（学位第３号様式）

# 学 位 論 文 要 旨

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| 題　目 | Terrain Analysis and Site Evaluation: Integrating a Geospatial Approach for Subtropical Forest Management Planning<br>(地形解析及び立地評価：亜熱帯森林管理計画への地理空間情報の統合化) |


This study demonstrates methods to map terrain variability and analyze the relationship between terrain characteristics and site suitability for sustainable forest management planning. An assessment was conducted in the Yambaru Forest Area (YFA), located in the northernmost part of Okinawa Main Island, Japan. Preservation and conservation of the natural environment in this area is a major issue, which requires more efforts for effective forest management. Presently, efforts are being made to designate the YFA as a national park due to its listing as a Word Natural Heritage. Spatial evaluations of the area were completed using various geospatial tools within GIS according to three objectives.

The first objective was to characterize landform features of YFA using an automated classification technique. Landform classification was performed using Digital Terrain Model (DTM) based on a Topographic Position Index (TPI). The process resulted in identifying ten landform classes that differentiate the slope positions of the area. Selected terrain variables were integrated into vegetation data for site evaluation. The Normalized Difference Vegetation Index (NDVI) values for the study site range between -1 and 0.77, suggesting a strong relationship between forest cover, tree height and slope position. In this chapter, the interaction between landform type, terrain characteristic and forest functions were critically discussed.

The second objective presented a method for erosion hazard site identification using Light Detection and Ranging (LiDAR) data. SAGA GIS software was effectively used to simulate secondary terrain attributes related to erosion development namely LS factor, SP index, and TW index. Vegetation cover analysis was completed by using the extraction of the Digital Canopy Height Model (DCHM) from the LiDAR data. All parameters were integrated, and a slope failure hazard map was produced. For verification, the simulated hazard map was then compared with the ground truth data of slope failure locations. Results indicated that 84.6% of a slope failure recorded from field verifications fall within the severe identified zones in the simulated map, associated with forest road construction.

The third objective aimed to examine the effects of terrain characteristics on stand structure and diversity through a combination of ground-based plot studies and computer-based spatial analyses. Vegetation indices consist of tree height, DBH, stand density, stand basal area, species' richness and a Shannon-Wiener diversity index were calculated from field measurements and correlated into terrain variables derived from the LiDAR data. Results suggested that species' richness between plots varied from 15 to 30 species. A Shannon-Wiener diversity index, tree height and DBH were significantly correlated with terrain factors. An assessment of site characteristics and its relationship with forest structure provides essential information for forest inventory and monitoring.

Each chapter in this thesis discussed the application of terrain analysis for site evaluation in a subtropical forest setting with heterogeneous terrain conditions. It provides a significant contribution to the understanding of interactions between terrain characteristics, hazard prediction and forest site productivity in YFA. Information and analytical methods discussed in this study will be beneficial for forest management planning, especially in the complex subtropical forest of Okinawa Island.