Facilitating soil salinity surveys with near surface sensing tools

Akmal Akramkhanov[1], Christopher Martius[2], Johannes P.A. Lamers[1]

[1] Center for Development Research, University of Bonn, Germany
[2] International Center for Agricultural Research in the Dry Areas (ICARDA), Program for Sustainable Agriculture in Central Asia and the Caucasus (CAC), Tashkent, Uzbekistan

Land degradation due to increased soil salinity in the lower reaches of the Amu Darya river has become widespread. Leaching of the soils at the end or beginning of the vegetation season is a necessary practice. However, water amount for leaching needs to be determined based on soil salinity level. Salinity is a dynamic property of the soil. Traditional salinity maps based on salinity survey become outdated by the time they are produced, due to time and labour consuming analyses, and may deem obsolete. Electromagnetic (EM) induction is used as a proxy for soil salinity; it measures average electric conductivity of the soil profile down to 1 meter depth. EM technique has shown great potential in fast and frequent sampling which allows producing high-resolution and more accurate salinity maps.

Electric conductivity of the soil depends on many factors such as soil salinity and texture, moisture, and temperature. Studies conducted with an EM device to measure soil salinity at farm scale in Khorezm region demonstrated that this device could accurately detect spatial extent of salinity during cropping seasons in 2002 and 2008. Calibration of EM device to transfer reading into commonly used indicators electrical conductivity of the saturation extract (ECe) or total dissolved solids (TDS) has been conducted. Accurate detection of soil salinity despite various circumstances contributing to variation in soil properties, i.e. irrigation, cropping, and cultivation, showed that EM can be used instead of soil sample analyses. Hence, EM device could be used for soil surveys of the larger areas at the end of vegetation season to determine water requirements for leaching soil salinity.

A salinity survey using EM device in autumn 2003 has been completed within 1 month, in an area covering about 400 km^2. The use of the modified version of the EM device and integration of GPS receiver in 2008 allowed further speeding up and increasing the frequency of sampling locations, since the device makes continuous reading while switched on and carried by operator. The modified version of the EM device allows taking readings from shallow (down to 0.75 m) and deeper layers (down to 1.5 m). An area covering 50 ha could be mapped within 2 days and soil salinity of 0.75 and 1.5 meter layers could be drawn next day.

Such advances are very useful to monitor soil salinity dynamics which represents the basis for evaluation of land reclamation and land management strategies in the Aral Sea Basin.