Soil Salinization Assessment and Monitoring over Damghan alluvial fan, based on RS technique and field investigation

Mohammad Sharifi Kia1* Afzali. A2
1 Department of Remote Sending, Tarbiat Modares University, Tehran, IRAN
2 M.S Student of Geography Tarbiat Modares University, Tehran, IRAN

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Introduction

Worldwide salinization and degradation of soil is a widespread and important environmental challenge. Soil salinization is one of the most common land degradation processes in arid and semi-arid regions, where evaporation exceeds over precipitation. Under arid climatic conditions, soluble salts are accumulated in the soil, influencing soil properties and environment with ultimate decline in soil productivity. Soil salinity monitoring in irrigated and drained fields is necessary to follow the control of soil salinity provided by a drainage system. A subsurface drainage system can prevent or decrease the salinization hazard trend, a common phenomenon wherever irrigation is practiced under arid and semi-arid climatic conditions. About 77 million hectares of the world’s land have been saline as a consequence of human activities (secondary salinization), with 58% in irrigated areas. 20% of the world’s irrigated lands are affected by salt, but this condition increases to more than 30% in countries which are located in arid lands such as Egypt, Iran and many similar areas. Implementation of this assessment, before doing any action, needs to use adequate techniques and to record the changes and disclose of soil salinity ratio and domain. Remote sensing data providing namely satellite image and Aerial photos along with processed thematic maps from this images over GIS platform is most effective in both coast-speed and accurate to control and assessment of this phenomenon.

Data providing is one of the main challenges in case of soil salinity studies based on remote sensing techniques. In this case, data resolution in form of spectral, spatial and temporal is an important task for data selection and collected from source. In order to provide data for such studies many sensors can be nominated while the TM and ETM sensors carry by Land sat satellites as well as ASTER sensor are more popular which is many researches has been done so far.

Material and Methods

Damghan alluvial fan located in north of Damghan county with longitude 54° 10 to 54° 31 and latitude of 36° 00 to 36° 15. This alluvial fan with area of 376 km² is a part of southern morphological unit of central Alborz range that formed by Damghan rood River flowed NW-SE direction.

The present study has been done based on pragmatic method along with field investigation and satellite data analysis. Research method is laboratory – surveying and analytical. The geo statistical database extracted from processed remote sensing and surveying data. Here’s the data which is used in this study:

- Satellite image obtained from ETM and TM sensors at row 163 and patch 35 in2003, 07, 20 and 2011,07,18 respectively.
- Survey data extracted from pisometric wells.
- Litho logical data gained from geological map in scale of 1:100000 provide by GSI (sheet name is Damghan).

* Email: sharifikia@modares.ac.ir Corresponding Author 00989122449619
Digital elevation model modified from SRTM data.

To extract effective factors in Stalinization and high correlation between salinity increasing and cultivation area index, Wells Ec index, wells water table decrease index, remote sensing data in different bands combining together and salinity map extracted by image processing techniques.

In next step correlation coefficient for each independent factors and soil salinity factor extracted from remote sensing data has been calculated. Furthermore, study area is divided to 1683 vector regions and assessed by network analysis and according to this, correlation rate for each factors at all vector Regions extracted.

Results and Discussion

The salinity assessment and analysis over the area study has been done based on spectral analysis and band combination applied over the LANSAT data (TM and ETM+). According to elements e.g: climate variables (temperature, evaporate transpiration, precipitation), vegetation coverage, soil conditioned Effect to IR part of spectrum, the spatial algorithm \([\frac{(B5-B7)}{(B5+B7)} - \frac{(B5-B7)}{(B5+B7)}]\) applied on 5 and 7 Band for soil salinity extraction. To assess soil salinity variability, the two data set of above sensors with almost 8-year deferential are processed and the individual salinity map extracted. The derived maps are overlaid to extract the salinity area variations. The result showed that 57 percent of pixels represent salinity was increasing, 19 percent with no fluctuations and 23 percent of total pixels affected by salinity decreasing procedure.

In network analysis, the study area divided to 1683 vector Regions with 500 meter length. Then for preparing a framework, correlation analysis between soil salinity factor and point independent variables is applied and a valuable map for all point data is generated. To this aim, using IDW interpolation technique, point data obtaining from survival field related to all independent variables transformed to pixel maps. Then pixel value joined with vector network. Because of the different dimensions in pixel size and vector cells, average of all pixel values located in each vector cells selected as reagent value. In the next step, in order to extract correlation range for salinity Index and all effective variables, statistical model generated in software environment, applied on related variables and spatial distribution for each variable factors associated with soil salinity index. Finally, the output of the investment plans of each effective factors are provided in the context of spatial distribution to visual analysis.

By network analysis, weight and location values of each factor are determined as follows:
- Regarding to correlation rate, most correlation rates associated with Water table lowest rate determined by Ec factor.
- According to area of land dedicated to Stalinization, the biggest contribution belonged to the vegetation index with 76 percent of all, that illuminated importance of this factor. But in terms of the area are owned by minimal conductivity factor.

The spatial distribution of each factor should be noted:
- Vegetation index factor is mainly disturbed in the central and eastern parts of study area.
- Underground water level index is limited to the northern and eastern part of the region
- And electric conductivity is observed in the northern and southern part of the alluvial fan.

Conclusion

According to the results of the factor analysis and the spatial distribution of salinity and it’s relation to each affective factors illuminated, salinity amount increased every year over the extent part of central and southern section where the arable and horticulatural land as well as most part of rural settlements are located. This fact is notable in two aspects:
• Stalinization of arable land and its surrounded may have adverse impact on agricultural productivity and garden area, given that the area has not enough industrial development. This will affect job subject in study area.

• Most part of the Damghan alluvial fan covered with pistachio cultivation that this horticultural yield assigns most part of export product of this region. According to this, overall cultivation land salinity and biological imbalance of this species, fails to export of this product.

• According to this problem, accurate and long term plan must be arrange to control of salinity increasing procedure.

**Key Word:** Stalinization, Damghan alluvial fan, Remote Sensing, Network Analysis.