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SOIL SALINITY DETECTION AND MAPPING UNDER CLIMATE AND LAND COVER CHANGES BETWEEN 2000 AND 2022: SMINJA CASE STUDY (TUNISIA)

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Introduction

Salinity is one of the most brutal environmental factors limiting the productivity of crop plants because most of the crop plants are sensitive to salinity [1]. This natural phenomenon is expected to affect the world more vigorously and extensively in coming years [2,3]. Soil salinity monitoring is essential for effective management and planning of agricultural activity in salt-affected soils. Assessing soil salinity can help with irrigation planning and ensure proper water management, leading to better crops and increased profitability. Truthful data through earth observation and evaluating the changes in soil salinity is crucial for the agriculture productivity growth and efficient soil management [4]. Climate change is a catalyst for the salinization processes, which are originally linked to agricultural practices, the dissolution of facies crossed by water, the conditions of permeability and drainage, the quality of irrigation water and the nature of crops, the quality and nature of soils, and topography.

The aim of this study is to assess the soil salinity dynamics between 2000 and 2022 under climate and land cover changes.

Methodology

The methodology flowchart involving fundamental stages of study is outlined in Figure 1.

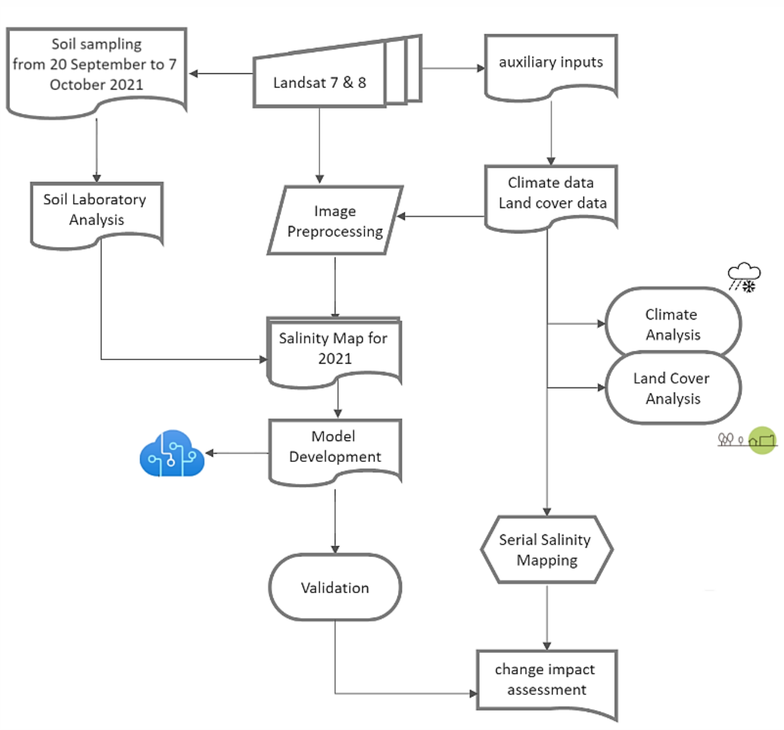


Figure 1: Flowchart of the methodology.

Study Area

This study was conducted in Sminja in the Zaghouan Governorate (Tunisia) and covers approximately 12 900 ha, as shown in Figure 1. The region is characterized by a semiarid Mediterranean climate characterized by mild, rainy winters and hot, dry summers.

Figure 2: A map of the study area and field sample point distribution

Field Work and Laboratory Analysis

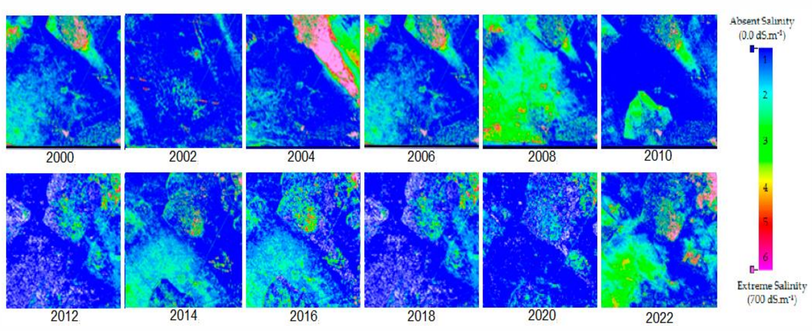
The Sminja area is afflicted by soil salinization, a significant environmental issue. In this regard, remote sensing techniques were used in the processing of satellite images acquired from Landsat 7 and Landsat 8 sensors [5]. Landsat satellites offer long-term observations, spanning several decades, allowing for the examination of changes in soil salinity over an extended period [6]. During the field survey conducted between 20 September and 7 October 2021, 150 geo-referenced soil samples were collected representing different soil salinity classes (Non saline, slightly saline, moderately saline, strongly saline and very strongly saline) [7].

Climatic Data

Over the course of the past 22 years, a network of climate and weather forecast stations was established under the regional Commissariat for Agricultural Development in Zaghouan.

Results and Discussion

The Landsat serial time's datasets acquired over the study area with the Enhanced Thematic Mapper Plus (ETM+) and OLI sensors during the last 22 decades over the intervals (2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2020, 2022) were radiometrically calibrated (fig 2).



Conclusions

These findings highlight the impact of land cover changes on soil salinity dynamics during the study period. The observed increase in moderately saline and highly saline soils can be attributed to alterations in land cover between 2000 and 2022. The correlation between land cover changes and soil salinity patterns emphasizes the need for effective land management strategies. The results of this study provide valuable insights for government authorities and land managers in developing future management strategies for the region. By recognizing that soil salinity dynamics are influenced by climate change and land cover changes, policymakers can devise targeted approaches to mitigate and manage soil salinity issues.

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International Network of Salt-Affected Soils

Managing salt-affected soils for sustainable future