International Journal of Agricultural and Environmental Information Systems
Volume 16 • Issue 1 • January-December 2025

Detecting Land Use Changes in Ordos City Using the Google Earth Engine Remote Sensing Cloud Platform

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ABSTRACT

This study leverages Google Earth Engine's remote sensing cloud platform to examine land use changes in Ordos City between 2000 and 2017. The analysis focuses on the quantitative shifts, intensity, and spatial structure of land use dynamics. Findings indicate significant land use transformation over the period, with woodland increasing by 56% at a rapid annual growth rate of 3.29%, while grassland, water areas, and unused land decreased. The development pace of various land types accelerated between 2010 and 2015, particularly for woodland, cultivated land, and construction land. Spatial disparities were evident among different types of land use changes, with more significant variations observed in the southeast compared to the northwest. Despite less noticeable differences from 2010 to 2017, land use diversity grew gradually. These results offer valuable data-driven insights for promoting sustainable land use and development strategies in the region.

KEYWORDS

Big Data Cloud Platform, Land Use, Ordos City, Remote Sensing, Spatial Structure

INTRODUCTION

The Ordos Plateau, located in the middle and upper reaches of the Yellow River, faces challenges related to soil erosion and sandstorm control. Land use and cover changes are directly linked to regional ecological construction and the stable development of the socio-economic environment. The city's unique geographical position and its role as an economic hub make it a critical area for studying the interaction between human activities and the natural environment. With rapid urbanization, agricultural expansion, and ongoing desertification control efforts, it is essential to assess how these processes are reshaping the landscape. Understanding these changes is crucial for developing effective strategies to promote sustainable land use, protect the ecological environment, and ensure long-term socio-economic stability (Jiang, 1999; Li et al., 2023; Wang et al., 2023). Research has demonstrated that a thorough investigation of land use change and its driving factors in Ordos City can reveal the patterns of this process and clarify the complex relationships among various influencing factors (Su & Qian, 2020; Zhao et al., 2022). This research not only contributes valuable data to global land use

DOI: 10.4018/IJAEIS.367572

change studies but also provides a basis for decision-making regarding the sustainable use of urban land resources and the smooth implementation of economic and social development (Tang et al., 2023).

The challenges faced by the Ordos Plateau, including soil erosion and sandstorms, require a comprehensive understanding of land use and cover changes (Wu et al., 2013). These changes directly impact the local ecological environment and socio-economic stability. Therefore, it is crucial to conduct an in-depth investigation into the patterns and drivers of land use change in Ordos City (Wang & Hasi, 2023; Yue et al., 2016). Such an investigation will enhance global knowledge of land use dynamics and inform local decision-making, ensuring the long-term sustainability of the region's land resources (Agarwal, 2002; Castella et al., 2007; Lambin et al., 2003; Rounsevell et al., 2012; Verburg et al., 2015).

To address these issues, this study employs remote sensing and geographic information system (GIS) technologies. Specifically, Landsat/TM bands 4, 3, and 2 composite images from the summer months of 2000, 2010, and 2017, alongside topographic maps at a 1:50,000 scale were adopted in this study. These data sources are integrated to assess the current land use status and characterize land use patterns within the study area. Our methodology involves applying GIS technology to analyze land use degree through location entropy, Lorentz curves, and regional differentiation models. Additionally, we utilize the land use stochastic matrix, dynamic attitude model, degree change model, and diversity index model to examine temporal and spatial land use changes.

Through this comprehensive analysis, the underlying mechanisms driving land use change are uncovered, providing a solid foundation for future land use planning and management in Ordos City. The article focuses on land in Ordos City as the research subject, utilizing the Google Earth Engine (GEE) remote sensing big data cloud platform to obtain remote sensing images from different periods. Land information is extracted, and an in-depth analysis of land use changes in Ordos City is conducted, examining land use quantity, degree, and spatial structure. The study aims to offer theoretical data support for the sustainable use and development of land in Ordos City, which holds significant practical importance for the protection and enhancement of the region's ecological environment.

LITERATURE REVIEW

Recently, technological advancements have significantly enhanced the study of land use and land cover change (LUCC), improving both the methodologies employed by researchers and their analytical capabilities. Key innovations, such as high-resolution remote sensing, advanced GIS, cloud computing platforms, machine learning, and big data analytics, have not only accelerated data processing speed and improved accuracy but also deepened the understanding and management of complex land use patterns (Abdollahnejad et al., 2019; Chang et al., 2018; Chughtai et al., 2021; Favorskaya et al., 2017).

The utilization of high-resolution satellite imagery, such as data from Sentinel-2 and Planet Labs, has enabled researchers to capture more detailed information about the Earth's surface (Kattenborn et al., 2019). The integration of these factors, combined with regularly updated multi-temporal datasets, allows for dynamic monitoring of land use changes, providing a more frequent and accurate view of how land is being used and altered over time (Hashim et al., 2020). The availability of high-resolution images and multi-temporal data has significantly improved the precision and frequency of land use change detection, thereby supporting more informed and nuanced land management decisions (Reba & Seto, 2020; Steinbach et al., 2021).

The advent of more advanced GIS has enabled the development of powerful tools for spatial statistical analysis and network analysis, allowing for more complex and sophisticated analyses (Lü et al., 2019; Oyana, 2020). The improved data visualization capabilities, including more intuitive maps and charts, have enhanced the understanding of land use patterns among decision-makers and the public. These GIS advancements have deepened comprehension of land use dynamics, thereby supporting more effective policy-making and planning processes (Giaoutzi & Papadopoulou, 2021).