Chapter VII

GENERAL DISCUSSION AND CONCLUSION

The forest vegetation of study site I comprise of 8 tree species, 4 shrub species and 11 herb species whereas the study site II was represented by 4 tree species, 3 shrub species and 15 herb species. The quantitative analysis have indicated that Q. dealbata was the most dominant tree species with maximum density (8.50 plants $100 \text{ m}^2$) followed by Q. fenestrata (8.00 plants $100 \text{ m}^2$), Q. griffithii (4.00 plants $100 \text{ m}^2$) and Q. griffithiana (2.00 plants $100 \text{ m}^2$) in the forest site I while in the forest site II Q. griffithii was the most dominant tree species with maximum density (9.20 plants $100 \text{ m}^2$) followed by E. arborea (5.60 plants $100 \text{ m}^2$) and A. nepalensis (2.85 plants $100 \text{ m}^2$).

The dominant tree species of Q. dealbata, Q. fenestrata and Q. griffithii have a great efficiency of sprouting from the stump after harvesting for fuel-ling cultivation. The multiplication by seedlings
was observed in the natural habitat in these species. Therefore, in both forest sites *Quercus* *sp.* was found dominant. Shrub species was very poor in both forest sites. *L. scripta* was the most dominant shrub species with maximum density (2.40 plants 25 m²) and VI(108.38) in the forest site I. *L. pinnata* also dominant shrub species exhibiting maximum density (2.50 plants 25 m²) and VI(157.94). Among the herb species, *C. wallichianus* and *H. robrum* were found dominant herb species each in study site I and site II respectively. *C. wallichianus*, the perennial herb species which was contagiously distributed to a shady habitat with close canopy in the forest site I whereas *H. robrum* was found contagiously distributed to the open canopy habitat of the forest site II. In the site I, the forest tree species i.e. *C. camphor*, *G. griffithiana*, *P. schlip*, *C. celebata*, *G. pentastata* and *G. griffithii* exhibited contagious distribution whereas *S. serrulatum* exhibited random distribution. The forest tree species of *A. nepalensis*, *G. griffithii* and *L. arboreum* exhibited contagious distribution while *L. ovalifolia* exhibited random distribution in site II. In both sites most of shrub and
herb species exhibited contagious distribution. Several workers reported that contagious distribution was common in the natural vegetation (Greig-Smith, 1959; Kershaw, 1973; Kalhan et al., 1982).

The total basal cover of tree species was recorded to be 3290.05 cm$^2$ 100 m$^2$ in the forest site I while in the forest site II total basal cover was recorded to be 3454.04 cm$^2$ 100 m$^2$. The total basal cover of the present study site was comparable to the total basal cover of Himalayan forest regions reported by Saxena and Singh (1982).

Aboveground biomass production of forest site I and site II in different strata namely - tree, shrub, and herb was estimated. In both forest sites, aboveground biomass production in different tree species was computed in different age series and in different girth classes. The aboveground biomass production in different components i.e. bole, branch, twig, leaf and fruits increased with the increase of age.

Maximum aboveground biomass per tree basis was recorded to be 81.75 kg tree$^{-1}$ in C. griffithii
and minimum aboveground biomass per tree basis was recorded to be 29.37 kg tree in *G. griffithii* at 40.1 - 50.0 cm girth class in forest site I. Highest value of biomass in *G. griffithii* may be related to higher leaf area per tree basis whereas minimum value in *G. griffithii* may be due to low leaf area. In the forest site II, *G. griffithii* exhibited highest value of aboveground biomass (102.8 kg tree) at 60.1 - 70.0 cm girth class while *L. ovalifolia* contributed lowest value of aboveground biomass (51.52 kg tree) at 50.1-60.0 cm girth class. The highest value of biomass in *G. griffithii* may be partly due to higher leaf area and the lowest value of aboveground biomass in *L. ovalifolia* may be due to low value of leaf area per tree basis. The total aboveground biomass of bole, branch, twig, leaf and fruits increased with the increase of girth class.

On the hectare basis, most of the tree species except *G. griffithii* exhibited maximum aboveground biomass production at 30.1-40.0 cm girth class whereas in the forest site II except *L. ovalifolia* all other species exhibited maximum aboveground biomass production at 40.1-50.0 cm girth class. The contribution
of maximum value of aboveground biomass in these girth class may be due to more density of tree species in these girth class per hectare basis.

The aboveground biomass of tree layer in the forest site I was recorded to be 183.29 t ha$^{-1}$. Maximum value of biomass was contributed by *G. dealbata* (61.10 t ha$^{-1}$), *G. fenestrata* (31.67 t ha$^{-1}$) and *G. griffithii* (27.01 t ha$^{-1}$). The aboveground biomass production in tree layer was recorded to be 211.49 t ha$^{-1}$ in the forest site II. Among the tree species, *G. griffithii* and *A. nepalensis* were the major tree species contributing maximum value of biomass which was recorded to be 94.16 t ha$^{-1}$ and 50.4 t ha$^{-1}$ respectively. The total forest biomass (including shrub and herb) was recorded to be 186.95 t ha$^{-1}$ in the forest site I and 215.08 t ha$^{-1}$ in the forest site II. Of the total forest biomass, tree layer contributed 92.03%, shrub 1.73% and herb 0.18% in the study site I. Of the total forest biomass, tree species contributed 98.33%, shrub 1.09% and herb 0.58% in the forest site II. The total aboveground forest biomass in the forest site II
was found a little higher than the forest site I. This may be due to high density of tree in large girth sizes in the forest site II.

Allometric relationships were computed in different tree species of forest site I and site II by taking two independent variables namely age and dbh with different dependent variables such as bole, branch, twig and leaf. The $r^2$ values were found highly significant. All the forest tree species in the forest site I exhibited their maximum girth size upto 50.0 cm while in the forest site II tree species attained maximum girth size upto 70.0 cm. The mean production of all tree species in the forest site I increased upto the age group of 15-27 years old trees and then declined thereafter. In the forest site II except for L. ovalifolia the other tree species reported increasing trend of mean production upto the age group of 30-32 years old trees and then declined thereafter. Chaturvedi (1987) reported that the current annual production of bole, branch and root system increase upto age group of 39 years old trees and then declined thereafter. Ovington (1962)
also observed the same trend in age series of *P. sylvestris*. The total net primary production in the forest site I was recorded to be 24.20 t ha$^{-1}$ yr$^{-1}$ whereas in the site II was recorded to be 23.80 t ha$^{-1}$ yr$^{-1}$.

The maximum contribution to total net primary productivity in the forest site I was shared by *Q. dealbata* (31.70%) and followed by *Q. fenestrata* (15.63%) and *Q. camphor* (13.52%). In the forest site II the maximum percentage contribution to the total net primary production was recorded to be 39.11% in *Q. griffithii* and 26.40% in *E. arboreum*. The total net primary production in the forest site I was found a little higher than the site II. This is due to more tree species in the forest site I than that of site II.

The concentration of nutrients (N, P, K and Na) were found highest in the leaf followed by twig, branch and bole in all the tree species of the study sites. The concentration of nutrients in different components of these forest tree species was in the order: $N > K > P > Na$. The concentration of nutrients (N, P, K and Na)
in the forest site I were found a little higher than the forest site II. The concentration of nutrients in the forest soil was estimated up to 1 metre depth and the values were found in the order: N > K > Na > P. The concentration of nutrients decrease with the increase of depth. Maximum concentration of nutrients (K, P, K and Na) in different layers was recorded in winter season and minimum was in rainy season. The low concentration of nutrients (N, P, K and Na) in the rainy season may be partly owing to downward movement with percolating water and partly due to peak growth of the vegetation resulting in the higher uptake of nutrients from the soil. The higher concentration of nutrients during winter season may be due to higher input of litterfall and low uptake of nutrient by vegetation. Maximum concentration of nutrients are held in the upper layer of soil owing to greater biological activity of microorganisms and mineralisation in the forest floor. The total storage of nutrients in the soil up to 1 metre depth was recorded to 7680 N, 228 P, 7104 K and 3360 Na kg ha⁻¹ in the forest site I whereas in the study site II values was recorded to be 7776 N, 230 P, 6240 K and 2880 Na respectively.
The storage of N and P was found a little higher in the forest site II than the forest site I. However, in the forest site I storage value of K and Na was higher than the site II. The maximum value of C : N ratio occur in the surface layer of soil (0-20 cm) in the rainy season and minimum in winter season. This may be due to the fact that in the rainy season mineralisation of nutrients in the forest floor was comparatively higher than the winter season.

The standing state of nutrients (N, P, K and Na) in tree layer were recorded to be 1390.23 N, 112.77 P, 365.83 K and 72.13 Na kg ha\(^{-1}\) in forest site I whereas in the forest II site II it was recorded to be 2084.92 N, 65.99 P, 439.36 K and 42.02 Na kg ha\(^{-1}\) respectively. Maximum amount of P and Na (112.77 and 72.13 kg ha\(^{-1}\) respectively) was occurred in the tree layer of forest site I while maximum amount of N and K (2084.92 and 439.36 kg ha\(^{-1}\) respectively) occurred in the tree layer of forest site II. The highest amount of all nutrients in the boles was due to higher accumulation of biomass.
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The standing state of nutrients (N, P, K and Na) in tree layer were recorded to be 1390.23 N, 112.77 P, 365.83 K and 72.13 Na kg ha\(^{-1}\) in forest site I whereas in the forest II site II it was recorded to be 2084.92 N, 65.99 P, 439.36 K and 42.28 Na kg ha\(^{-1}\) respectively. Maximum amount of P and Na (112.77 and 72.13 kg ha\(^{-1}\) respectively) was occurred in the tree layer of forest site I while maximum amount of N and K (2084.92 and 439.36 kg ha\(^{-1}\) respectively) occurred in the tree layer of forest site II. The highest amount of all nutrients in the boles was due to higher accumulation of biomass.
although bole had the lowest nutrient concentration among the aboveground component of trees. The distribution of total standing state of nutrients in different components of tree layer were in the order of: bole > leaf > branch > twig. The total uptake of nutrients in the tree layer of forest site I were recorded to be 279.56 N, 18.47 P, 69.92 K and 12.59 Na kg ha⁻¹ yr⁻¹ whereas in the site II it was recorded to be 277.58 N, 8.56 P, 57.35 K and 5.28 Na kg ha⁻¹ yr⁻¹ respectively. The annual uptake of N, P, K and Na was recorded to be a little higher in the forest site I than that of forest site II. The higher uptake of nutrients in the former site may be responsible for higher net primary productivity. The forest tree species retrace highest amount of N followed by P, K and Na from the soil. Turnover time(year) of all nutrients in the forest I were recorded to be 4.98 years for K, 6.10 years for P, 5.23 years for K and 5.72 years for Na and in the forest site II it was recorded to be 7.51 years for N, 7.70 years for P, 7.66 years for K and 7.99 years for Na. Low uptake of nutrients in the forest site II may be responsible for higher turnover time in this site than that of site I.
The total return of nutrients via tree litterfall in the present study site I were 79.43 N kg ha\(^{-1}\), 4.82 P kg ha\(^{-1}\), 15.97 K kg ha\(^{-1}\) and 2.70 Na kg ha\(^{-1}\) and in the study site II were 49.88 N kg ha\(^{-1}\), 2.47 P kg ha\(^{-1}\), 10.46 K kg ha\(^{-1}\) and 1.02 Na kg ha\(^{-1}\). Of the total 93.40% of nutrients input was contributed through leaf litter and 6.59% through miscellaneous litterfall in the study site I while in the site II about 89.69% through leaf litter and 10.30% through miscellaneous litterfall.

The return of N, P, K and Na in the study site I via litterfall was found to be more than the study site II. This is obvious because of higher value of litterfall in the study site I than that of the study site II. The total release of all nutrients (N, P, K and Na) through decomposition of litterfall were recorded to be 48.36 N kg ha\(^{-1}\), 2.76 P kg ha\(^{-1}\), 9.67 K kg ha\(^{-1}\) and 1.38 Na kg ha\(^{-1}\) in the forest site I and in the forest site II it was recorded to be 31.90 K kg ha\(^{-1}\), 1.50 P kg ha\(^{-1}\), 6.62 K kg ha\(^{-1}\) and 0.30 Na kg ha\(^{-1}\) respectively.
The amount of release of nutrients in the study site I were more than the study site II. This may be partly due to large quantity of substrata and faster rate of decomposition of litterfall. Higher values were recorded in annual uptake, return and release of nutrients in the forest site I than that of forest site II. This may partly be responsible for higher net primary production in the site I than that of site II.