CHAPTER 7

RAINFALL OVER FOREST REGIONS - INTERCEPTION LOSS
7.1 GENERAL

Interception is the portion of the precipitation falling on the earth's surface which is stored or collected by vegetal cover and subsequently evaporated. The volume of water so lost is called interception loss. In studies of major storm events and floods the interception loss is generally neglected. But in water balance studies it is a very significant parameter. Precipitation falling on vegetation may be retained on leaves or blades of grass, flow down the stem of plants and become 'stem flow', or fall off the leaves to become part of the 'through fall'. The amount of water intercepted is a function of (i) the storm character; (ii) the species, age and density of plants and trees; and (iii) the season of the year.

A number of studies on interception have been reported from different parts of the world. Studies on rainfall interception in the forests of New Zealand have been reported by Miller (1963) and Aldridge and Jackson (1973). Rowe (1975, 1979) has reported studies in the mountain beech on the Craigieburn Range of Canterbury and also for a mixed beech hardwood forest near Reefton. Dolman (1987) has compared summer and winter rainfall interception in an Oak forest and tried to predict with an analytical and a numerical simulation model. Studies conducted in Britain
(Calder, 1976; 1978) reveal that in some climates interception losses can be double that of the water used by transpiration. Yadav and Mishra (1985) have given an idea about the distribution of precipitation under a tropical dry deciduous forest stand of central India.

The present Chapter describes the interception study carried out during the southwest monsoon months (June - September) of 1986 in the dense forest at Peruvannamuzhi, Kozhikode District.

7.2 EXPERIMENTAL SITE

The site chosen for the study is a small deciduous forest catchment at Peruvannamuzhi, 75 km northeast of Kozhikode city. It lies on the Western Ghats at 11° 35' N and 75° 29' E (Fig 7.1). The average altitude above mean sea level is 350 m having a catchment slope of 9.76 per centage. Average annual rainfall of the region is about 4500 mm, of which 70% is during southwest monsoon (June-September), 20% during northeast monsoon (October-December) and the remaining 10% distributed during the rest of the period.

The mixed forest of the study area comprises about 17 tree species. The height of the trees vary from 5 m to 25 m and the average is 11 m. Diameter at breast height (dbh) varies from 5 cm to 100 cm having an average of 24 cm.
FIG. 7.1 INTERCEPTION STUDIES - EXPERIMENTAL SITE AT PERUVANAMUZHI
varies from 5 cm to 100 cm having an average of 24 cm. Canopy thickness of the region varies from 1.5 m to 17.0 m. In the 5-15 cm dbh class, the average tree density is 275 trees/ha, 16-30 cm class it is 125 trees/ha; 31-50 cm class 75 trees/ha and 51-100 cm class 33 trees/ha. During the study period crown cover of the study area was visually estimated to be about 75-90 percentage opaque to direct sunlight. The important species in the study area are Dalbergia latifolia, Elaeocarpus serratus, Acacia ferruginea, Aporusa lindleyana, Machilus macrantha, Euodia lunuakenda, Terminalia paniculata, Diospyros candolleana, Caloplyllum apetalum, Grewia tiliefolia, Ficus arnottiana, Terminalia bellirica, Ailanthus triphysa, Seheleichera oleosa, Bombax insigne, Strychnos nux-vomica, Tectona grandis, etc. Ground flora is rich in species and mostly consisted of shrubs and grasses. Since the study area is a mixed thick forest the branches of the trees are overlapped each other and most of the cases the canopy thickness is not of a single tree but a mixture of different trees.

7.3 EXPERIMENTAL METHODS

7.3.1 Incident Daily Rainfall:

No attempt was made to measure rainfall immediately above the forest crown. Standard ordinary and automatic
recording raingauges installed at the ground level just outside the forest edge are used to estimate the direct incident rainfall. Records from the six raingauges installed on the boundary of the forest show that there may not be much difference between the rainfall inside the forest and just outside the forest edge.

7.3.2 Throughfall:

Metal Throughfall troughs (Wright, 1977) of size 200 cm x 20 cm x 30 cm (Fig 7.2) were used to measure the throughfall. They were constructed of pre-fabricated mild steel sheet. The troughs were placed, 5 to 10 at a spot interconnected with each other, below the crown at the ground level. The troughs were tilted for rapid transfer of the water to the measurement device. A shallow tilt increases the response time of the gauge and also increases evaporation loss. A steep tilt means that the shallow flow is fast enough to wash any trash towards the drain hole. The water collected through the troughs were measured and compared, in depth, with the readings in the raingauges kept just outside the forest. The troughs were kept as clean as possible to minimise evaporation loss from damp trash in the trough. Ten troughs were used for keeping randomly under different tree crowns. Daily average values were computed and compared with the incident rainfall.
FIG. 7.2 THROUGHFALL TROUGH AND COLLAR TYPE STEMFLOW GAUGE
Since the position of the troughs were changed frequently, it was observed that on an average the excess readings obtained due to 'drip points' had neutralised with the 'null points'. During large storms water leave branches at some bends and low points in a steady trickle; it is meant by 'drip point'. 'Null Point' is where there are no drop even during large storms.

7.3.3 Stemflow:

Collar type gauge has been used to compute the stemflow. Thick (1 mm) and stiff polythene collars were sealed to the trunks with bitumastic sealing compound and had drain-tubes to conduct the water to the measuring device. The crown areas were estimated from the vertical projection of the edge of the crown to the ground and used in computing the net stemflow. In the present study six trees were selected, of which the crown areas ranging from 11.34 sq.m to 40.69 sq.m. and dbh from 12.1 cm to 51.6 cm. The height of the trees selected for the study ranges from 5 m to 22 m.

Stemflow varies mainly with dbh, crown area, canopy thickness. Therefore the trees for stemflow studies were selected in such a way that the average of each parameter of the selected trees are almost coinciding with the averages of the total trees in the study area.
During the southwest monsoon period, most of the days the rainfall is either continuous or with very less time-gap between showers in the Western Ghats region of Kerala. Hence, measurements were made daily during June, July, August and September of 1986. To minimise the evaporation losses from the measuring devices, polythene covers were used on the top of the collecting jars and a thin layer of coconut oil was applied daily over the water content. By these methods it was found that the evaporation loss was almost zero from the measuring devices of the gauges. During heavy raining, intermittent measurements were made to prevent overflow from the collectors and in most of the cases data was collected immediately after very mild showers. General views of throughfall troughs and stemflow gauges are given in Figs 7.3 and 7.4, respectively.

7.4 RESULTS

7.4.1 Throughfall

The values in Table 7.1 indicate that during the monsoon period throughfall did not occur when the daily rainfall is less than 2.0 mm. In the range of 2 to 2.9 mm rainfall, only an average of 6% of the rainfall occurred as throughfall under the thick mixed forest, but it increased with the rainfall. In the case of 4 to 4.9 mm range of
Table 7.1: Distribution of daily incident rainfall under the forest stand as throughfall, stemflow and interception loss

<table>
<thead>
<tr>
<th>Date of measurement</th>
<th>Incident rainfall (mm)</th>
<th>Average total (mm)</th>
<th>% of incident rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thro-</td>
<td>Stem</td>
<td>Interc-</td>
</tr>
<tr>
<td></td>
<td>ugh -</td>
<td>flow</td>
<td>tion -</td>
</tr>
<tr>
<td></td>
<td>fall</td>
<td>loss</td>
<td>fall</td>
</tr>
<tr>
<td>01.6.86</td>
<td>4.3</td>
<td>2.32</td>
<td>0.10</td>
</tr>
<tr>
<td>04.6.86</td>
<td>0.2</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>06.6.86</td>
<td>110.2</td>
<td>97.34</td>
<td>6.76</td>
</tr>
<tr>
<td>07.6.86</td>
<td>2.3</td>
<td>0.08</td>
<td>0.02</td>
</tr>
<tr>
<td>08.6.86</td>
<td>3.3</td>
<td>0.98</td>
<td>0.08</td>
</tr>
<tr>
<td>09.6.86</td>
<td>32.5</td>
<td>27.00</td>
<td>1.35</td>
</tr>
<tr>
<td>10.6.86</td>
<td>0.3</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>11.6.86</td>
<td>0.3</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>12.6.86</td>
<td>16.4</td>
<td>12.99</td>
<td>0.65</td>
</tr>
<tr>
<td>13.6.86</td>
<td>44.4</td>
<td>38.90</td>
<td>1.98</td>
</tr>
<tr>
<td>14.6.86</td>
<td>73.7</td>
<td>65.23</td>
<td>3.60</td>
</tr>
<tr>
<td>15.6.86</td>
<td>97.5</td>
<td>87.65</td>
<td>5.17</td>
</tr>
<tr>
<td>16.6.86</td>
<td>68.4</td>
<td>58.57</td>
<td>3.30</td>
</tr>
<tr>
<td>17.6.86</td>
<td>28.6</td>
<td>22.86</td>
<td>1.12</td>
</tr>
<tr>
<td>18.6.86</td>
<td>72.5</td>
<td>64.79</td>
<td>3.73</td>
</tr>
<tr>
<td>19.6.86</td>
<td>75.1</td>
<td>64.45</td>
<td>4.02</td>
</tr>
<tr>
<td>20.6.86</td>
<td>71.3</td>
<td>63.67</td>
<td>3.67</td>
</tr>
<tr>
<td>21.6.86</td>
<td>66.4</td>
<td>57.77</td>
<td>3.19</td>
</tr>
<tr>
<td>22.6.86</td>
<td>27.5</td>
<td>21.89</td>
<td>0.92</td>
</tr>
<tr>
<td>23.6.86</td>
<td>84.2</td>
<td>72.09</td>
<td>4.48</td>
</tr>
<tr>
<td>24.6.86</td>
<td>79.2</td>
<td>68.33</td>
<td>4.17</td>
</tr>
<tr>
<td>25.6.86</td>
<td>102.7</td>
<td>90.65</td>
<td>6.11</td>
</tr>
<tr>
<td>26.6.86</td>
<td>37.5</td>
<td>32.83</td>
<td>1.62</td>
</tr>
<tr>
<td>27.6.86</td>
<td>34.5</td>
<td>30.02</td>
<td>1.32</td>
</tr>
<tr>
<td>28.6.86</td>
<td>61.5</td>
<td>52.98</td>
<td>2.76</td>
</tr>
<tr>
<td>29.6.86</td>
<td>66.6</td>
<td>58.66</td>
<td>3.17</td>
</tr>
<tr>
<td>30.6.86</td>
<td>26.1</td>
<td>20.33</td>
<td>0.95</td>
</tr>
<tr>
<td>Date of measurement (mm)</td>
<td>Incidence</td>
<td>Average total (mm)</td>
<td>% of incident rainfall</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------</td>
<td>--------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>01.7.86</td>
<td>62.6</td>
<td>55.97</td>
<td>3.00</td>
</tr>
<tr>
<td>02.7.86</td>
<td>0.2</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>06.7.86</td>
<td>2.4</td>
<td>0.06</td>
<td>0.02</td>
</tr>
<tr>
<td>07.7.86</td>
<td>19.2</td>
<td>15.64</td>
<td>0.76</td>
</tr>
<tr>
<td>08.7.86</td>
<td>12.6</td>
<td>8.88</td>
<td>0.44</td>
</tr>
<tr>
<td>09.7.86</td>
<td>15.5</td>
<td>11.06</td>
<td>0.58</td>
</tr>
<tr>
<td>10.7.86</td>
<td>0.4</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>12.7.86</td>
<td>9.3</td>
<td>5.66</td>
<td>0.24</td>
</tr>
<tr>
<td>13.7.86</td>
<td>138.8</td>
<td>125.16</td>
<td>8.72</td>
</tr>
<tr>
<td>14.7.86</td>
<td>60.3</td>
<td>50.28</td>
<td>2.81</td>
</tr>
<tr>
<td>15.7.86</td>
<td>54.5</td>
<td>44.47</td>
<td>2.53</td>
</tr>
<tr>
<td>16.7.86</td>
<td>32.4</td>
<td>26.73</td>
<td>1.44</td>
</tr>
<tr>
<td>17.7.86</td>
<td>4.2</td>
<td>0.27</td>
<td>0.09</td>
</tr>
<tr>
<td>19.7.86</td>
<td>16.3</td>
<td>12.76</td>
<td>0.64</td>
</tr>
<tr>
<td>20.7.86</td>
<td>42.2</td>
<td>36.28</td>
<td>1.76</td>
</tr>
<tr>
<td>21.7.86</td>
<td>65.2</td>
<td>56.35</td>
<td>3.12</td>
</tr>
<tr>
<td>22.7.86</td>
<td>15.6</td>
<td>11.35</td>
<td>0.59</td>
</tr>
<tr>
<td>23.7.86</td>
<td>15.4</td>
<td>11.07</td>
<td>0.58</td>
</tr>
<tr>
<td>24.7.86</td>
<td>12.5</td>
<td>8.99</td>
<td>0.41</td>
</tr>
<tr>
<td>25.7.86</td>
<td>31.7</td>
<td>26.49</td>
<td>1.27</td>
</tr>
<tr>
<td>26.7.86</td>
<td>12.7</td>
<td>9.32</td>
<td>0.42</td>
</tr>
<tr>
<td>27.7.86</td>
<td>2.3</td>
<td>0.36</td>
<td>0.02</td>
</tr>
<tr>
<td>29.7.86</td>
<td>0.3</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>30.7.86</td>
<td>20.2</td>
<td>15.73</td>
<td>0.80</td>
</tr>
<tr>
<td>31.7.86</td>
<td>9.0</td>
<td>6.23</td>
<td>0.24</td>
</tr>
<tr>
<td>02.8.86</td>
<td>27.5</td>
<td>22.75</td>
<td>1.10</td>
</tr>
<tr>
<td>03.8.86</td>
<td>18.5</td>
<td>13.43</td>
<td>0.72</td>
</tr>
<tr>
<td>04.8.86</td>
<td>6.3</td>
<td>2.41</td>
<td>0.16</td>
</tr>
<tr>
<td>05.8.86</td>
<td>84.4</td>
<td>75.49</td>
<td>4.26</td>
</tr>
<tr>
<td>06.8.86</td>
<td>41.4</td>
<td>35.77</td>
<td>1.78</td>
</tr>
<tr>
<td>07.8.86</td>
<td>135.3</td>
<td>121.13</td>
<td>8.35</td>
</tr>
<tr>
<td>08.8.86</td>
<td>67.4</td>
<td>59.09</td>
<td>3.35</td>
</tr>
<tr>
<td>09.8.86</td>
<td>58.5</td>
<td>51.90</td>
<td>2.73</td>
</tr>
<tr>
<td>10.8.86</td>
<td>40.3</td>
<td>34.09</td>
<td>1.85</td>
</tr>
<tr>
<td>Date of measurement</td>
<td>Incidence daily rainfall (mm)</td>
<td>Average total (mm)</td>
<td>% of incident rainfall</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>Thru fall</td>
<td>Stem flow</td>
<td>Interception loss</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>11.8.86</td>
<td>68.1</td>
<td>60.51</td>
<td>3.42</td>
</tr>
<tr>
<td>12.8.86</td>
<td>37.3</td>
<td>29.24</td>
<td>1.60</td>
</tr>
<tr>
<td>13.8.86</td>
<td>18.0</td>
<td>13.39</td>
<td>0.69</td>
</tr>
<tr>
<td>14.8.86</td>
<td>22.6</td>
<td>17.63</td>
<td>0.86</td>
</tr>
<tr>
<td>15.8.86</td>
<td>7.2</td>
<td>3.24</td>
<td>0.18</td>
</tr>
<tr>
<td>16.8.86</td>
<td>2.3</td>
<td>0.14</td>
<td>0.02</td>
</tr>
<tr>
<td>22.8.86</td>
<td>4.4</td>
<td>2.14</td>
<td>0.09</td>
</tr>
<tr>
<td>06.9.86</td>
<td>16.3</td>
<td>11.15</td>
<td>0.59</td>
</tr>
<tr>
<td>07.9.86</td>
<td>22.2</td>
<td>17.47</td>
<td>0.86</td>
</tr>
<tr>
<td>08.9.86</td>
<td>12.3</td>
<td>8.70</td>
<td>0.43</td>
</tr>
<tr>
<td>09.9.86</td>
<td>1.3</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10.9.86</td>
<td>3.2</td>
<td>0.36</td>
<td>0.07</td>
</tr>
<tr>
<td>11.9.86</td>
<td>2.4</td>
<td>0.22</td>
<td>0.02</td>
</tr>
<tr>
<td>16.9.86</td>
<td>4.1</td>
<td>1.92</td>
<td>0.08</td>
</tr>
<tr>
<td>17.9.86</td>
<td>9.3</td>
<td>6.52</td>
<td>0.26</td>
</tr>
<tr>
<td>18.9.86</td>
<td>56.2</td>
<td>49.70</td>
<td>2.44</td>
</tr>
<tr>
<td>19.9.86</td>
<td>38.0</td>
<td>32.46</td>
<td>1.55</td>
</tr>
<tr>
<td>20.9.86</td>
<td>51.4</td>
<td>44.68</td>
<td>2.24</td>
</tr>
<tr>
<td>21.9.86</td>
<td>175.6</td>
<td>157.34</td>
<td>11.62</td>
</tr>
<tr>
<td>22.9.86</td>
<td>36.0</td>
<td>30.01</td>
<td>1.49</td>
</tr>
<tr>
<td>23.9.86</td>
<td>2.0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>24.9.86</td>
<td>4.0</td>
<td>0.98</td>
<td>0.08</td>
</tr>
<tr>
<td>26.9.86</td>
<td>42.3</td>
<td>36.18</td>
<td>1.77</td>
</tr>
<tr>
<td>27.9.86</td>
<td>2.2</td>
<td>0.09</td>
<td>0.02</td>
</tr>
<tr>
<td>28.9.86</td>
<td>0.4</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
rainfall, the average throughfall was 36% and in the range of 15 to 19.9 mm it was 75%. When the rainfall exceeded 50 mm there was no much steep change in the through throughfall percentage (Fig. 7.5).

Linear regression analysis was used to determine relationship between daily rainfall and throughfall. In Fig. 7.6 the throughfall is shown in relation to daily rainfall. The linear regression of mean throughfall (T mm) on daily rainfall (R mm) using the data for 79 days gave the equation.

\[ T = 0.909 R - 2.325 \]

Daily rainfall versus throughfall is plotted in Fig. 7.7 and the regression line is drawn. It can be seen that throughfall linearly increases with the daily rainfall and has a strong relationship with each other. The correlation coefficient between throughfall and daily rainfall is computed as \( r = 0.9996 \), which is almost a perfect correlation and is highly significant.

Separate regression analysis were done for different ranges of rainfall. The regression equations and the correlation coefficients are given in Table 7.2 for different ranges of rainfall. All the equations give almost identical results when used to estimate the mean throughfall from daily rainfall.
Fig 7.5 AVERAGE THROUGHFALL, STEMFLOW AND INTERCEPTION LOSS IN DIFFERENT RANGES OF DAILY RAINFALL
Fig 7.6 STEMFLOW, THROUGHFALL AND NET RAINFALL AS PERCENTAGE OF DAILY RAINFALL
RELATION OF THROUGHFALL (T) TO DAILY RAINFALL (R)

\[ T = 0.909R - 2.325 \]
Table 7.2: Regression equations and correlation coefficients between throughfall and rainfall

<table>
<thead>
<tr>
<th>Ranges of rainfall (mm)</th>
<th>Regression equation (T)</th>
<th>Correlation coeff. (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 19.9</td>
<td>0.832 R - 1.567</td>
<td>0.9904</td>
</tr>
<tr>
<td>20 - 49.9</td>
<td>0.950 R - 3.857</td>
<td>0.9947</td>
</tr>
<tr>
<td>50 - 99.9</td>
<td>0.929 R - 3.719</td>
<td>0.9925</td>
</tr>
</tbody>
</table>

7.4.2 Stemflow

As in the case of throughfall, average stemflow increased with the increase of rainfall. In the range of 2 to 2.9 mm of rainfall the average stemflow was less than one percentage. In some cases it was very little, not even measurable. In Fig 7.6 the increase in stemflow with the rainfall is shown. From the data collected, it was noticed that for a rainfall of 175.6 mm, the average stemflow was only 11.62 mm. The characteristics of the trees selected for the stemflow studies are shown in Table 7.3 and the variations in average stemflow in different trees with different ranges of rainfall are illustrated in Table 7.4.
Table 7.3 Characteristics of the forest trees selected for stemflow recording

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Species</th>
<th>Height (m)</th>
<th>dbh (cm)</th>
<th>Crown area (sq.m)</th>
<th>Crown thickness (m)</th>
<th>Crown coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aporusa lindleyana</td>
<td>5</td>
<td>16.5</td>
<td>11.34</td>
<td>2.5</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>Machilus macrantha</td>
<td>8</td>
<td>12.1</td>
<td>19.63</td>
<td>6.0</td>
<td>85</td>
</tr>
<tr>
<td>3</td>
<td>Euodia lunuakenda</td>
<td>12</td>
<td>27.7</td>
<td>30.18</td>
<td>5.5</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Terminalia paniculata</td>
<td>13</td>
<td>26.4</td>
<td>28.26</td>
<td>8.0</td>
<td>80</td>
</tr>
<tr>
<td>5</td>
<td>Terminalia paniculata</td>
<td>22</td>
<td>51.6</td>
<td>40.69</td>
<td>12.0</td>
<td>85</td>
</tr>
<tr>
<td>6</td>
<td>Ailanthus triphysa</td>
<td>12</td>
<td>20.1</td>
<td>15.20</td>
<td>5.5</td>
<td>75</td>
</tr>
</tbody>
</table>

* Crown thickness and coverage including branches of nearby trees
Table 7.4: Variations in average stemflow (%) in the selected trees (as shown in Table 7.3) with different ranges of rainfall

<table>
<thead>
<tr>
<th>Range of rainfall (mm)</th>
<th>Trees selected for stemflow measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0-0.9</td>
<td>0.00</td>
</tr>
<tr>
<td>1-1.9</td>
<td>0.00</td>
</tr>
<tr>
<td>2-2.9</td>
<td>0.82</td>
</tr>
<tr>
<td>3-3.9</td>
<td>2.31</td>
</tr>
<tr>
<td>4-4.9</td>
<td>1.76</td>
</tr>
<tr>
<td>5-6.9</td>
<td>2.50</td>
</tr>
<tr>
<td>7-9.9</td>
<td>2.56</td>
</tr>
<tr>
<td>10-14.9</td>
<td>2.89</td>
</tr>
<tr>
<td>15-19.9</td>
<td>3.23</td>
</tr>
<tr>
<td>20-29.9</td>
<td>2.96</td>
</tr>
<tr>
<td>30-49.9</td>
<td>3.39</td>
</tr>
<tr>
<td>50-69.9</td>
<td>4.30</td>
</tr>
<tr>
<td>70-99.9</td>
<td>4.89</td>
</tr>
<tr>
<td>100-149.9</td>
<td>6.24</td>
</tr>
<tr>
<td>150-200.0</td>
<td>6.67</td>
</tr>
</tbody>
</table>

Linear regression analysis using the data of the monsoon months, in which rainfall varies from 0 to 175.6 mm, gave the following relation between the average depth of stemflow (S) and daily rainfall (R).

\[ S = 6.026 \times 10^{-2} R - 0.439 \]

In Fig. 7.8, stemflow versus daily rainfall is plotted and the regression line is drawn. Between 20 and 90
mm of rainfall the stemflow showed a slight decrease compared to the line of best fit. The correlation coefficient between stem flow and the daily rainfall is found to be 0.9881, which is significant. The regression equations and the correlation coefficients between stemflow and daily rainfall for different ranges are illustrated in Table 7.5.

Table 7.5 : Regression equation and correlation coefficient coefficients between stemflow and rainfall

<table>
<thead>
<tr>
<th>Ranges of rainfall (mm)</th>
<th>Regression equation (S)</th>
<th>Correlation coeff. (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 19.9</td>
<td>0.04138 R - 0.0126</td>
<td>0.9918</td>
</tr>
<tr>
<td>20 - 49.9</td>
<td>0.04983 R - 0.2880</td>
<td>0.9813</td>
</tr>
<tr>
<td>50 - 99.9</td>
<td>0.06600 R - 1.1330</td>
<td>0.9908</td>
</tr>
</tbody>
</table>

7.4.3 Net Rainfall

Net rainfall is the water that reaches the surface of the ground as throughfall and stemflow. The sum of mean throughfall (T) and the mean stemflow (S) was used as the net rainfall (N). That is the difference between the incident rainfall and the lost rainfall due to interception. Since N is dependent of T and S, naturally when T and S increase N also increases.
The percentage of lost rainfall is less in the range of 100 to 149.9 mm, when compared to 0 to 19.9 mm rainfall. But when it was considered in quantity-wise the lost rainfall was high in the first case. Specifically, in the range of 2 to 2.9 mm rainfall, the average lost rainfall was 93.21% of incident rainfall and in 100-149.9 mm range, it was 4.68%. Depth-wise it was 2.12 mm and 5.7 mm, respectively.

Linear regression analysis using the net rainfall and the daily rainfall, varies from 0 to 175.6 mm, gave the following relation between the net rainfall (N) and daily rainfall (R).

\[ N = 0.969 \times R - 2.764 \]

Using the above equation the line of best fit is obtained and is plotted in Fig. 7.9. The correlation coefficient computed between net rainfall and daily rainfall show a value of \( r = 0.9995 \), which is positive and highly significant.

Separate regression analysis were also done for different ranges of rainfall. The regression equations and the correlation coefficients are given in Table 7.6 for different ranges of rainfall.
Fig 7.9 RELATION OF NET RAINFALL (N) TO DAILY RAINFALL (R)

The relation is given by the equation:

\[ N = 0.969R - 2.764 \]
Table 7.6 Regression equations and correlation coefficients between net rainfall and daily rainfall

<table>
<thead>
<tr>
<th>Ranges of rainfall (mm)</th>
<th>Regression equation (N)</th>
<th>Correlation coeff. (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 19.9</td>
<td>0.8740 R - 1.639</td>
<td>0.9908</td>
</tr>
<tr>
<td>20 - 49.9</td>
<td>0.9996 R - 4.145</td>
<td>0.9952</td>
</tr>
<tr>
<td>50 - 99.9</td>
<td>0.9940 R - 4.853</td>
<td>0.9937</td>
</tr>
</tbody>
</table>

The results based on the data of southwest monsoon months of 1986 reveal that 10.45% of the total incident rainfall has been lost as interception. During the period, throughfall is 84.67% and stemflow is 4.88%. In terms of depth correlation between throughfall and interception loss is positive but it is negative between percentage throughfall and percentage interception loss which indicates that the percentage interception loss decreases with the increasing proportion of throughfall and also with stemflow and amount of incident precipitation.

Because of the retention of a good amount of rain water in the forest canopy, it was noticed that the humidity of the region is very high compared to the open area. This will prevent evaporation from forest soil. Because of the good coverage of green leaves, the gravitational force of
rain drops are minimised on the way, which is a natural prevention against soil erosion.

The study reported is only a footstep of novel studies to be carried out in the forest region of Western Ghats. The study has to be continued in the months other than southwest monsoon period and it should be extended to different forest types. Since Kerala is covered by about 20% of forest, similar type of studies have got vital importance while considering the water balance of the region.