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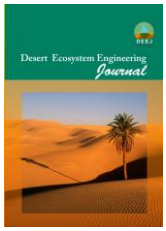

Trend Analysis of Key Indicators Affecting Desertification in the Nosratabad Plain, Taft

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Extended Abstract

Introduction: Desertification stands as one of the most severe global ecological and environmental challenges, affecting one-fifth of the world's population residing in drylands. The biophysical variables of an ecosystem, primarily vegetation cover and soil condition, are most frequently used to assess desertification. Among the critical factors driving this process in various ecosystems are soil salinity and moisture. A significant obstacle in studying changes in desertification indicators is the scarcity of accurate historical spatial data. However, the consistent availability of multi-temporal satellite data across various spectral bands has led to the growing application of time-series remote sensing methods. These techniques are increasingly vital for monitoring a wide array of features associated with the desertification phenomenon.

Materials and methods: This study investigated the trends of vegetation cover, soil salinity, and soil moisture as key factors influencing desertification in the Taft-Nosratabad Plain of Yazd Province over the period 2001–2024. Utilizing MODIS satellite data, we calculated the Enhanced Vegetation Index (EVI), the Normalized Difference Salinity Index (NDSI), and the Normalized Multi-band Drought Index (NMDI). The trends in these parameters were subsequently analyzed using a combined approach of the Mann-Kendall test and the Theil-Sen estimator.

Results: The results indicated a distinct seasonal pattern in vegetation cover, with peak EVI values observed in May and June. Trend analysis revealed that the highest EVI value occurred in 2024 across 65% of the study area, attributable to increased recent rainfall and reduced grazing pressure. An earlier peak was observed in 2020 for 15.2% of the area. Conversely, the lowest EVI values were recorded in 2008 across 66.5% of the region—primarily mountainous areas—and in 2018 across 21.2% of the area, mainly plains.

Trend analysis showed that 71% of the region exhibited a stable EVI trend with no significant change. A slight increasing trend was observed in 21.2% of the area, mostly in mountainous regions, while a slight decline occurred in 7.7%, predominantly in plain areas. These findings indicate relative stability of vegetation cover across most of the study area.

Soil salinity assessment showed the highest NDSI values in 2008 across 53.7% of the study area (mostly mountainous), and in 2018 across 34.4% (mainly plains). The lowest NDSI values, reflecting improved conditions, were recorded in 2024 across 76% of the area—an improvement associated with increased vegetation cover.

Trend analysis indicated stable NDSI conditions in 63.6% of the study area. A slight increase in salinity was observed in 12.5% of the area, while 23.9% showed a slight decrease.

Soil moisture analysis revealed the highest NMDI values in 2018 (39.8% of area) and 2019 (33% of area). The lowest values occurred in 2019 (44.4% of area) and 2024 (28.1% of area). Trend analysis indicated stable conditions across 91.8% of the region, suggesting relative hydrological stability. Slight increases were observed in 1.6% of the area, with decreases in 1.2%.

The findings demonstrate the interrelationship between vegetation cover, soil salinity, and moisture dynamics in this arid region, with most areas showing stable conditions over the study period.

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Discussion and conclusion: In general, the Taft-Nosratabad Plain in Yazd Province can be considered one of the more favorable areas within the province from a climatic perspective. This has contributed to the development of a relatively more stable ecosystem here compared to other regions in Yazd. However, the study identifies localized areas where vegetation cover is declining and soil salinity is increasing. These specific degraded areas should be prioritized for targeted management interventions by natural resource managers. The key objectives would be to restore these ecosystems to a healthier state and effectively control the process of desertification. This study underscores the critical importance of integrated natural resource management, controlling destructive anthropogenic activities, and implementing continuous monitoring programs for this sensitive ecosystem. The methodology and findings provide a valuable model for designing sustainable land management strategies in other arid regions of Iran.

Keywords: EVI, The process of changes, Theil-Sen, Mann-Kendall, MODIS, NDSI, NMDI.