Chapter 6

CONCLUSIONS
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- The trend of CO₂ emission rate is followed uniformly under all the land uses and soil associations i.e. maximum during monsoon and minimum during winter period.
- The monthly CO₂ emission rate showed wide variations. Highest rate was noticed in the month of August followed by July and September and it was lowest in the month of January followed by December.
- Soil moisture and temperature are the most influencing factors for CO₂ emission rate from soils. During monsoon period both the temperature as well as soil moisture are favourable for higher CO₂ efflux in the study area.
- The amount of CO₂ emitted varies with the variation in land-use and soil association. The variations are also observed within the same land-use due to change in the vegetative cover.
- The total range of variation in CO₂ emission rate varied from 1.38 g m⁻² h⁻¹ in soil mapping unit 61 (Udifuventic Ustochrepts - Typic Ustipsamments) in the month of September to 0.16 g m⁻² h⁻¹ during February in the same soil association.
- The effect of soil association became very distinct when the CO₂ emission rate during the study period was averaged. The highest CO₂ emission rate (0.81 g m⁻² h⁻¹) was found in Typic Ustochrepts (F.S.)-Typic Ustochrepts (F.L.) soil association (SMU 128) and minimum of 0.53 g m⁻² h⁻¹ in Typic Ustochrepts (F.L.)-Typic Ustochrepts (C.L.) soil association (SMU 140).
- The presence of calcareousness in the soil is one of the main factors responsible for higher CO₂ emission rate and therefore the soil association like Fine silty Typic Ustochrepts–Fine loamy Typic Ustochrepts (128), Coarse loamy Typic Ustifluvents–Coarse loamy Aquic Ustifluvents (SMU 244), Fine loamy Fluventic Ustochrepts–Coarse loamy Fluventic Ustochrepts (SMU 185), Fine silty Typic Ustochrepts–Fine loamy Typic Ustochrepts (SMU 120), Typic Ustipsamments–Coarse loamy Typic Ustifluvents (SMU 236) etc. which have calcareous soils, released more CO₂ than other soil association.
- However, calcareousness is not the only factor that contributes to CO₂ emission rate. In general, the fine textured calcareous soils, cultivated for agricultural crops, emitted more CO₂ in comparison to coarse textured soils supporting tree
cover because these soils experience intense cultivation practices and the irrigation maintains the availability of water.

- The maximum CO₂ emission rate 1.48 g m⁻²h⁻¹ was noticed in the month of September followed by 1.18 g m⁻²h⁻¹ in July under the forest cover, 1.07 g m⁻²h⁻¹ in the month of July and August in orchard and 1.11 g m⁻²h⁻¹ in the month of August in plantation area respectively.

- Annual average emission rate of CO₂ was highest (0.64 g m⁻²h⁻¹) from the soil by agriculture followed by supporting tree plantation (0.63 g m⁻²h⁻¹) and 0.60 g m⁻²h⁻¹ from orchard and forest. The agricultural fields are applied with intense cultivation practices, organic matter, nutrients and water. These human interventions affect the amount of CO₂ emission rate through influencing the amount of nutrients, water and organic matter in the soil. The species planted i.e., Poplar and Eucalyptus, are short rotation crops normally felled after 6-8 years of planting. These are fast growing species and need higher amount of nutrients and water and specified management practices. However, in case of old Sal (Shorea robusta) forest, the area is left to nature and hardly any silvicultural practice is applied.

- In both the forests, CO₂ emission rate remained minimum between January to March and maximum during the month of September. The increasing trend was observed from the month of April, there are two peaks of higher CO₂ emission rates in July and September, which follows the climatic trend.

- The average annual CO₂ emission rate for Mango-Litchi orchard was comparatively higher and the same was lower for Mango-Guava.

- Poplar plantation emitted higher CO₂ than Eucalyptus in terms of average annual rate.

- Among the various crop combinations Jowar-Barseem (fodder crops), had higher rate of CO₂ emission rate and the soils under vegetables crops showed next higher CO₂ emission rate. Wheat crop (Wheat-fallow-Paddy, Wheat-fallow, Wheat-Maize, Wheat-Pulses, Wheat-Sugarcane, Wheat-Jowar, and Wheat-Vegetable) combinations showed relatively lower values of average annual CO₂ emission rate.

- Significant positive correlation (p<0.01 probability) was observed between CO₂ emission rate and soil moisture, pH and base saturation. The highest positive correlation was noticed for soil moisture.
• The soil pH and base saturation showed almost similar relationship.
• $E_H$ showed significant ($p<0.01$ probability) negative correlation. pH and $E_H$ are highly dependent on each other.
• Soil temperature, sand and soil organic carbon showed non-significant positive correlation.
• Other properties namely nitrogen, clay and silt showed negative correlation coefficient but these are also not significant.
• Multiple regressions, considering all the soil properties, were also attempted to obtain very encouraging results.
• Stepwise multiple regression analysis was also performed in six steps to evaluate the importance of variable on CO$_2$ emission rate from soil. A stepwise procedure was used in to reduce the number of variable and use only those that were significant at the 0.05 level. Selected variables were moisture, $E_H$, and sand.
• Several statistical models of $R_s$, were fitted with the collected/calculated data. Least value of RMSe was observed in Janssens et al. (2000) equation model, the data follow this equation closely.

Model: TM4

Model equation: $R_s = \exp(a_1 + a_2 T + a_3 M)$

General Form: Exponential polynomial linear

RMSe: 0.0634