Soil and Groundwater Salinization Problems in the Khorat Plateau, NE Thailand - Integrated Study of Remote Sensing, Geophysical and Field Data

Probleme der Boden- und Grundwasserversalzung in der Khorat Hochebene, NE Thailand - Studie mit Fernerkundung, Geophysik und Geländekartierung

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Abstract

The study area is located in the western part of the Khorat basin, a sub basin of the Khorat Plateau, northeastern Thailand. The aims of the study are to map the distribution of saline soil at the surface of the study area, to correlate presumably salt-related features visible in the remote sensing data with information/indications provided by geophysics or other sources of data, to develop tentative assumptions on relationships between typical salt-related features in the remote sensing imagery and corresponding subsurface conditions, to outline concepts on the development of soil salinity, depending on lithological and structural conditions, and to investigate the differentiation between saline and non-saline soil by differences of their spectral properties.

The non-remotely-sensed data, e.g. geophysics, groundwater, borehole logs and GIS data were employed to study the distribution, depth and shape of the rock salt members of the Maha Sarakham Formation, which are supposed to be the major sources of the salinity in this region. Results from geophysical investigations by conducting seismic reflection, resistivity and microgravity investigation indicate that the rock salt beneath the moderately to the severely salt-affected areas is present at a depths range from 80 to 100 m. The rock salt has a relatively flat to broadly anticlinal surface. These results also imply that beneath the elevated areas the rock salt is situated at greater depths than under the low-lying areas, troughs or swampy areas, e.g. in the vicinity of the Khong District, Nakhon Ratchasima Province.

Remotely sensed data including Landsat 5 (TM), Landsat 7 (ETM+) and ASTER covering the study area were used to map the land use and salinity in the study area by means of visual interpretation and digital classification. Based on visual interpretation of land use and existing saline soil maps and two additional field trips investigating the amount of salt crust present at the surface, salt-affected areas in the study area could be categorized into three major types: severely, moderately and slightly salt-affected. Land use classifications of Landsat 7 and ASTER data showed good results in differentiating salt-affected from non salt-affected areas. Especially ASTER data gave high accuracy. Soil salinity classification derived from Landsat 7 by Band Math techniques gave poor results, particularly, when differentiating saline areas from bare ground, while those derived from ASTER data gave higher accuracy. Processing and interpreting ASTER data made it possible to effectively differentiate saline areas from bare ground. The total area of classified salt-affected areas in the study area is 495 km^2.

Results from reflectance spectra measurements showed that salt crust covering saline areas has specific spectral absorption feature at 1 750 nm wavelength. It is notable that most of the salt affected areas are located where lineaments occur. The dissolved salt rises to the surface using increased permeability along fault and fracture planes which are featured by lineaments on satellite images; salt crusts accumulate along these features and cause salinity later on. Based on hydrogeology, geology and topography, this study classifies the salinity in the study area into three main types: 1) Salinity along weak zones including salinity along a rock boundary, salinity along a lineament and a river course, 2) salinity in depression areas, and 3) salinity affected by reservoir and irrigation systems.

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