) for both categories of CTC and orthodox tea. In fact, the gap is widening over the years. In 1975-76, the difference of average price was Rs. 0.65 and Rs. 2.10 which increased to Rs. 21.76 and Rs. 29.39 respectively at Guwahati and Kolkata auction centres in the year 2000.
Table 35: Comparative price realization of Assam and Cachar tea at Guwahati and Kolkata Tea Auction Centres (1975-76 - 2002) (Average price Rs./Kg.)

| Year  | Guwahati |  |  | Kolkata |  |  |
|-------|----------|  |  |         |  |  |
|       | Assam    | Cachar |  | Assam    | Cachar |  |
|       | CTC Orthodoxy Total |  |  | CTC Orthodoxy Total |  |  |
| 1990  | 43.79 43.50 43.77 | 39.51 39.51 |  | 44.65 51.41 47.60 |  | 39.73 - 39.73 |
| 1995  | 50.31 50.60 50.31 | 45.11 45.11 |  | 50.60 58.67 52.12 |  | 43.65 66.00 43.65 |
| 1998  | 80.60 70.42 80.51 | 68.38 68.38 |  | 83.92 85.70 84.61 |  | 67.92 90.69 67.95 |
| 2000  | 71.76 73.21 71.76 | 50.00 50.00 |  | 76.31 98.11 81.51 |  | 52.12 - 52.12 |
| 2002  |  |  |  |  |  |  |

Source: Tea Statistics, Tea Board.
Fig 7: Comparative price realisation of Assam and Cachar teas (1980-2000)

a. Guwahati Auction

b. Kolkata Auction
6.5 Result and discussion

6.5.1 Part A

6.5.1.1 Analysis of soil types of Dibrugarh and Cachar Districts

Tea grows well in a wide heterogenic soil and climatic conditions. The bulk of the soils of tea gardens in North-East India are alluvial in origin from the river Brahmaputra, and its tributaries. The rich loamy very suitable soils for tea in Upper Assam districts of Dibrugarh, Lakhimpur are soils deposited by the tributaries of the Brahmaputra. The Surma Valley which includes Cachar and Sylhet (now in Bangladesh) has topography of flat lands and bheels surrounded by teelas (low hillocks). The flats are derived mostly from the alluviums of hills on the eastern and southern boundaries made of sandstones of the tertiary period. The flats vary in texture from sands to heavy clays. The plateau soil of Cachar on the North of the Barak river are weathered soil pushed up by geological activity. The teelas are made of sandstones and the bheels are drained peats very rich in organic matter.8

The soil profile studies of Cachar tea gardens was completed by Tocklai Experimental Station in 1992-93. The study found that sandy loam and loam soil predominated in teela, plateau and high flat areas. In waterlogged areas, profiles with layered soils of different textures were observed which may be due to deposition of silt and sand in layers in the flood prone area.9

Another study of Tocklai Experimental Station, Jorhat (1995) found that soils of Cachar were usually sandy loam, loam and silt loam texture but profiles composed of loamy sand and silty clay loam were also encountered. The teela, plateau and high flat areas were having sandy loam and loam soil whereas silt loam and layered soils of silt and sand decomposition are encountered in waterlogged flat areas. In Cachar areas, organic Carbon percentage was very much higher in

waterlogged areas even in the lower depths due to presence of peat layers at 90 to 150 cm depths. The low hillocks known as teelas were weathered sand dunes and many teelas were composed of sand stones which were geologically very young rocks.10

A compilation of routine soil testing analysis carried out at Tea Research Association, Silcuri Branch (2000) on soil fertility status of different sub-areas of Barak Valley are presented in Table 36. The study indicated that majority of the soil samples tested were in the pH level of 4.5 – 5.5 (59-72%) for the sub-areas but also a large number of samples were with pH below 4.5 (28-40%). The organic matter status was medium and potassium, phosphate and sulphur status were medium to low.

Table 36: Soil fertility status of different sub-areas of Barak Valley
(Study period: 1993-97. TRA, Silcuri)

a. Soil pH

<table>
<thead>
<tr>
<th>Sub-area</th>
<th>No. of samples</th>
<th>Present area under different pH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Below 4.5</td>
</tr>
<tr>
<td>(i). Happy Valley</td>
<td>1098 (13)</td>
<td>40</td>
</tr>
<tr>
<td>(ii). North Cachar</td>
<td>770 (10)</td>
<td>34</td>
</tr>
<tr>
<td>(iii). Chutlabheel</td>
<td>924 (15)</td>
<td>30</td>
</tr>
<tr>
<td>(iv). Hailakandi</td>
<td>738 (10)</td>
<td>39</td>
</tr>
<tr>
<td>(v). Longai and Karimganj</td>
<td>161 (6)</td>
<td>28</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate number of gardens

b. Organic matter

<table>
<thead>
<tr>
<th>Sub-area</th>
<th>No. of samples</th>
<th>Percent area under different organic matter status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Below 2% (1% Carbon) Above 2%</td>
</tr>
<tr>
<td>(i). Happy Valley</td>
<td>457 (12)</td>
<td>33</td>
</tr>
<tr>
<td>(ii). North Cachar</td>
<td>366 (10)</td>
<td>39</td>
</tr>
<tr>
<td>(iii). Chutlabheel</td>
<td>392 (13)</td>
<td>62</td>
</tr>
<tr>
<td>(iv). Hailakandi</td>
<td>249 (9)</td>
<td>43</td>
</tr>
<tr>
<td>(v). Longai and Karimganj</td>
<td>70 (2)</td>
<td>54</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate number of gardens

c. Potassium

<table>
<thead>
<tr>
<th>Sub-area</th>
<th>No. of samples</th>
<th>Percent area under different organic matter status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low (below 60 ppm) Medium (60-100 ppm) High (above 100 ppm)</td>
</tr>
<tr>
<td>(i). Happy Valley</td>
<td>N.A.</td>
<td>24</td>
</tr>
<tr>
<td>(ii). North Cachar</td>
<td>N.A.</td>
<td>48</td>
</tr>
<tr>
<td>(iii). Chutlabheel</td>
<td>N.A.</td>
<td>62</td>
</tr>
<tr>
<td>(iv). Hailakandi</td>
<td>N.A.</td>
<td>42</td>
</tr>
<tr>
<td>(v). Longai and Karimganj</td>
<td>N.A.</td>
<td>61</td>
</tr>
</tbody>
</table>

d. Phosphate

<table>
<thead>
<tr>
<th>Total No. of samples</th>
<th>Low (Below 10ppm)</th>
<th>Medium (10-30ppm)</th>
<th>High (Above 30ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>304</td>
<td>26</td>
<td>69</td>
<td>5</td>
</tr>
</tbody>
</table>
A study (1995) on nutrient status of Cachar tea garden soil observed higher C : N ratio in teela, plateau and high flat areas as compared to waterlogged areas. In the top (0-30 cm layer) available potash was found to be highest in teela and plateau followed by high flat and lowest in waterlogged flat. Available phosphate content was also low in Cachar as in other areas of North-East India. The variation of available Zinc with depth was found to be inconsistent in Cachar soils.  

A study was carried out by Soil Department, Tocklai Experimental Station, Jorhat (1995-2000) under Tea Board project on soil properties of Upper Assam tea soils. The high yielding tea estates of Upper Assam had a pH range of 4.50- 5.0. The overall clay content ranged from 5.30 per cent and the high yielding sections had clay content of 11-20 per cent. The level of available phosphate was low being less than 10 ppm for 38 per cent of the soils and 11-20 ppm for 22 percent soils. The available potash level was high (above 100 ppm K₂O) for more than 57 per cent of the soils. But most of the soils (about 80%) were deficient in available sulphur (less than 40 ppm). The cation exchange capacity of the soils were by and large less than 10 me/100g soil.  

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The tea areas of Upper Assam occasionally suffered from high water table during growing season due to restricted outfall as a result of rising river bed of the Brahmaputra.

Analysis of typical tea garden soils of Assam presented in Table 37.

Table 37: Typical constituent tea soils of some tea districts of Assam (After Mann and Gokhale, 1960, expressed as per cent on oven dry basis)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Upper Assam</th>
<th>Tezpur</th>
<th>Cachar Teela</th>
<th>Cachar clayflat</th>
<th>Cachar plateau</th>
<th>Cachar bheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>0</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Fine sand</td>
<td>26</td>
<td>24</td>
<td>38</td>
<td>9</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>Silt</td>
<td>15</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>27</td>
<td>9</td>
</tr>
<tr>
<td>Fine silt</td>
<td>8</td>
<td>16</td>
<td>8</td>
<td>25</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>Clay</td>
<td>15</td>
<td>18</td>
<td>10</td>
<td>28</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>Loss of ignition</td>
<td>5.8</td>
<td>5.2</td>
<td>5.5</td>
<td>11.0</td>
<td>5.1</td>
<td>46.0</td>
</tr>
<tr>
<td>Organic matter</td>
<td>1.55</td>
<td>2.20</td>
<td>2.20</td>
<td>4.0</td>
<td>1.60</td>
<td>25.0</td>
</tr>
<tr>
<td>(grandeur)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.106</td>
<td>0.096</td>
<td>0.120</td>
<td>0.220</td>
<td>0.130</td>
<td>0.600</td>
</tr>
<tr>
<td>Total phosphoric acid</td>
<td>0.075</td>
<td>0.046</td>
<td>0.300</td>
<td>0.072</td>
<td>0.100</td>
<td>0.200</td>
</tr>
<tr>
<td>Available Phosphoric acid</td>
<td>0.011</td>
<td>0.003</td>
<td>0.140</td>
<td>0.003</td>
<td>0.025</td>
<td>0.050</td>
</tr>
<tr>
<td>Available Potash</td>
<td>0.009</td>
<td>0.007</td>
<td>0.120</td>
<td>0.015</td>
<td>0.005</td>
<td>0.040</td>
</tr>
<tr>
<td>Available lime</td>
<td>0.020</td>
<td>0.030</td>
<td>0.050</td>
<td>0.080</td>
<td>0.020</td>
<td>0.030</td>
</tr>
<tr>
<td>pH water extract</td>
<td>5.7</td>
<td>5.2</td>
<td>5.6</td>
<td>5.2</td>
<td>-</td>
<td>4.8</td>
</tr>
<tr>
<td>pH KNO₃ extract</td>
<td>4.6</td>
<td>4.4</td>
<td>4.6</td>
<td>4.5</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>Insoluble siliceous matter</td>
<td>84</td>
<td>80</td>
<td>92</td>
<td>78</td>
<td>84</td>
<td>53</td>
</tr>
</tbody>
</table>

Note: Mechanical analysis by the method of Hall. Coarse Sand, 1.0-0.2 mm, Time sand, 0.2-0.4 mm; Silt, 0.04-0.01 mm; Fine Silt, 0.01-0.002 mm, Clay, <0.002 mm.
The tea soils of Upper Assam were endowed with good plant food, apart from being deep and friable to a great depth and hence, these soils are considered most ideal for tea.\textsuperscript{13}

However, organic matter and nitrogen contents of Brahmaputra Valley are generally lower than Cachar.

The tea plantations in Cachar suffered from water stress and drought, particularly in the hot slopes (South and South-West facing slopes), but the tea plantations of Dibrugarh district were mostly in alluvial flats. The topography of Dibrugarh district was more suitable for growth of tea plant.

6.5.1.2 Influence of climate and analysis of climate of Upper Assam and Cachar districts

Climate plays a crucial role in growth tea plant though extensive research on the effects of the vital parameters on growth and quality of tea in North-East India are yet to be carried out. The important parameters of the climate, influencing growth of tea plant are mainly rainfall, temperature, day length, humidity and wind velocity etc.

The important climatic conditions and their effect on shoot growth are as follows:

a. Air temperature: On an average, net photosynthesis is maximum at 30° C. Growth is most rapid and leaf size is maximum at 30° C and growth of shoots ceases below 12.5° C.

b. Day length: Better growth of shoots is observed in longer days. Stem length increases with longer days. Eleven hours 15 minutes is found to be the critical day length for shoot growth.

c. Humidity: The growth of shoot is limited by low humidity. It is observed that increase in humidity increases number of shoots.

d. Soil temperature: Positive correlation exists between soil temperature and shoot growth. Experimental findings revealed that when soil temperature was raised from 15° C to 18° C through mulching, it resulted in enhanced rate of shoots growth with higher production.

e. Leaf temperature: Temperature of fully exposed horizontal leaf is 2° C - 4° C higher than erect or semi-erect leaves. The net photosynthesis declines sharply above 35° C and there is no net photosynthesis between 39° C and 42° C, but respiration continues up to 48° C, above which the leaves are damaged.

f. Rainfall and soil moisture: One hectare standing mature tea plants require 10 tonnes of water per day, which is equivalent to 2.5 mm rainfall. However, bulk of precipitation occurs during certain period of the year, resulting in loss
of water through run-off, seepage, evaporation etc. Thus, average well
distributed rainfall of more than 1000 mm is necessary.

Tea is a rain-fed crop and the total rainfall and its distribution are vital
considerations in the culture of tea. Rainfall in the tea growing areas of the World
varies from less than 1000 mm to 6000 mm per annum. Topography of the area
causes variation between total rainfall and distribution within a region. The
availability of water ultimately depends on soil and environmental conditions, health
of the tea bushes and cultural practices adopted. November to April is a dry period
in North-East India and some areas are more susceptible to drought than others.
Parts of Central Assam, Cachar, Dooars and Terai are such susceptible areas to
drought than Upper Assam which normally gets a few showers during this period of
the year.

Tea grows in tropical to temperate temperature conditions, and the air temperature
regime varies widely between 12° C to 37° C. Photosynthesis rate of tea is maximum
at 30° C, falls rapidly at 37° C, and there is virtually no net Photosynthesis between
39° C and 42° C. 14 In general, temperature above 30° C and below 13° C are
harmful for the growth of the tea plants. There is no uptake of Carbon dioxide at
about 42° C and leaf is irrevocably damaged at 48° C. Hence, there is need of shade
trees in tea plantations in North-East India as air temperature remains above 30° C
for long periods during harvesting season. Difference in elevation, topography and a
few other factors of the environment are partly responsible influencing temperature
changes.

Like the other climatic factors, tea grows in a wide range of day lengths of 9.4 to 15
hours. Better growth of tea shoots is generally observed in longer days. Eleven hours
fifteen minutes was observed to be the critical day length for shoot growth. The
winter dormancy in tea in North-East India is due to short day length and also low

Soil moisture and soil temperature are also important factors for growth. The available water in the soil should not fall below 50 per cent of its field capacity for optimum growth.

The invisible water content of the air is expressed variously as Relative Humidity, Saturation Vapour Pressure Deficit (SVPD) or Dew point. High humidity reduces water loss by evapotranspiration, but low humidity increases it. The humidity level remains high during the harvesting period in North-East India and it is generally considered to be conducive to growth.

Saturation vapour pressure deficit indicates the dryness of ambient air due to which water evaporates into atmosphere from water bodies and soil and also transpiration loss occurs from plants. Reduction in shoot expansion is caused when the vapour pressure deficit exceeds 2.0 k Pa (20 m bar) even if the soils is at field capacity.

Wind effects plants directly by increasing transpiration, reducing high leaf temperature and transportation of hot and cold masses of air causing temperature fluctuation, movement of clouds affecting water relations, evaporation of water from soil and water reservoirs and also causing mechanical damage. In the North-East India, tea is grown in sheltered valleys where wind speed is generally low. Its direct effect in reducing the leaf temperature is minimal.

6.5.1.3 Climate of Dibrugarh and Cachar District

The important climate parameters i.e. rainfall, maximum and minimum temperatures, average sunshine hours per day and relative humidity for Upper Assam (Dibrugarh) and Cachar areas recorded at Margherita/ Dikom and Sileuri are presented in Table 38 and Table 39 respectively.

Fig 6: Monthwise comparison of climatic parameters of Dibrugarh and Cachar districts (1999) a. Rainfall

b. Maximum temperature

c. Minimum temperature

d. Average sunshine hours
The climatic parameters of the two districts revealed that the total rainfall was comparatively higher in Cachar as compared to Dibrugarh. May to September were the highest rainfall months for both the districts but the Cachar and the Upper Assam also received more rains in the months December to March which are crucial to early crop and to avoid droughty conditions.

The average temperature of Dibrugarh was moderate as compared to Cachar district. The maximum average temperature of Dibrugarh was within the range of 21° C to 36° C (mostly around 25° C to 32° C) and minimum average temperature of 8° C to 25° C (monthly around 13° C to 24° C). The maximum average temperature of Cachar was within the range of 27° C to 35° C (mostly around 27° C to 34° C) and minimum average temperature of 12° C to 25° C (mostly around 14° C to 25° C). Dibrugarh was cooler as compared to Cachar in favourable range for growth of tea.

The average sunshine hours were however, higher in Cachar compared to Upper Assam (Dibrugarh). The daily average sunshine hours recorded in Dibrugarh ranged 3 to 8 whereas it was 4 to 9 for Cachar.

The relative humidity was very high for both the districts. The morning relative humidity (%) level for Dibrugarh was 91 to 97 and afternoon 45 to 80. the corresponding figures for Cachar were 91 to 98 and 50 to 80 respectively.

A study of Tocklai Experimental Station, Jorhat on saturation vapour deficit during the winter months i.e., October to April are presented here (Table 40). 17

Table 40: Saturation Vapour deficit (m b) in Assam

<table>
<thead>
<tr>
<th>Meteorological Station</th>
<th>Months</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dikom (Upper Assam)</td>
<td></td>
<td>16</td>
<td>14</td>
<td>14</td>
<td>11</td>
<td>17</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Tocklai (South Bank)</td>
<td></td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>12</td>
<td>18</td>
<td>13</td>
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<tr>
<td>Silcuri (Cachar)</td>
<td></td>
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<td>14</td>
<td>17</td>
<td>14</td>
<td>22</td>
<td>22</td>
<td>21</td>
</tr>
</tbody>
</table>

The saturation vapour deficit of Cachar exceeded 20 m b (on critical limit) during February to April whereas it was less than 20 m b being favourable for growth in Upper Assam.

Though the sunshine hours is marginally higher in Cachar district, the saturation vapour deficit is more than Upper Assam, negating the beneficial effect of greater sunshine hours.

Thus, Cachar climate was hot and humid with longer sunshine hours compared to Upper Assam (Dibrugarh) but Upper Assam had well distributed rainfall, particularly received adequate showers during the crucial months of November to April. The overall climate of Upper Assam was more suitable for growth of tea which might also result in better quality tea produced.
6.5.2 Part B

6.5.2.1 Agronomic and garden management practices of Dibrugarh and Cachar districts

The quality of green leaf produced in the field is the most important factor which is transformed into quality made tea by proper manufacturing.

The quality of the end product tea made is as it is harvested in the field. Tea quality is an integration of agro-climate parameters which are ultimately manifested by the process of manufacturing in the factory and overall management practices of a particular tea estate. The important agronomic parameters or field management practices determining quality are broadly the kind of planting materials used with inherent quality factors, plucking round in particular period of the season and standard of plucking, handling of green leaf plucked, pruning cycle followed, shade status, balanced maturing and control of pests and diseases by timely use of agro-chemicals etc.

The analysis of data collected by questionnaires from the sample tea estates of Dibrugarh and Cachar district for the research study on agronomic and other garden management practices responsible for production of quality tea were analysed and the following factors were identified which are presented in Table 41 in descending order as determined by Garette ranking technique.
Table 41: Rankwise agronomic and garden management practices affecting production of quality tea in Dibrugarh (Upper Assam) and Cachar districts

<table>
<thead>
<tr>
<th>Rank</th>
<th>Particulars</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Type of planting materials used</td>
<td>88%</td>
</tr>
<tr>
<td>2.</td>
<td>Standard of green leaf plucked</td>
<td>85%</td>
</tr>
<tr>
<td>3.</td>
<td>Soil and climatic factors</td>
<td>70%</td>
</tr>
<tr>
<td>4.</td>
<td>Pruning cycle and other field management practices</td>
<td>68%</td>
</tr>
<tr>
<td>5.</td>
<td>Leaf handling and transportation</td>
<td>65%</td>
</tr>
<tr>
<td>6.</td>
<td>Manufacturing process in factory</td>
<td>65%</td>
</tr>
<tr>
<td>7.</td>
<td>Condition of factory machineries</td>
<td>64%</td>
</tr>
<tr>
<td>8.</td>
<td>Factory hygiene</td>
<td>60%</td>
</tr>
<tr>
<td>9.</td>
<td>Sorting, handling of made tea, storage, packing and transportation</td>
<td>40%</td>
</tr>
<tr>
<td>10.</td>
<td>Labour management</td>
<td>23%</td>
</tr>
<tr>
<td>11.</td>
<td>Quality conscientfulness</td>
<td>22%</td>
</tr>
<tr>
<td>12.</td>
<td>Age of bushes</td>
<td>18%</td>
</tr>
</tbody>
</table>

1. Type of planting materials used (mean score = 88%)

Almost all the surveyed tea estates were of the firm belief that planting material was the most important basic factor for producing quality tea. The various seed and clonal planting materials used and their proportion in a tea estate were the determining factors on production of quality tea. The Dibrugarh tea estates have old seeds jals like Tingamira, Betjan, Kharijan, Dilia, Dangri Marlpur etc. to a large extent in their total array of planting materials in the estate. Tocklai released clones (TV clones) and biclonal seed stocks are also very popular in the tea estates. However, the Upper Assam tea estates are very much quality conscious and have gone for quality and standard TV clones like TV 1, TV-17, TV 18, TV 20, TV 25, TV 26, etc. mostly. But the Cachar tea estates have been using yield and standard clones like TV 22, TV 23, TV 25, TV26, TV18, etc. to a large extent, particularly in their spectacular rise in productivity by rejuvenation pruning and infilling, uprooting and replanting in the last decade. In Upper Assam, garden series clones such as Teen Ali 17/1/54, SA3, P 126 etc. are very popular. In Cachar, Teen Ali 17/1/54 only has
been planted, other such clones were missing. Tocklai released seed stocks viz. TS 450, TS 462, TS 464, etc. are equally popular in all areas, though the extent of planting is much less compared to clones.

2. Standard of green leaf plucked (mean score = 85%)

The standard of green leaf plucked in the field determined by standard of plucking was the most vital factor in quality tea production. If plucking was standard or fine (i.e. 7 days or below), the right combination of quality and crop was achieved. Most of the tea estates while making premium high quality tea were found to resort to shorter plucking round of less than the standard 7 days and fine plucking.

However, most of the tea estates of Dibrugarh followed standard plucking round of 7-9 days throughout the year depending of growth and part of the season. In contrast, the Cachar tea estates followed longer plucking rounds of 9 to 11 days in general and it extended even by a day or two sometimes. But the quality conscious tea estates in Cachar also plucked at 7-9 days. Labour shortage was a major reason for Cachar estates being forced to adopt longer plucking round, the other factor being pressure to increase production.

3. Soil and climatic factors (mean score = 70%)

Soil and climatic parameters like temperature, distribution of rainfall, day length, etc. are considered to be vital for tea quality and the inherent tea quality is produced in the tea field cannot be reproduced elsewhere. The Upper Assam area, being place of origin of tea plants, was considered to be bestowed with most favourable conditions for growth of tea by the nature. The growth and quality of shoots plucked also varied throughout the year and the second flush tea produced the best quality.

Moderate temperature and distribution of rainfall, particularly receipt of rainfall in time were important. In North-East India 600-700 µmol m$^{-2}$ s$^{-1}$ keeps the leaf temperature at 30°C which is reported to be optimum for maximum photosynthesis.
Shade trees play vital role in reducing the light intensity to be suitable for growth. Tea shoot succulency deteriorated in sections with poor shade. Pest and disease infestation and a tea bush growing in a constrained condition adversely affected green leaf production.

4. Pruning cycle and other field management practices (mean score = 68%)

The field management practices are largely responsible in optimizing and maintaining the quality raw material (green leaves) produced in the field. The green leaf plucking standard is so vital that it is treated separately as second most important factor. The field management practice is a broad term, encompassing all aspects from land preparation to regular maintenance of the tea bush in the field.

The next important factor in quality tea production after plucking is pruning cycle followed. In Dibrugarh, quality was the dominant factor in deciding pruning cycle. Most of the tea estates followed a three year cycle of LP-DS-UP or LP-UP-DS in the youngish mature tea for maintaining quality. In older mature teas, however, a four year pruning cycle of LP-UP-DS-UP or LP-UP-DS-MS was followed in general. There was increased tendency and willingness to go for three year pruning cycle. However, in Cachar, the pruning cycle of most of the tea estates were crop oriented except for few quality conscious tea estates. A three year cycle of LP-UP-UP or a four year cycle of LP-UP-MS-UP was popular.

Adequate shade status, timely control of pest, disease and weeds, manuring at proper dose, particularly organic manure to improve organic matter content and maintaining fertility status, drainage and bush hygiene and overall maintenance of the bush were important field management practices in production of quality tea.

Timely application of agro-chemicals in the right close and interval, application of only approved agro-chemicals are important factors on which quality depends.
particularly in international market. The tea made should be free from contaminants and pesticide residues which are originated in the field.

Improvement of soil conditions by soil amendments, balanced manuring and need based foliar application of nutrients and integrated pest and disease management were of crucial importance in field management practices.

5. Leaf handling and transportation (mean score=66%)

In addition to production of quality leaf in the field, its handling during and after plucking, prompt and careful transportation to factory is important. While plucking, more number of shoots should not be held in hand by the pluckers. The plucked leaves should not be compressed in the plucking basket and then kept in sun. 3-4 weighments a day reduce leaf damages. The plucked tender leaves should be handled with extreme care, kept in shade with proper spreading and then transported to factory without any damage and at the earliest possible. Leaf temperature above 30°C deteriorates quality. The more quality oriented tea estates used tractors with special trolleys and baskets for totally undamaged transport of plucked leaves from the field to factory. Excess packing of green leaf in bags generate excessive heat leading to leaf damages. More than 25 kg leaf should not be packed in bag for transporting.

The Dibrugarh district tea estates accorded much higher priority in leaf handling and transportation as compared to tea estates of Cachar.

6. Manufacturing process in factory (mean score=65%)

The plucked green leaves (shoots) are converted into the final product made tea through a four step manufacturing process in factory. These four basic steps involved are withering, rolling/cut in C.T.C. machine, fermentation (oxidation) and finally drying. The persons i.e. supervisor and labour etc. involved in this whole
process should have sound knowledge on the manufacturing process. Otherwise, even if good quality leaf is plucked in the plantation, it may not result in desired quality final product.

Maintenance of the parameters within the required limits by strict supervision is essential.

7. Condition of factory machineries (mean score=64%)

In order to facilitate proper manufacturing process, the machineries in the factory should perform at optimum level of efficiency. The factory machineries should be maintained regularly with regard to sharpness, rotation, lubrication, etc. in order to achieve quality standard. The factory should also be well equipped with machineries of latest developments with higher efficiency, phasing out older versions regularly. The factory planning and management should be flexible enough to be able to cope up with any situation and sufficient inventory should also be maintained.

8. Factory hygiene (mean score=60%)

Factory cleanliness and overall hygiene is crucial in quality tea production. All the quality tea makers assign top priority to this factor. Factory cleanliness during the manufacturing process ensures bacteria and other microbe free tea made and eliminate undesired contaminants, iron filings, lead, copper and alkalinity, etc. Thorough cleaning of the factory machineries, floor after completion of the day’s manufacturing process was accorded top priority by the tea estates.

9. Sorting, handling of made tea, storage, packing and transportation (mean score=40%)

Once the manufacturing process is completed, sorting of tea made is important factor. Proper attention should be given at the time of sorting to get the sorted
material free from fiber and with bloom. Grade size should also be maintained.

Too much handling should be avoided in the factory which reduces bloom.

Storage of the tea made in proper sized bins and its not picking up of moisture in storage are important.

Use of high quality packing materials and early disposal were also important so that quality of tea produced in the factory reached the auction or buyers at highest standards. Delay and disruption in transportation caused deterioration of quality.

10. Labour management (mean score=23%)

The whole process starting from tea plantation to production of final made tea is a labour intensive one. Labours are involved in every step of this process and their proper management was considered to be crucial in order to produce quality product. Motivation of the workers by interaction with them at regular intervals and using management techniques were found to be very much beneficial.

11. Quality consciousness (mean score=22%)

There should be quality consciousness among all the persons involved from top to bottom in the whole process. Everyone starting from plucking to manufacturing in the factory to final destination should be intimately involved in the quality circle. Also, adaptation of quality standard e.g. HACCP system in tea and IS 15000:1998 certificate was target of many high quality making tea estates to ensure quality standard of international acceptance. Application of modern management concepts on quality was considered to be very important.
The Dibrugarh area tea estates were more quality conscious.

12. Age of bushes (mean score=18%)

The young tea bushes with quality planting materials not only gave high yield but also produced better quality. Thus, regular uprooting and replanting/ replacement planting/ rejuvenation pruning and infilling operations were important from the point of view of quality also.

Thus, use of better quality planting materials, adaptation of standard plucking round, shorter pruning cycle and superior field management practices, suitable soil and climatic factors, utmost care and importance in leaf handling and transportation, maintenance of high level of factory hygiene and overall quality consciousness were found to be the main factors for Upper Assam tea estates producing better quality tea and fetching better prices as compared to Cachar tea estates. However, there was a feeling among the Cachar tea planters that they were also making better quality tea at present but failed to fetch as much price due to ‘Cachar stigma’.

6.6 Quality parameters

The determining factors of tea quality for buyers and brokers point of view were based on made tea appearance, made tea aroma, made tea colour, liquor, taste, infused leaf appearance and infused leaf aroma etc. The buyers and brokers evaluated tea based on their main parameters i.e. leaf appearance and aroma, size and cup quality. In leaf appearance and aroma the desired aspects were blackish brown physical appearance with bloom and less fiber content; proper and uniform granule size and a host of characters in cup quality viz. brightness, briskness, colour, strength, flavour and creaming down qualities, etc. for CTC tea.