CHAPTER VI

WATER BALANCE AND CLIMATIC CLASSIFICATION OF THE
BRAHMAPUTRA VALLEY

Because of seasonal nature of rainfall, the Brahmaputra Valley suffers from frequent floods during summer and a long drought during winter. During summer, the valley loses sufficient amount of water, mainly by surface runoff, while during winter it suffers from water deficiency. So, for the planning for better utilization of the water resource of the region, the study of water balance of the region is very important. Moreover, being intimately related to rainfall and other climatological parameters, it is important for the rational classification of regional climates.

Water balance includes several other related parameters like - rainfall, potential and actual evapotranspirations, water deficit, water surplus, moisture index, runoff etc. Thus, it forms a link among atmosphere, soil and plant kingdom. Here, water balance parameters of the Brahmaputra Valley have been computed and then, climatic classification of the valley is made.

Methodology:

Thornthwaite's bookkeeping procedure (Thornthwaite, 1948) is used to study the water balance of the Brahmaputra Valley. The method is simple and seems to have wide application.
(Mather, 1969, 1974; Sanderson, 1966; Thornthwaite and Mather, 1955; Van Hylckama, 1956; Subrahmanyan and Kumar, 1976; Reddy, 1977; Abbi, 1979). It includes the (1) estimation of potential evapotranspiration, (2) determination of actual evapotranspiration, (3) determination of water surplus and water deficit, (4) determination of runoff and (5) determination of moisture index.

(1) Estimation of potential evapotranspiration:

The evaporation from soil surfaces and the transpiration by the plants are collectively known as evapotranspiration. Generally, for a certain period of the year, sufficient water is available for evapotranspiration, while for the rest of the period, specially during lean season, supply of water for evapotranspiration is not enough. So, during the lean period, evapotranspiration is less than the amount that would have been available if there were sufficient supply of water for evapotranspiration (potential evapotranspiration). The evapotranspiration that actually takes place is called the actual evapotranspiration.

There are several empirical formulae for the estimation of potential evapotranspiration (Thornthwaite, 1948; Kohler et al., 1955; Penman, 1948, 1956, 1963; Hamon, 1961; Slatyer and Mollory, 1961; Reddy and Rao, 1973). Sanderson (1950) has shown that Thornthwaite's formula gives satisfactory results for diverse climatic situations from high Arctic latitudes to equatorial regions. But, Padmanabhamurthy and Biswas (1971)
observed that in Indian climate potential evapotranspiration estimated by Thornthwaite's formula, underestimate the winter months and overestimate the rest of the months of the year. Sellers (1965) and Hounam (1971) suggested that Penman's formula is most advisable for the estimation of potential evapotranspiration, compared to all other formulae.

In this study, Penman's formula is used for the estimation of potential evapotranspiration. The formula may be represented as,

\[ PE = \left[ \frac{P_o}{P_h} \frac{\Delta}{\gamma} \right] \left[ R_A (1-r) (0.29 \cos \phi + 0.52 (1-m)) \right. \\
- \sigma T^4 (0.56 - 0.092 \sqrt{e_d} ) (0.10 + 0.09 (1-m)) \left. \right] \\
+ 0.35 (e_a - e_d ) (1 + \frac{m}{100}) \right] \left( \frac{\Delta}{\gamma} + 1 \right) \frac{P_o}{P_h} \]

where, \( PE \) = potential evaporation in mm/day,

\( R_A \) = incident radiation outside the top of the atmosphere on a horizontal surface expressed in mm of evaporable water/day,

\( r \) = albedo = 0.25 (assumed)

\( m \) = average cloudiness at 0830 hr. and 1730 hr.

expressed as a decimal factor,

\( T \) = mean temperature in degree absolute,

\( \phi \) = Stefan - Boltzmann constant,

\( e_a \) = saturation vapour pressure in mm of Hg,
$e_d$ = actual mean vapour pressure in mm of Hg,
$u$ = wind speed at 2 metres above the ground in miles/day,
$\Delta$ = rate of change of saturation vapour pressure with temperature in mb/°C,
$\psi$ = psychrometric constant = 0.62 mb/°C,
$\phi$ = latitude of the station,
$P_o$ = sea level pressure in mb, and
$P_h$ = station level pressure in mb.

Generally, wind data that are available, are measured at a standard height of 10 metres above ground level. So, the wind velocity at 2 metres above ground is obtained by the equation (Conrad and Pallak, 1950),

$$v_2 = v_h \left( \frac{2}{h} \right)^{1/5}$$

(6.2)

where, $v_2$ = wind velocity at 2 metres above ground,
$v_h$ = wind velocity at height, $h$, above ground, and
$h$ = height of the measuring instrument in metre.

Finally, the monthly values of potential evaporation obtained by using equation (6.1) are multiplied by a factor 0.7 to convert them into potential evapotranspiration as suggested by Penman (Padmanabhamurthy and Reddy, 1970).
(2) Determination of actual evapotranspiration:

For computational purposes of actual evapotranspiration and other water balance parameters, precipitation (P) is compared with potential evapotranspiration (PE\(_T\)) on a monthly basis. In the months during which P > PE\(_T\), actual evapotranspiration is equal to the potential evapotranspiration. But in the months during which P < PE\(_T\), actual evapotranspiration is less than the potential evapotranspiration and the moisture losses from the soil obey an exponential decay law (Thornthwaite and Mather, 1955). During this period soil moisture storage is estimated by,

\[
\text{Storage} = (\text{Field capacity}) \times \exp \left[ \frac{(P - PE_T)}{\text{Field capacity}} \right] \quad (6.3)
\]

where P < PE\(_T\). Here field capacity is assumed to be 20 cm of rainfall. Subba Rao and Subrahmanyan (1961), and Abbi and his co-workers (1978) also assumed the same value (20 cm) of field capacity for Mahanadi, Kosi and Ashni catchments. Now, the actual evapotranspiration is estimated by adding the amount of precipitation (monthly value) with the change of storage. Thus, actual evapotranspiration,

\[
\text{AE}_T = PE_T, \quad \text{where } P > PE_T \quad (6.4)
\]

\[= P + |\Delta S|, \quad \text{where } P < PE_T \quad (6.5)
\]

where |\(\Delta S\)| = change of soil moisture storage.
(3) Determination of water surplus and water deficit:

In the months during which \( P > PE_T \), water becomes surplus, otherwise there is a deficit of water. Water surplus (\( WS \)) and water deficit (\( WD \)) are given by:

\[
WS = P - PE_T - \Delta S, \quad \text{when} \ P > PE_T
\]

and

\[
WD = PE_T - AE_T, \quad \text{when} \ PE_T > AE_T
\]

respectively.

(4) Determination of runoff:

When soil moisture storage reaches its field capacity, an excess of precipitation is treated as moisture surplus. It is assumed that only 70% of this surplus of moisture contributes to the surface runoff and the remaining 30% is detained to the next month. Thus runoff (\( R_{oi} \)) of the \( i \)th month is given by

\[
R_{oi} = 0.7 \ (WS_i + 0.3 \ WS_{i-1})
\]

where, \( WS_i \) = water surplus in the \( i \)th month, and \( WS_{i-1} \) = water surplus in the \((i-1)\)th month.

(5) Determination of moisture index:

For climatic classification purpose a moisture index (\( I_m \)) suggested by Thornthwaite (1948) is calculated out for all the stations. The index is given by,

\[
I_m = \frac{100WS - 60WD}{PE_T}
\]
Data:

The climatological data used for this analysis are the monthly mean values of rainfall, daily maximum and minimum temperatures, humidity, vapour pressure, station level pressure and cloud amount for the period 1931-1956. For some stations the period is shorter than this. However, the effect of this discrepancy is assumed to have negligible effect on the results. The selected meteorological stations are Dhubri, Goalpara, Gauhati, Tangla, Tezpur, Majbat, Gohpur, Chaparmukh, Haflong, Sibsagar, North Lakhimpur, Dibrugarh and Digboi (Appendix I).

The factor albedo (r) depends on the exposed surface and hence have different values for different surfaces. For forests, green fields, dry plowed fields, grass, bare ground and sand, the value of albedo are about 3-10%, 3-15%, 20-25%, 15-30%, 7-20% and 15-25% respectively (Riehl, 1978). Since, the observed data for albedo in the Brahmaputra Valley is not available, by considering the above mentioned values of albedo, 25% or 0.25 is taken as the value of albedo for all the stations and for all the months of the year. The same value of albedo (0.25) was also used by Abbi and his co-workers (1978) in the water balance analysis of Mahanadi catchment in India.

Data for solar radiation outside the atmosphere (R_A) is taken from the book "Weather and Climate" (Koppen and Long, 1958) and for all the stations interpolated values are used. The climatological as well as the solar radiation data for all the
stations are presented in Appendix VII.

Results and discussion:

Potential evapotranspiration

For all the stations, amounts of potential evaporation in all the months of the year are calculated out by using equation (6.1) and then converted into potential evapotranspiration by multiplying each of the values of potential evaporation by a factor 0.7. The monthwise variations of potential evapotranspiration for different stations are shown in the water balance diagrams (Figure 10.3). At majority of the stations, maximum amount of monthly potential evapotranspiration is observed in the month of April and its minimum amount is observed in the month of either December or January.

For the whole valley, on the average, amounts of potential evapotranspiration ($PET$) in all the months individually are calculated out by applying "Thiessen's Polygon" method (Thiessen and Alter, 1911). The seasonal variation of potential evapotranspiration for the whole valley also is shown in Figure 10.3. It is observed that for the period April to October $P > PET$. So, as there is an excess of precipitation ($P$) than the potential evapotranspiration or water need, this period is a wet period in the valley. During the rest period of the year (November to March) $P < PET$, that is, the supply of water by precipitation is less than that of water need. So, this period is a dry period in the valley. From the month of January onwards, potential evapotranspiration increases becoming maximum in April and then decreases to minimum in
December. Thus it is observed that the growth of the seasonal variation curve of potential evapotranspiration is more rapid than its decay. The maximum and the minimum value of potential evapotranspiration in the months of April and December respectively are mainly associated with the variation of wind speed \( u \) and the difference between saturated and actual vapour pressure \( (e_a - e_d) \). These two factors which have positive contribution to potential evapotranspiration (equation (6.1)), also show April maximum and December minimum. Cloud amount \( (m) \), which is inversely associated with potential evapotranspiration (cloud amount reduces solar radiation), and solar radiation outside the atmosphere \( (R_A) \) though does not show minimum and maximum values respectively in the month of April, their combined effect, that is the first term of the numerator in equation (6.1) \( (R_A(1-r) \{0.29 \cos \theta + (1 - m)\}) \) shows April maximum. Thus, the maximum value of potential evapotranspiration in the month of April is due to the contribution of the first and the third term of the numerator in equation (6.1).

The minimum values of wind speed \( u \) and the difference between the saturated and actual vapour pressure, that is the third term \( (0.35 (e_a - e_d) (1 + \frac{u}{100}) \) in equation (6.1) causes December minimum in the seasonal variation of potential evapotranspiration.

The areal distribution of annual total potential evapotranspiration is shown in Figure 10.1. The distribution pattern is governed by the combined effect of the parameters which are related to potential evapotranspiration (equation (6.1)).
Fig. 10.1 Areal distribution of mean annual potential evapotranspiration in the Brahmaputra Valley (in cm.).
Generally, potential evapotranspiration seems to be greater in the lower part of the valley than the upper part, being a maximum at Tangla (153.2 cm/yr) and a minimum at Digboi (115.7 cm/yr). The areal average of the annual total potential evapotranspiration in the valley is found to be about 133.56 cm/yr or 1335.6 litre/m²/yr.

**Actual evapotranspiration:**

During wet period (April to October) in which $P > P_{ET}$, actual and potential evapotranspiration are same, but during the lean or dry period (November to March), when $P < P_{ET}$, actual evapotranspiration ($AE_T$) is less than potential evapotranspiration. Climatologically, during this period, the supply of water by precipitation is not sufficient for vegetation and arid atmosphere prevails. So, in this period plants use a part of the moisture that is stored in soil during the wet period. For this period, actual evapotranspiration in each month is calculated by using equation (6.5). Graphical representation of the amount of actual evapotranspiration for all the station are shown in Figure 10.3.

The areal distribution of the annual total actual evapotranspiration is shown in Figure 10.2. The areal distribution pattern is not similar to the distribution pattern of the potential evapotranspiration. Actual evapotranspiration generally, increases with latitude except towards the southern part of the Mikir Hills, where the case is reverse. Thus,
Fig. 10.2 Areal distribution of mean annual actual evapotranspiration in the Brahmaputra Valley (in cm.).
towards the northern boundary of the valley actual evapotranspiration is high. In other words, the amount of water that evaporated from soil and transpired by the plants is high towards the northern boundary of the valley. Towards the south of the Mikir Hills, though potential evapotranspiration decreases, actual evapotranspiration increases. This anomaly between the actual and potential evapotranspiration distribution patterns are mainly due to the different lengths of the dry period \( P < PE_A \) and also the occurrence of different amount of rainfall during the dry period at different locations in the valley. Maximum and minimum values of actual evapotranspiration are found at Gohpur (138.70 cm/yr) and at Sibsagar (113.29 cm/yr) respectively. On the average, actual evapotranspiration in the valley is found to be about 123.84 cm/yr or 1238.4 litre/m²/yr.

**Water surplus and water deficit**

Total annual water surplus and water deficit calculated by using equations (6.6) and (6.7) respectively are presented in Table VIII(a). Water deficit is found to be maximum at Dhubri. At North Lakhimpur, water deficit is minimum, while water surplus is maximum. In the upper part of the valley water deficit is very small in comparison to that in the lower part. Reverse is the case for water surplus. The average picture of the valley shows about 9.72 cm water deficit and about 106.80 cm water surplus in a year. On the average, the periods of water deficit and water surplus are found to be from November
Table VIII(a): Annual water deficit and water surplus at different stations

<table>
<thead>
<tr>
<th>Station</th>
<th>Water deficit in cm/yr</th>
<th>Water surplus in cm/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dhubri</td>
<td>24.67</td>
<td>127.44</td>
</tr>
<tr>
<td>2. Goalpara</td>
<td>18.34</td>
<td>109.12</td>
</tr>
<tr>
<td>3. Gauhati</td>
<td>20.38</td>
<td>46.41</td>
</tr>
<tr>
<td>4. Tangla</td>
<td>15.05</td>
<td>67.43</td>
</tr>
<tr>
<td>5. Tezpur</td>
<td>14.38</td>
<td>65.74</td>
</tr>
<tr>
<td>6. Majbat</td>
<td>12.71</td>
<td>78.43</td>
</tr>
<tr>
<td>7. Gohpur</td>
<td>8.35</td>
<td>101.68</td>
</tr>
<tr>
<td>8. Chaparmukh</td>
<td>23.11</td>
<td>40.16</td>
</tr>
<tr>
<td>9. Haflong</td>
<td>5.98</td>
<td>96.49</td>
</tr>
<tr>
<td>10. Sibsagar</td>
<td>2.52</td>
<td>136.14</td>
</tr>
<tr>
<td>11. North Lakhimpur</td>
<td>1.61</td>
<td>229.47</td>
</tr>
<tr>
<td>12. Dibrugarh</td>
<td>1.68</td>
<td>156.50</td>
</tr>
<tr>
<td>13. Digboi</td>
<td>1.86</td>
<td>149.65</td>
</tr>
</tbody>
</table>
to March and May to October respectively. In April, there is no water surplus or deficit.

**Soil moisture utilisation and recharge**

It has already been mentioned that the period from October to April is dry, that is, the amount of precipitation is generally less than that of the water need for evapotranspiration (Fig. 10.3). During this period, water stored as soil moisture is utilized by the plants. After the month of April, rainfall in the valley increases and the amount of rainfall becomes more than that of water need. This surplus water in the beginning of the rainy season is utilized to recharge the soil till it reaches field capacity and then, runoff takes place.

Assuming that the increase or decrease of rainfall to be uniform within a month, the probable date on which soil moisture reaches its field capacity and also the amount of water utilised from the soil moisture storage during the lean period are found out and presented in Table VIII(b). Maximum utilisation of soil moisture is observed at Dhubri. The minimum of soil moisture utilisation is observed at North Lakhimpur. In the upper part of the valley soil moisture utilisation is found to be smaller than in the lower part.

Of all the stations, the soil moisture reaches its field capacity earliest in North Lakhimpur (19th April) and latest in Chaparmukh (22nd June).
Water balance diagrams for some stations located in the Brahmaputra Valley.
Table VIII(b): Amount of soil moisture utilisation and
the date on which soil moisture regains
its field capacity

<table>
<thead>
<tr>
<th>Station</th>
<th>Amount of soil moisture utilisation in cm.</th>
<th>Approximate date on which soil moisture regains its field capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dhubri</td>
<td>17.58</td>
<td>22nd May</td>
</tr>
<tr>
<td>2. Goalpara</td>
<td>16.50</td>
<td>25th May</td>
</tr>
<tr>
<td>3. Gauhati</td>
<td>16.90</td>
<td>11th June</td>
</tr>
<tr>
<td>4. Tangla</td>
<td>15.73</td>
<td>29th May</td>
</tr>
<tr>
<td>5. Tezpur</td>
<td>15.52</td>
<td>1st June</td>
</tr>
<tr>
<td>6. Majbat</td>
<td>15.00</td>
<td>3rd June</td>
</tr>
<tr>
<td>7. Gohpur</td>
<td>13.19</td>
<td>28th May</td>
</tr>
<tr>
<td>8. Ghaparmukh</td>
<td>17.36</td>
<td>22nd June</td>
</tr>
<tr>
<td>9. Haflong</td>
<td>11.76</td>
<td>6th May</td>
</tr>
<tr>
<td>10. Sibsagar</td>
<td>8.44</td>
<td>26th April</td>
</tr>
<tr>
<td>11. North Lakhimpur</td>
<td>7.00</td>
<td>19th April</td>
</tr>
<tr>
<td>12. Dibrugarh</td>
<td>7.13</td>
<td>24th April</td>
</tr>
<tr>
<td>13. Digboi</td>
<td>5.92</td>
<td>18th April</td>
</tr>
</tbody>
</table>
Runoff:

For all the stations, runoff in each of the months of the year is calculated out by using equation (6.8) and presented in Figure 10.4. It is observed that in the valley runoff begins after the month of either April or May when soil moisture reaches its field capacity. From April or May onwards runoff increases to a maximum in the month of either June, July or August and then decreases to a minimum till the soil reaches its field capacity or the period of water surplus begins. Due to the rapid increase of rainfall from April/May to June/July, the amount of surplus water also increases. As the seasonal variation of potential evapotranspiration is small in comparison to precipitation, the time of occurrences of the maxima of precipitation and water surplus coincides at majority of the stations. Thus, water surplus becomes maximum in the month of either June or July. On the other hand, with the increase of water surplus, runoff also increases attaining its maximum value with a little later than the time of water surplus maximum or rainfall maximum. This delay of runoff maximum is due to the assumption that 30% of the surplus water is retained for the succeeding month. For this assumption, the rate of decrease of runoff from its maximum value is small. Though the dry period begins from either October or November, runoff tends to continue till the beginning of water surplus period (April or May), however small it may be. Thus, in the valley as a whole, significant runoff takes place only during the
Fig 10.4 Monthly runoff estimated for different stations located in the Brahmaputra Valley.
Period from May to October. During the remaining period, runoff is negligible. Maximum runoff is observed in the month of June and July in the lower and upper part of the valley respectively, excepting Gohpur, Tezpur and Chaparmukh which show maximum runoff in the month of August.

**Moisture index:**

In Table VIII(c), values of the moisture index calculated by using equation (6.9) are given for all the stations. In the central part of the valley moisture index is observed to be low. In the upper part of the valley, the values of the moisture index are found to be comparatively high. The maximum and minimum values of moisture index are obtained at Chaparmukh and North Lakhimpur respectively. On the average, moisture index is about 75.60 for the whole valley.

**Climatic type:**

Moisture index, water need or potential evapotranspiration, summer concentration, index of aridity and climatic type based on them, are presented in Table VIII(c) for all the stations considered. The tables for climatic classification based on these parameters are given in Appendix VIII. The summer concentration is defined as the percentage of water need during the summer season. The index of aridity is nothing but the water deficit expressed as the percentage of the annual water need.
Table VIII(c): Moisture index, water need, summer concentration, aridity index and climatic type observed at different stations.

<table>
<thead>
<tr>
<th>Station</th>
<th>Moisture index</th>
<th>Water need in cm</th>
<th>Summer concentration in %</th>
<th>Aridity index</th>
<th>Climatic type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dhubri</td>
<td>75.50</td>
<td>149.18</td>
<td>59.38</td>
<td>16.54</td>
<td>B₃A₃wb₂</td>
</tr>
<tr>
<td>2. Goalpara</td>
<td>70.60</td>
<td>138.97</td>
<td>60.23</td>
<td>13.20</td>
<td>B₃A₂wb₂</td>
</tr>
<tr>
<td>3. Gauhati</td>
<td>24.96</td>
<td>136.94</td>
<td>61.44</td>
<td>14.88</td>
<td>B₁A₂wb₂</td>
</tr>
<tr>
<td>4. Tangla</td>
<td>38.11</td>
<td>153.24</td>
<td>65.22</td>
<td>9.82</td>
<td>B₁A₃wb₁</td>
</tr>
<tr>
<td>5. Tezpur</td>
<td>41.64</td>
<td>137.17</td>
<td>61.76</td>
<td>10.48</td>
<td>B₂A₂wb₁</td>
</tr>
<tr>
<td>6. Majbat</td>
<td>53.50</td>
<td>132.34</td>
<td>62.17</td>
<td>9.60</td>
<td>B₂A₂wb₁</td>
</tr>
<tr>
<td>7. Gohpur</td>
<td>65.74</td>
<td>147.05</td>
<td>66.14</td>
<td>5.68</td>
<td>B₃A₃wb₁</td>
</tr>
<tr>
<td>8. Chaparmukh</td>
<td>18.37</td>
<td>143.16</td>
<td>63.20</td>
<td>15.14</td>
<td>C₂A₃wb₁</td>
</tr>
<tr>
<td>9. Haflong</td>
<td>69.55</td>
<td>133.57</td>
<td>61.05</td>
<td>4.48</td>
<td>B₃A₂rb₂</td>
</tr>
<tr>
<td>10. Sibsagar</td>
<td>116.25</td>
<td>115.81</td>
<td>63.60</td>
<td>2.18</td>
<td>A₁rb₁</td>
</tr>
<tr>
<td>11. North Lakhimpur</td>
<td>193.12</td>
<td>118.32</td>
<td>63.32</td>
<td>1.36</td>
<td>A₁rb₁</td>
</tr>
<tr>
<td>12. Dibrugarh</td>
<td>130.99</td>
<td>118.71</td>
<td>63.58</td>
<td>1.42</td>
<td>A₁rb₁</td>
</tr>
<tr>
<td>13. Digboi</td>
<td>128.36</td>
<td>115.72</td>
<td>63.91</td>
<td>1.61</td>
<td>A₁rb₁</td>
</tr>
<tr>
<td>14. Average condition of the valley</td>
<td>75.60</td>
<td>133.56</td>
<td>62.41</td>
<td>7.28</td>
<td>B₃A₂rb₁</td>
</tr>
</tbody>
</table>

The table provides the moisture index, water need, summer concentration, aridity index, and climatic type for different stations in Assam, India.
Regions of different climatic types as observed in Table VIII(c), are shown in Figure 10.5. Only the upper part of the valley is observed to be perhumid. Rest of the valley is found to be $B_1$ to $B_3$ humid except the Mikir Hills. Thermal index shows that the valley belongs to megathermal type of climate. Lakhimpur, Dibrugarh and Sibsagar districts are observed to be $A_1'$ megathermal type. Other districts are found to be of either $A_2'$ or $A_3'$ megathermal type of climate. In the lower part of the valley (Goalpara, Kamrup and Nowgong districts, and the western part of Darrang district), some water deficiency is observed. The remaining part of the valley have negligible water deficiency. The temperature efficiency in the valley is found to be normal to the either first or second mesothermal.

On the average, the climatic type of the valley is (third) humid (second) megathermal with negligible water deficiency and having a thermal efficiency normal to the first mesothermal type of climate.

**Conclusion:**

Water balance analysis at different locations in the valley shows nine types of climate in the valley. Moisture index shows three climatic types - perhumid, humid and subhumid in the valley. Thermal index shows that the valley belongs to megathermal type of climate. On the average, the climate of the valley is third humid second megathermal with negligible winter water deficiency and having a thermal efficiency normal to the first mesothermal.
Fig 10.5 Regions having different climatic types as obtained from the water balance study.
Annual evapotranspiration in the valley is found to be about 133.56 cm/yr or 1335.6 litre/m²/yr. Seasonal variation of potential evapotranspiration shows April maximum and December minimum. Again, potential evapotranspiration is greater in the lower part of the valley in comparison to the upper part. Actual evapotranspiration is found to increase with latitude except towards the south of the Mikir Hills. In the valley, as a whole, it is found to be about 123.84 cm/yr or 1238.4 litre/m²/yr. Thus, an annual water deficit of about 9.72 cm is observed in the valley. During the period October to April, the amount of actual evapotranspiration is less than that of the potential evapotranspiration. So, this is the water deficit or lean period of the year in the valley. In the upper part of the valley, water deficit is negligible and the soil moisture storage reaches its field capacity earlier than the lower part of the valley. The average annual runoff from the valley is found to be about 1068.0 litre/m². Runoff takes place mainly during the period May to October. During the remaining months of the year it is negligible. It becomes maximum in the month of either June or July at all the stations except at Tempur, Gehpur and Chaparmukh.