# ABSTRACT

The floristic compositions play important roles in determining the functioning and ecosystem services of the forests in the Eastern Himalayan region. With considerable variations in species compositions and vegetation types over short distances, the forests of this region play unquestionably vital role in the conservation of the biological diversity. The plants, soil and climatic conditions share convoluted and dynamic relationships influencing water retention, nutrients' availability and habitat provisioning. Hence, understanding these interrelations play important role in the management and conservation of the forests. Nevertheless, studies highlighting the interrelations in the Eastern Himalayan region are scarce in number resulting in dearth of baseline data and limited comprehension of the responses of forest ecosystem to the changes in the climatic conditions. Therefore, the study was conducted in Sonai Rupai Wildlife Sanctuary of Assam located at the foothills of the Eastern Himalayan region of India to minimize the research disparities and enhance the comprehension of the interrelationships between vegetation, soil nutrients, and meteorological parameters. In this study, the phytosociological structure of the tropical semi-evergreen forest was investigated, along with the seasonal variabilities in the physicochemical properties of soil, and occurrences of the phenophases and their relationship with the climatic variables like precipitation, temperature, relative humidity, etc.

The thesis comprises of 7 chapters, each incorporating detailed findings of the study. A brief summary of all the chapters is provided below.

**Chapter 1** provides an overview of the general introduction that describes the Eastern Himalaya and mentions the types of vegetation observed in the Northeastern part of India. It also mentions the variations in the edaphic properties in association to the vegetation and climatic conditions. Furthermore, the chapter addresses the research gaps and mentions the objectives along with the hypotheses included in the study, thereby emphasizing the necessity of the study in this region.

**Chapter 2** provides a summary of the researches carried out across worldwide, more specifically in the Eastern Himalayan region of Northeast India that aligns with the objectives of the present study. The literature review reveals that sporadic studies related to vegetation diversity and phenology are done in Northeast India, thereby highlighting the

necessity to advance the current understanding of the interrelations between plants, soil and climate in this region.

**Chapter 3** details the research carried out to understand phytosociological attributes of the herbs, shrubs and trees in the study site, Sonai Rupai Wildlife sanctuary of Assam, northeast India. From the study, a total of 191 angiosperms were identified comprising of 68 herbs, 42 shrubs and 82 trees. The native and non-native status of the plants in each community were also determined. Among the three community, herbs recorded the highest density (169085 $ha^{-1}$) followed by shrubs (4670 $ha^{-1}$) and trees (535 $ha^{-1}$). The basal area of trees and shrubs were 54.08 $m^2 ha^{-1}$ and 0.34 $m^2 ha^{-1}$ indicating a well-established forest structure with canopy cover. The species with highest IVI tends to dominate the community. It was observed that along with the native plants, several non-native plants also exhibited high IVI such as *Axonopus compressus* (32.25), *Imperata cylindrica* (23.39) and *Ageratum houstonianum* (10.67) among herbs, and *Chromolaena odorata* (89.83), *Lantana camara* (20.82) among shrubs. Only one non-native tree species i.e. *Senna siamea* with an IVI of 2.59, was recorded. The values of Shannon-Weaver diversity index, Simpson dominance index, Menhinick's index, Margalef's index and Pielou's evenness index indicated diverse species composition with low dominance, and evenness within the communities. The findings of this study indicated the successful establishment of non-native plants in the protected area.

**Chapter 4** focuses on the vegetative and reproductive phenophases of the selected trees species that characterizes the tropical semi-evergreen forest of the study site, and their associations with the climatic parameters. In this study it was observed that the vegetative phenophases of the evergreen trees did not display any association with the temporal fluctuations in precipitation, temperature, relative humidity and photosynthetically active radiation. Meanwhile, positive or negative associations were observed between the reproductive phenophases and climatic variables for all the selected tree species. The application of Rayleigh's test revealed that although all species displayed non-uniform distribution of phenophases with the exception of the vegetative phenophases for *Dillenia indica, Magnolia hodgsonii* and *Toona ciliata*. However, when all the selected species were analysed together, only leaf initiation and flowering displayed non-uniform distribution of occurrence implying distinct seasonality.

**Chapter 5** emphasizes on the nine physicochemical properties of the top soil in to the vegetation cover. The soil from both forest and scrub covered areas were acidic in nature. The samples from both the sites displayed comparable values of the analysed parameters which were varied seasonally. However, the Kruskal-Wallis test of the physicochemical properties across different seasons revealed that in forest soil, the soil moisture remains same across different season ($\alpha = 0.09$). On the other hand, the bulk density ($\alpha = 0.18$) and available nitrogen ($\alpha = 0.75$) of the scrub soil remained same across different seasons. These findings highlight the influence of vegetation cover on seasonal variations of physicochemical properties of soil thereby affecting the soil nutrient dynamics of both the study sites.

**Chapter 6** focuses on the regression-based models of phenophases displaying seasonality – leaf initiation, and flowering. Regression analyses of the phenophases with the climatic variables allowed the establishment of the relationship between them using predictive models. The resulted models were evaluated based on adjusted $R^2$, AIC and AICc, and they displayed $\Delta AIC > 2$ when compared with the respective null models of phenophases. In comparison to the simple linear models, application of generalized linear models and ridge regression models to the phenophases allowed the inclusion of the relevant climatic variables. However, simple linear regression models were affected by the non-normality of the residuals and generalized linear models were affected by the presence of collinearity among the climatic variables. On contrary, ridge regression addresses the aforementioned issues, and models the relationships between the phenophases and climatic variables relevant to the study.

**Chapter 7** encompasses the overall conclusion and further research potentials in the aspect responses of tropical semi evergreen forest to the non-native plant species and changes in the climatic conditions.