SUMMARY

The State of Assam has been identified as one of the most important landscapes in the northeastern region of India, dominated by varied forest types and supporting a variety of flora and fauna. The lower Assam region, like other parts of the region is undergoing rapid transformation due to deforestation, urbanization, *jhum* and extraction of forest products. Due these activities, natural forests are getting fragmented in to small patches.

In the last two decades, Species distribution models (SDMs) have been established as important tools for extrapolating such *in situ* observations. SDMs analyze empirical correlations between geo-referenced species occurrence data and environmental variables to obtain spatially explicit surfaces indicating the probability of species occurrence. Especially during the last three to five years, the number of studies making use of modeling techniques using environmental datasets for species distributions has therefore multiplied. Due to the novelty of this field of research, this study pursued following objectives:

- To quantify populations of selected tree species in grid-based samples of lower Assam region of India,
- To map potential distribution of selected tree species in current climatic condition, and
- To model future distribution of species in two different climate change scenarios.

The distribution modeling of sixteen selected tree species was done using the Maximum Entropy algorithm (Maxent) developed by Phillips et al. (2006).
Size-class distributions of the 16 tree species have shown two major groups; (1) species with inverse J-shaped curve, and thus having healthy regeneration status, and (2) species with higher proportion on individuals in lower size-class, but missing individuals in the subsequent middle and higher size-classes, showed bell shaped distribution, and thus hampered regeneration status. Among all 16 tree species, only *Phyllanthus emblica* showed the regular dispersion and rest species showed the clumped dispersion pattern.

The modeled potential distribution of sixteen tree species in current scenario in lower Assam region of India is presented in Fig. 1 below. The Maxent models performed better than random, with an average test AUC values ranging from 0.710 to 0.892. For all models, average training AUC ranged from 0.841 to 0.972. Test AUC values were lower than training AUC values. The training/testing models correctly predicted most of the test locations in lower Assam region for studied tree species.

The maxent model for *Schima wallichii* and *Shorea robusta* performed very well with an average $AUC_{\text{train}}$ 0.942 ± 0.004 and $AUC_{\text{train}}$ 0.927 ± 0.003 respectively. The model calibration test for six tree species yielded average $AUC_{\text{test}}$ values more than 0.80 viz. *Schima wallichii* (0.893 ± 0.111), *Shorea robusta* (0.890 ± 0.077), *Dillenia pentagyna* (0.881 ± 0.115), *Careya arborea* (0.844 ± 0.128), *Lagerstroemia parviflora* (0.842 ± 0.102) and *Cassia fistula* (0.803 ± 0.127). Whereas, another ten species ranged 0.710 to 0.798 test AUC, and out of these *Gmelina arborea* had lowest value of $AUC_{\text{test}}$ 0.710 ± 0.194.

Amongst all twenty environmental variables, altitude (alt) was the most influential variable and contributed from 19.0% to 51.3% for sixteen tree species in lower Assam region.
Fig. 1. Modeled potential distribution of sixteen tree species in current scenario in lower Assam region of India.
An assessment of the current patterns of habitat types of sixteen tree species showed that the species occurred both in disturbed and undisturbed moist-deciduous and semievergreen forests of lower Assam region. These species were also present in builtup areas (i.e., urban and rural), agricultural lands, homegardens, wastelands, grasslands and scrublands.

Superimposing the predicted potential habitat suitability maps on Land use and Land cover (NRSA 2008), forest types maps (FSI 2011) and Google Earth satellite imageries revealed patches of habitat to be suitable for the species persistence (Table 5.23). The area with medium and high suitability classes for selected tree species ranges, continuous and mosaic of moist-deciduous and semievergreen forests, builtup areas, wasteland, agricultural and grasslands, while the area of very high habitat suitability class ranges continuous patches of semievergreen and moist-deciduous forests, degraded forests, scrublands, plantation, builtup and agricultural lands.

The future distribution of different habitat suitability classes and predicted suitable habitat for selected tree species were spatially heterogeneous depending on the GCM and emission scenarios. The results for change in tree species distribution under different future GCM scenarios are summarized and examined at species level.

The modeling results suggest that the geographical distribution of the selected tree species will change under predicted levels of climate change in future. Much of the area that is currently suitable will not remain suitable in the future. In these future unsuitable habitats, local extinction is the most likely outcome.
The application of distribution models to plant inventory data can provide useful indications of which areas may be important for biodiversity conservation, and offers a means to estimate the niche-space available for species of conservation concern. Whilst models are highly sensitive to spatial bias in the inventory data, especially for ecological important tree species, we suggest that predictive definitions of conservation priority could be systemically improved by targeting field sampling towards locations with large discrepancies between observed and predicted diversity.