CHAPTER IX

SUMMARY AND CONCLUSIONS

Vegetational composition of five selected forest sites was determined by point-centre-quarter method and Tectona grandis, Terminalia tomentosa, Anogeissus latifolia, Diospyros melanoxylon, Butea monosperma and Lannea coromandelica were found to be the dominant tree species according to their importance-value-indices (IVI). The IVI of T. grandis was highest in 4 sites ranging from 125.7 to 204.2. Only in site 2, i.e. Bandri Forest, Aegle marmelos was found to be dominant possessing maximum IVI (93.4).

Five CBH classes were made to categorise the trees of lowest to highest (i.e. from 10 to 120 cm.) CBH. The classes possess the following ranges of CBH.

<table>
<thead>
<tr>
<th>Class</th>
<th>Range</th>
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<tbody>
<tr>
<td>1</td>
<td>12.5 to 15 cm.</td>
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<tr>
<td>&quot;</td>
<td>23.0 to 30 cm.</td>
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<tr>
<td>&quot;</td>
<td>49.0 to 55 cm.</td>
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<tr>
<td>&quot;</td>
<td>72.0 to 85 cm.</td>
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<td>100 to 107 cm.</td>
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Average biomass of 3 to 5 trees of each CBH class has been determined in each species.

A study of above and underground biomass of the first four species indicated that dry weights of different parts of a tree increased with tree age (i.e. CBH). It was observed that in total aboveground dry weight, maximum part was contributed by tree trunk (≈ 65%). But the amount varied from species to species as well as from age to age. In earlier stages of life, the percentage biomass of trunk towards the total plant biomass was found to be lesser, but it became higher as the trees grew older. Branches and twigs also showed such fluctuations. On an average they contained 24 and 8% parts of the total aerial biomass respectively. Rest of the portion (≈ 4%) was that of leaves.

In the trunk, about 80% part was seen to be contributed by wood while the remainder was that of bark. The root on an average, contributed about 15% of the dry weight of total plant body. In underground biomass, primary roots showed maximum portion (≈ 65%) in the young age of the tree, but at maturation, secondary and tertiary roots showed higher values of percentage biomass due to their high lateral spread.

It was observed that a mature tree of A. latifolia contained maximum amount of organic matter (1050.36 Kg.) in its above and underground parts than any other species presently of the
same CBH. Other species studied have shown the following order of degradation in the biomass values: *T. grandis* (771.15 Kg.), *T. tomentosa* (764.75 Kg.), *D. melanoxylon* (512.9 Kg.), *B. monosperma* (477.12 Kg.) and *L. coromandelica* (398.1 Kg.).

The life period of a tree in these species could be divided into 4 distinct growth phases which are:

(1) Seedling or coppice : 0-20 cm. CBH
(2) Juvenile phase : 21-50 cm. CBH
(3) Adult phase : 51-90 cm. CBH
and (4) Senile phase : 90 cm. CBH

Hence, the species showed a specific pattern of growth, development and regeneration. In the first phase of life, the trees of about equal age may differ significantly in their CBH because, growth in coppices was seen to be faster than that of the seedlings. This phase remains very short than the juvenile phase in which the trees become well-established. Adult phase is the largest in duration and maximum organic matter is synthesized and stored in the trees in trunk this phase hence, the tree CBH increases considerably in this phase of life. The tree trunks become usually hollow in the last, senile phase. In this stage of over-maturation, trees are usually thought to be suitable for cutting. Number of leaves and total photosynthetic area per tree have shown
a straight rise with an increase in tree CBH and maximum values in all the four species were found for trees of highest CBH. Total leaf area (263.62 sq.m.) and number of leaves (123726) per tree were recorded maximum in a tree of *A. latifolia* while minimum number of leaves per tree was seen in *T. grandis* (4145) and minimum value of leaf area per tree was observed in *D. melanoxylon* (98.7 sq.m.). Average dry weight of a leaf of *T. grandis* was found to be maximum (7.93 g.) whereas it was lowest in *A. latifolia* (0.2 g.).

It is well-known that leaves are the most important part of a plant since they take active part in almost all the life processes of plants like photosynthesis, respiration, transpiration, etc. Synthesis and accumulation of organic matter is totally dependent on the duration and area of leaves on a tree. Therefore, rate of organic matter production was determined in relation to the leaf area. Maximum and minimum rates were found in *D. melanoxylon* (30.8 Kg./sq.m. photosynthetic area/tree) and *T. grandis* (1.28 Kg./sq.m. photosynthetic area/tree). The rate has shown many fluctuations. It actually depends upon the quantity of chlorophyll content in the leaves. Water and light amounts are also very important in the manufacture of organic matter in the plants.

A comparative account of total aboveground plant biomass per hectare in all the five forest sites shows that on an average, aboveground dry weight was about $115 \times 10^3$ Kg./ha.,
whereas the average photosynthetic area was recorded to be $44.55 \times 10^3$ sq.m./ha. Aboveground plant biomass ranged from $87.56 \times 10^3$ Kg. per hectare (site 3: Patharia Forest) to $138 \times 10^3$ Kg. per hectare (site 5: Gopalpura Forest). The variation may be due to the differences in tree densities per hectare at these sites and also due to the variation in age of the stands.

Aboveground plant biomass was observed for tree and shrub layers separately. It was found that shrub layer contributed only a tiny part (0.58% to 2.6%) in the total aboveground plant dry weight per hectare. Only in site 2 (Bandri Forest), due to a luxuriant growth of shrubs, the percentage fraction of shrub layer was considerably high (7.1%).

Total photosynthetic area per hectare ranged from $29.21 \times 10^3$ sq.m. to $65.51 \times 10^3$ sq.m. and shrub layers contributed only 2.29 to 6.82% of the total leaf area per hectare. It was observed that thickness and density of bark differed from species to species and also from part to part in a tree. *T. tomentosa* showed the thickest while *A. latifolia* showed thinnest bark. A direct relationship was observed between girth of stem/root and quantity of bark per unit area. As the girth increased, dry weight of bark/100 sq.cm. also increased. An inverse relationship between the girth of stem/root and percentage dry weight of bark was also observed. Percentage dry weight of bark showed a regular decrease as the girth of
stem/root increased. The above relationships have been encountered in all the four species.

An observation on total aboveground biomass of selected six species in comparison to other species of the same CBH showed that the values of aerial biomass were quite lower in the species studied presently. Trees of semi-arid-zone of Rajasthan (Vyas et al. 1971a, b, c, 1972) showed higher values probably due to a higher amount of leaf area in those species.

On a unit volume basis, dry weights of wood and bark showed highest values in *T. tomentosa* (913 and Kg./cm.) and lowest values in *L. coromandelica* (241 Kg./cm.). It was observed that wood, in all species possessed approximately 3 times more values of dry weight per cubic meter, than that of the bark of corresponding species. Horizontal distribution of roots in an area of 2 x 2 m. around the tree trunk showed that roots were profusely branched in all directions in all species. Maximum number of lateral roots was observed in *A. latifolia* (6-10) whereas the lowest number of lateral roots was observed in *D. melanoxylon* (4-6). Small and thin rootlets were seen arising randomly from any part of primary, secondary or tertiary roots. Other workers of temperate zone (Danial 1962, and Nihlgard 1972) also found such rootlets in *Pinus contorta, Picea marina* and *Fagus sylvatica*, etc. Vegetative
propagation was seen to be very frequent in *D. melanoxylon* by root-suckers. Roots of *B. monosperma* showed a special knotted appearance.

An observation on the data of calorific values of various plant parts showed that leaves possessed highest values of energy content, probably because of their living condition. Wood also showed quite high values of energy content, no matter it belonged to the trunk or root. Barks always showed lowest values of energy content. On ash free dry weight, energy values increased a little in comparison to those of dry weight basis.

Percentage ash content varied from 0.68% to 20.71% in various plant parts. Roots showed highest values of percentage ash content (5.3% to 20.71%) due to considerable contamination of soil particles in them. Woods always showed lowest values of percentage ash content. When the ash content determined by bomb-calorimetry was compared with that determined by muffle-furnace-ignition technique.

A study of total energy content present in the aboveground vegetation showed that on an average $334.2 \times 10^6$ Kg.cal. of energy content per hectare was present in the tree layer only. Ovington (1965) in a 26-year old plantation of *P. sylvestris* found a comparatively low value of energy content ($339 \times 10^5$ Kg.cal./ha.) in the tree layer. He explained this low value
as a result of lesser amount of solar radiation \((100 \times 10^{10} \text{ Cal./ha.})\) received by the forests of temperate zone, than those of the tropical zone \((600 \times 10^{10} \text{ Cal./ha.})\). In the shrub layer, also he found quite low values \((6 \times 10^{5} \text{ Kg.Cal./ha.})\) of energy content than that of the tropical dry deciduous forests of Sagar \((9.8 \times 10^{6} \text{ Kg.Cal./ha.})\).