（別紙様式第３号）（Format　No. 3）

学　位　論　文　要　旨
SUMMARY OF DOCTORAL THESIS

氏名　Name:　NEPAL CHANDRA DEY

題目　Title:

Evaluation and Assessment of Local Environmental Vegetation Indices of Forest and Soil Surface Conditions Using Remote Sensing Data

（リモートセンシングを用いた森林域における局地環境植生指数と土壌表面状態の評価に関する研究）

Summary

Remote sensing is an emerging technology to acquire information precisely on the forest vegetation characteristics and soil surface conditions at regional and local scales. Biophysical characteristics of vegetation are typically estimated from remotely sensed data through the application of a vegetation index. The normalized difference vegetation index (NDVI), one of the most popular vegetation indices, was used to assess and evaluate the characteristics of different vegetation species. The NDVI appeared different because the image acquisition times were different in every year and the successive stages of green leaf density as well as the variations in the physical characteristics of vegetation were also different. The lower values of NDVI showed in the years 1985, 1987 and 1996 and the lowest values came into view in 2003. The lowest value of NDVI was found for the month of April, which marked the end of winter season or the beginning of the spring season. During this time, all matured leaves of some species of trees were already dropped. The NDVI values were relatively less in the case of Ca species for 1985 and 2003 because trees and plants of this species had fewer or less leaves and almost uniform changes for both R and C species. The Q species had the highest NDVI values in the spring season.

It was discovered that the NDVI was higher for taller heights (H?8m) of the trees. The difference of NDVI was relatively low between the two heights of the trees (H?8m and 3?H<8m) during winter season, when the trees and plants do have less or no leaves. We also found that NDVI was higher to both Red and NIR (near-infrared) reflectance for taller trees, but lower to both Red and NIR for shorter trees. It was depicted that NDVI was higher for taller trees because of larger green leaf density. It was revealed from the study that NDVI was highly correlated with green leaf density and being used as a representative for the status of ground surface biomass.

The values of leaf area index (LAI) were different from year to year because the seasonal timings of image acquisition were different with the variations in phenological development of vegetation. It was found that there were not only the successive stages in different vegetation types, but they also statistically different as per their physiologic characteristics. There was a seasonal variation in LAI through the stages that was remarkably different between the stages.

The lowest LAI (0.34) appeared in the winter season, when trees and plants had insignificant or no leaves. LAI varied from 0.51 to 0.1.31, when new leaves appeared in the trees during spring season, while in the autumn ranged from 0.62 to 1.1. The linear relationships for the different vegetation species depicted that LAI increased with the increase of NDVI or SR (simple ratio). The linear relationships were significantly (R2=0.82 to 0.95) correlated between LAI and NDVI. However, good correlation coefficient (R2=0.71 to 0.95) was obtained because of the non-linear relationship between LAI and SR. The relationship was stronger in case of FPC (foliage projected cover) with NDVI than of FPC with SR.

The spectral reflectance that best represents the stone percentages on the soil surface was identified using correlation between spectral reflectance and percentages of stone on the soil surface in different soil moisture conditions for each of the spectral wavelengths used. Three wavelengths 790, 890, 980 nm from near infrared (NIR) and 2140nm from Mid-infrared (MIR) region were selected based on higher correlation coefficient (R2?0.82) and the wavelengths were more sensitive to different stone percentages on the soil surface. A white stone has a higher reflectivity, so reflectance increased with increase of percentages of white stone on the soil surface. Reflectance from bare dry soil was higher than bare wet soil. However, reflectance decreased due to the increase of percentages of black stone on the soil surface. A simple linear relationship (y = ax + c) is derived empirically for estimating reflectance from different stone percentages on the soil surface from reflectance measurements. An attempt has been undertaken to estimate percentages of stone on the soil from spectral reflectance information. Adjustment of the relationship over different percentages of stone for different soil moisture content environment would provide better conditions for retrieval performances.
Key words: Remote Sensing, TM, ETM+, Reflectance, Vegetation Index, NDVI, NIR, MIR