DEEJ (2020) 9 (29) 15-26

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir

Mapping soil salinity using Landsat 8 images for land evaluation: A Case Study of Saveh

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Received: 14/01/2020 Accepted: 02/11/2020

Extended Abstract

Introduction: As a valuable asset that play a key role in the environment, natural resources, and the production of agricultural products, soil provided an appropriate ground for plant growth and vegetation development. Therefore, any disregard to the preservation of such a valuable capital may result in food shortages, soil erosion, and degradation of natural resources.

From among different indices offered for land degradation, soil saturation and salinity are regarded as the main factors involved in desertification. According to the estimates presented by the US Environmental Protection Agency, about 20 percent of the world's agricultural land is under salt stress, and soil salinity is a major constraint on the use of arable land. Meanwhile, soil salinity has rendered

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DOI: 10.22052/deej.2020.9.29.11

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many parts of different regions unusable and inappropriate for agricultural activities and natural resources and it is considered as a major problem in arid and semiarid regions. Thus, as more than one-third of the world's soils and much of Iran's soils are located in arid and semi-arid regions, it is necessary to take soil salinity into account. In this regard, assessing the environmental potentials could be used a solution for optimal use of soil and water facilities with the least environmental consequences.

Using laboratory methods for estimating salinity is generally time-consuming and costly. Also, due to high spatial variability of soil salinity, it is better to use remote sensing data to determine and monitor saline soils. Considering the importance of the subject and the capability of remote sensing, this technique has been extensively used for studying salinity inside and outside Iran. However, few studies have ever been conducted with eight Landsat images and all salinity indices.

Materials and methods: this study sought to summarize and study all salinity indices used in remote sensing for soil salinity zonation. To this end, using modern remote sensing and GIS software is inevitable. Therefore, as the first step in applying the remote sensing method, spectral indices were used to extract the soil salinity map. For this purpose, after studying salinity indices such as BI, DVI, NDSI, IPVI, SI, SI1, SI2, SI3, SI5, SI6, SIA, SIT, the brightness value of the sampling points was extracted. Based on satellite images, the study region was classified into urban areas (class 1), low salinity areas (class 2), high salinity areas (class 3), mountainous lands (class 4), agricultural lands (class 5). Considering the ability of each of these indices in presenting soil salinity maps, the data were analyzed by SPSS software. Except the EC parameter which was normalized via logarithmic transformation, all other parameters were found to be normal. Having assured of the normality of the data, the correlation between the maps derived from these indices and actual data collected from the area were compared and contrasted.

Results: Having examined the correlation between the obtained data, it was found that that NDSI and SI3 had the highest correlation with field study data, and that they were the best method for preparing salinity maps without any need to sampling. Moreover, from among the indices investigated in terms of effectiveness, DVI, IPVI, and SI2 were found to have the lowest accuracy in revealing salinity.

Discussion & conclusion: The findings of this study indicated that remote sensing techniques were much more useful in preparing soil's salinity maps than other methods in terms of accuracy and costs. Generally, it could be said that remote sensing is a very powerful tool in soil salinity mapping. Considering the sensor's low resolution and radiometric accuracy, the fact that salinity changes are not very sensitive and detectable, and that salinity, unlike vegetation, indirectly reveals the waves' reflections, it should be noted that achieving the best index requires higher resolution images in a wider region so that more significant results could be obtained for defining a regional index.

According to the study's findings, the electrical conductivity of the intended region ranged from 6/11 to 5/5. Ds/m. Moreover, based on soil salinity maps, the southeast lands were found to have more salinity, and that all twelve indices used for identifying the salinity of the region could also be used to distinguish the saline lands. Researchers such as Darwish Sadif et al. (2000), Chitaz (1999) and Abdi

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Nam (2004) have produced salinity maps using correlation coefficients of spectral values of images and electrical conductivity. Akhzari and Asadi (1395) introduced the NDSI index with 88% correlation as the most appropriate index and identified SI1 and SI2 as inappropriate indicators for soil salinity examination in their study area.

The findings of the current study indicated that NDSI and SIT were the best indices in the study region. Moreover, DVI, IPVI, SI2 were found to be the least efficient indices in salinity detection, and that the largest saline area belonged to NDSI and SIT.

Keywords: Classification, Landsat 8, Remote Sensing, Soil salinity, Spectral index.