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An image-based diversity index for assessing land degradation in an arid environment in South Australia

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Abstract

One of the major indirect effects of artificial watering points in a grazed landscape is the development around them of a zone of extreme degradation called a piosphere. We investigated the use of the moving standard deviation index (MSDI) applied to Landsat TM band 3 data for detection and assessment of these zones in the arid grazing lands of South Australia. We found that watering points had significantly higher MSDI values ($p < 0.001$) than non-degraded reference areas in four different land systems. Comparison of two vegetation indices, the normalised difference vegetation index (NDVI) and perpendicular distance vegetation index (PD54), used as reference indices, showed that the PD54 was more appropriate than NDVI in this perennial-dominated arid environment. Piospheres were found to be more heterogeneous in vegetation cover, with higher MSDI values, compared with non-degraded areas, and spatial heterogeneity in cover decreased with increasing distance from water points. This study indicates that MSDI can be used as an appropriate method for land degradation assessment in naturally heterogeneous arid lands of South Australia.

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Keywords: Arid land degradation; Landsat TM; MSDI; NDVI; PD54; Piosphere

1. Introduction

Arid lands occupy nearly one-third of the world's total land surface and support about 13% of the world's population (Matlock, 1981). Drought, low and variable rainfall and high temperature and evaporation are the main characteristics of these dry lands, defined as areas falling within the annual rainfall range of 0–300 mm (FAO, 1987). Because of variability in rainfall and the short growing period of less than 74 days (FAO, 1987), these areas are not suitable for intensive agriculture, and the main land use is grazing based mostly on native vegetation cover. Research by FAO in 36 dry countries showed that without changes in areas under grazing, the numbers of stock increased from 400 million head in 1961 to 600 million in 1995 (FAO, 1996). As a result, increase in stock numbers has been one of the main causes of land degradation in these low productive lands.

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