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Application of Deep Learning Model to LULCC Monitoring using Remote Sensing Images-A case study in suburban areas of central Taiwan

Zhong-Han Zhuang[1] and Hui Ping Tsai[2]
[1]National Chung Hsing University, Civil Engineering, Taichung, Taiwan (d109062003@mail.nchu.edu.tw)
[2]National Chung Hsing University, Civil Engineering, Taichung, Taiwan (huiping.tsai@nchu.edu.tw)

1. INTRODUCTION

Monitoring land use and land cover change (LULCC) is one of the best methods to understand the interactive changes of agriculture, climate change, and ecological dynamics. In eastern Asia, Taiwan is characterized by high population density, rich biodiversity, and complex terrain. However, recent climate change has impacted the people and ecosystems in Taiwan. Therefore, we applied landscape metrics and the deep learning U-net semantic segmentation model to enhance the remote sensing images based LULCC monitoring efficiency and take a case study in suburban areas of central Taiwan, a place that plays an important economic role in Taiwan occupied with intensive agricultural activities.

2. METHOD

This study focuses on six townships in Nantou County in Central Taiwan, where the major agricultural products are rice, tea, and fruit. We obtained four dates of Sentinel-2 images in February for 2018 and 2021 and classified the landscape into five classes: agricultural, forest, built-up, free water bodies, and bare land. The spectral bands information (Blue, Green, Red, NIR), the normalized difference vegetation index (NDVI), and soil-adjusted vegetation index (SAVI) were obtained for establishing the deep learning U-net semantic segmentation model. The accuracy and the loss function of the training model results are 0.89 and 0.02, respectively. In addition, the ground truth data was consulted with the official land-use classification information and the high spatial resolution imagery in Google Earth Pro. Finally, we analysed the classified images' results to detail the study area's changing trajectory to explore the complex spatiotemporal landscape patterns.

3. RESULTS AND DISCUSSIONS

According to the result, the forest area on the eastern side accounts for more than 70% of the study area. The construction area and the agricultural area have an upward trend during the

research period (16% and 5%); in addition, except for the number of patches in free water bodies decreased, all other categories had an upward trend, especially the construction and agricultural area are the largest. The Shannon's Evenness Index reflects that all patches are evenly distributed in space and the area-weighted average fractal dimension index decreases reflecting possible influences of anthropogenic activities. Thus, the results indicate an increasing level of fragmentation, supported by the decrease of the area-weighted average fractal dimension index. In conclusion, using satellite imagery with the deep learning U-net semantic segmentation model can sufficiently discern a detailed LULCC. Furthermore, with the combination of landscape matrix information, the interactions between humans and the environment can be understood better quantitatively.

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