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“Reconcile land system changes
with planetary health”

Navigating agro-ecological challenges and food futures under drought stress in central Iran

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Abstract

In recent decades, agricultural regions in Central Iran have faced increasing challenges such as drought, land use change, and urban expansion—factors that significantly threaten the sustainability of agro-ecosystems and food security. This study aims to assess the agro-ecological resilience and food security status of a key agricultural region in central Iran using remote sensing indices and spatial analysis. This study employs remote sensing indicators, including the Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) for vegetation dynamics; the Modified Normalized Difference Water Index (MNDWI) for surface water availability; the Standardized Precipitation Index (SPI) and Land Surface Temperature (LST) for climatic change; and urban development data for land use dynamics, to investigate two decades of environmental and anthropogenic changes in a selected agricultural area of Central Iran.

The primary aim of this research is to assess the temporal trends and spatial correlations between climatic stress, urban growth, and agro-ecological stability from 2005 to 2025. Data were sourced from satellite imagery, including MODIS, Landsat and Sentinel-2, and analysed to detect patterns and interrelations. Preliminary findings indicate a decline in vegetation cover coinciding with rising land surface temperatures and increasing urban sprawl, particularly during severe drought periods. Correlation analyses among the indices reveal concerning trends in terms of declining agricultural productivity and increasing ecological vulnerability.

This study provides a data-driven framework to evaluate regional sustainability and offers valuable insights for policymakers working on sustainable agriculture, water resource management, and urban planning in arid and semi-arid regions. By integrating environmental and socio-economic indicators, the research contributes to a more comprehensive understanding of the risks to food security amid rapid climatic and demographic transitions.

Keywords: Agro-ecology, food Security, Iran, remote Sensing, Sustainability Risk Mapping