ZUR no. 9

ZEF-UNESCO Rivojlanishlari*

October 2009

Science brief from the ZEF-UNESCO project on Sustainable Management of Land and Water Resources in Khorezm, Uzbekistan

Zentrum für Entwicklungsforschung
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GERMAN-UZBEK KHOREZM PROJECT

German Ministry for Education and Research (BMBF)

UNESCO
United Nations Educational, Scientific and Cultural Organization

Soil salinity monitoring using modern techniques

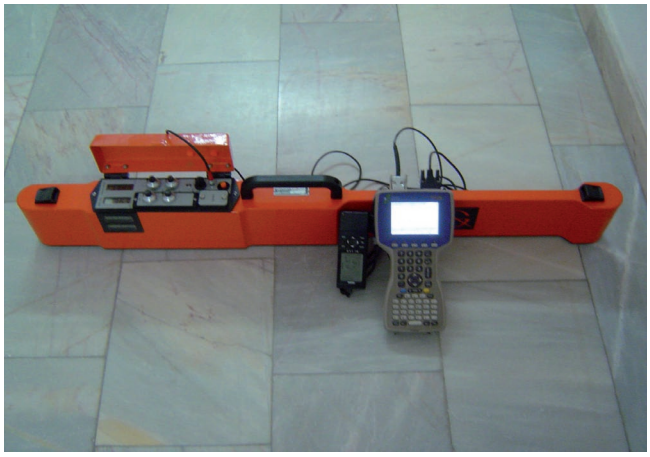
Summary

Soil salinity is a major indicator of soil condition. Rapid and frequent measurements of the electrical conductivity (EC) of the soil as an equivalent of soil salinity status offer useful information on occurring changes.

The measurement of electric conductivity

There are several factors indicating the condition of the soil. Electric conductivity (denoted as apparent EC_a) is a collective term for these factors, mainly indicating soil salinity, clay content and temperature.

The electromagnetic induction meter (EM) estimates the bulk electric conductivity of the soil. The EM device has been adapted from geophysical applications. The EM device is widely used for various purposes in agriculture in the US, Australia, and Canada and numerous journal articles have been published on it internationally. Since soil salinity is the main factor contributing to soil condition in Uzbekistan, the EM device is most suitable for its assessment.



Picture 1: The EM38-MK2-2 device with field computer and GPS attached

There are several modified versions of the device measuring different depths depending on the intercoil spacing. For agricultural purposes, intercoil spacing of 1 meter is widely used providing an effective measuring depth of up to 1.5 meters, suitable for deep- and shallow-rooted crops. In horizontal mode the EM reading provides average EC_a of the 0.75 meter soil layer.

The project has been using EM devices to assess and monitor soil salinity for its activities since 2002. The capacity built within the project concerning the use of the EM device, obtaining geo-referenced measurements, calibration, and interpretation of the results is available to interested parties. The capability of the device to cover large areas and to carry out rapid measurements makes it most suitable for organizations, research institutes, and development projects involved in soil salinity appraisal and monitoring.

Picture 2: Illustration of measurements conducted using EM38 in a pilot area of around 70 hectares

Advantages and disadvantages

At present, soil salinity assessment in Central Asia is based on conventional laborious soil sampling of representative surveyed areas, with subsequent laboratory analyses – a process that is very resource consuming. Traditional soil salinity analysis involves determining the amount of total dissolved solids (TDS) in a given soil sample. Consequently, maps of soil salinity are only available after long delays, which reduce their usefulness.

Surveys conducted with EM allow the identification of fine-scale spatial variation because they offer non-destructive and continuous measurements. Thus, advantages of EM are: (i) rapid and non-destructive measurements; (ii) most suitable for monitoring; (iii) suitable for fine- and large-scale mapping; (iv) low cost per hectare; (v) possibility of logging and geo-referencing by coupling GPS; (vi) possibility of mounting on a vehicle for mobile mapping of large areas; (vii) the fact that they have been successfully tested under conditions in Uzbekistan.

Picture 3: The use of EM38 in the field by operator

Disadvantages of the EM devices include dependence on soil moisture; soils should not be very dry during measurements. Since EM readings provide an average EC_a value of the soil profile, a proper calibration for soil salinity interpretation needs to be conducted for different soil textures.

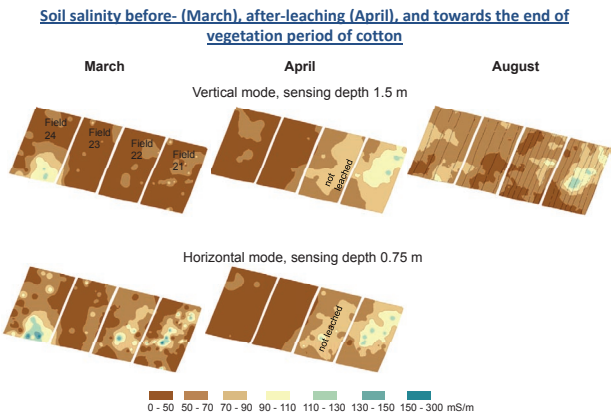


Figure 1: The interpolated maps of electric conductivity measured by EM38 in selected fields before and after leaching events

Technical-economic parameters

The EM device can be managed by one operator. Depending on the land cover and the density of transects within the field, an area of 70-80 hectares can be measured in 1-2 days. The rapidity of the measurements depends on the walking speed of the operator or the mobile system.

The price for EM38 starts from 11,000 USD. Data-logger and GPS have to be purchased additionally for the surveys requiring automatic logging and geo-referencing of the measured positions. The market for data-loggers is diverse and the user has a wide variety of choices. The maximum price of the set (including data-logger and GPS) can reach 4,000 USD.

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Editor: Alma van der Veen (ZEF)

* ZUR is an abbreviation of ZEF-UNESCO Rivojlanishlari, meaning ZEF-UNESCO Developments. The ZUR science briefs publish scientific project output with policy relevance on a regular basis.

Published by the Center for Development Research (ZEF)
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