Chapter 10
Developing Logistic Regression Models to Identify Salt-Affected Soils Using Optical Remote Sensing

Nirmal Kumar
National Bureau of Soil Survey and Land Use Planning, India

G. P. Obi Reddy
National Bureau of Soil Survey and Land Use Planning, India

S. K. Singh
National Bureau of Soil Survey and Land Use Planning, India

R. K. Naitam
National Bureau of Soil Survey and Land Use Planning, India

ABSTRACT

A major part of Indo-Gangetic plain is affected with soil salinity/alkalinity. Information on spatial distribution of soil salinity is important for planning management practices for its restoration. Remote sensing has proven to be a powerful tool in quantifying and monitoring the development of soil salinity. The chapter aims to develop logistic regression models, using Landsat 8 data, to identify salt affected soils in Indo-Gangetic plain. Logistic regression models based on Landsat 8 bands and several salinity indices were developed, individually and in combination. The bands capable of differentiating salt affected soils from other features were identified as green, red, and SWIR1. The logistic regression model developed in the study area was found to be 81% accurate in identifying salt-affected soils. A total area of 34558.49 ha accounting to ~10% of the total geographic area of the district was found affected with salinity/alkalinity. The spatial distribution of salt-affected soils in the district showed an association of shallow ground water depth with salinity.

DOI: 10.4018/978-1-5225-7784-3.ch010

INTRODUCTION

Soil salinity/ alkalinity has been identified as a major cause of land degradation after erosion (Oldeman et al., 1991; Bai et al., 2008) and a major threat to agriculture, especially in arid and semi arid areas (Bai et al., 2008; Maji et al., 2010). Current global estimates reveal over one billion ha area affected to various degrees of soil salinity/ alkalinity (Singh 2009). In India, Mandal *et al.* (2009) digitized maps in geographical information system (GIS) depicting salt affected soils (SAS) of the country. An area of 6.73 million hectare of SAS was estimated for the entire country. State wise estimates showed that this extensive area is distributed over the Gangetic plain of Uttar Pradesh; the arid and semiarid regions of Gujarat and the peninsular plains of Maharashtra state. A significant area is also located in the coastal region covering seven states. The SAS are primarily saline in deltaic, coastal and mud flats/mangrove swamps and sodic in alluvial, aeofluvial /aeolian/arid and peninsular plains. Quantifying and monitoring the spatial distribution of SAS is important for increasing productivity and production, apart from increasing area under cultivation. Commonly used method of soil survey is time consuming and hard to reproduce. Remote sensing has proven to be a powerful tool in quantifying and monitoring the development of soil salinity.

A variety of remote sensing data has been used for identifying and monitoring SAS (Kumar and Singh, 2018), including aerial photographs, thermal infrared images, visible and near infrared (NIR) multispectral and microwave images (Metternicht and Zinck, 2003). Different bands of multispectral satellite data have been used individually or in combinations to identify SAS or to differentiate it from other surface features. Alternatively, many image transforms such as, principal components (PC) and Tasseled Cap Transformation (TCT) have been found effective in assessment of SAS. In addition, vegetation indices (VIs) and several salinity indices (SIs) have been used to get better accuracies in identification of SAS. These indices make the required salinity information more prominent while suppressing the effects of other land use/land cover features.

The remote sensing data have been used to identify SAS in two manners: visual interpretation and supervised classification of moderate resolution data such as Landsat. Most attempts to assess and map SAS in India is based on visual interpretation initially of aerial photographs and later of one or more seasons false colour composites (FCC) of moderate resolution satellite data (Sharma and Bhargawa, 1988; Singh and Dwivedi, 1989; Dwivedi, 1992, 1994; Sujatha *et al.*, 2000; Sethi *et al.*, 2006). Visual interpretation of remote sensing data is also time consuming (though, less than survey), subjective, and hard to reproduce. An alternative for visual interpretation techniques is the automatic extraction of the SAS from satellite