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Land Use Classification Using Machine Learning: A Case Study of the Upper Awash Basin, Ethiopia

TECHNOLOGY SHOWCASE

■ Introduction

Understanding land use and land cover (LULC) dynamics is essential for sustainable environmental management, especially in rapidly changing regions like Ethiopia's Upper Awash Basin. The Awash Basin, situated in the Horn of Africa, is a critical region characterized by diverse topography and home to the Awash River. This basin plays a pivotal role in impacting both natural ecosystems and human activities across Ethiopia. Despite its ecological and economic significance, the basin faces increasing pressure from urban expansion, agriculture, and climate variability. To address this, the present study aims to generate a high-resolution LULC map for the year 2020 using the Random Forest(RF) algorithm on the Google Earth Engine platform and assess the efficiency of the RF classifier. This approach leverages cloud-based geospatial processing and machine learning to deliver accurate, scalable, and timely land cover insights, supporting informed decision-making for resource planning and conservation(Aryal et al., 2023).

■ Methods and Objectives

This study utilized Landsat 8 Operational Land Imager (OLI) satellite imagery for the year 2020, accessed via the Google Earth Engine (GEE) platform. Landsat 8 was considered for its high-quality spatial resolution and consistent global coverage, making it suitable for detailed LULC mapping. GEE was selected for its cloud-based processing capabilities, which allow efficient handling of large geospatial datasets and facilitate scalable analysis. A Random Forest (RF) classifier was implemented within GEE due to its robustness, efficiency, and ability to handle high-resolution data. RF was chosen for its proven performance in remote sensing applications and its capability to reduce overfitting while maintaining high accuracy in different studies.

■ Key results

The classification results for the Upper Awash Basin in 2020 revealed distinct patterns of land use change. Agricultural and vegetative areas showed a noticeable decline, while urban and barren lands expanded significantly. These changes were quantified using a confusion matrix, yielding an overall accuracy of 0.97 and a Kappa coefficient of 0.86, indicating a reliable classification process.

The observed decline in agriculture and vegetation, alongside an increase in urban and barren land compared to the observed reference condition, reflects ongoing urbanization and shifts in agricultural practices. These trends suggest transformation in land management, likely driven by population growth, infrastructure development, and changing socio-economic priorities.

■ Future directions

Building on this result, future studies should examine the effects of climate change, integrate socioeconomic data, and use cutting-edge technologies for future land use/land cover scenario modeling and real-time change detection.

■ References

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■キーワード: (1) Random Forest
(2) Google Earth Engine
(3) Land use classification

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