UNIVERSITY OF HOHENHEIM

Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg Institute) Crop Water Stress Management

Mapping groundwater salinity using electrical resistivity in rice production systems

A case study from Tra Vinh, Vietnam

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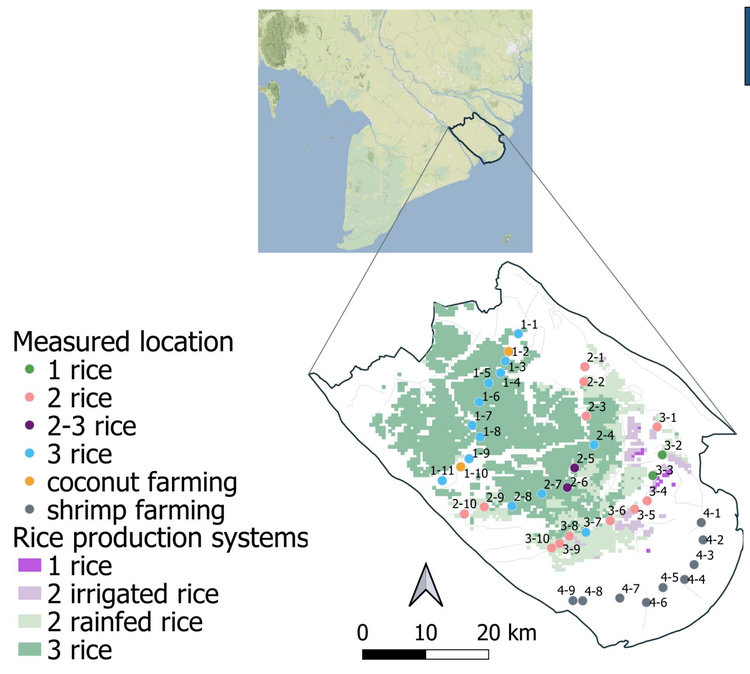
Introduction

Climate change, decreased river flow, and land subsidence result in saltwater intrusion, which poses a significant threat to rice production in Vietnam and elsewhere. Developing management strategies for adapting rice production systems to the increasing danger of soil salinization requires characterizing, and subsequently monitoring, of the spatial distribution and dynamics of salinity in the shallow aquifers. For this, we tested here the suitability of ARES II soil resistivity measurements and mapping.



Conclusions

- ARESII proved to be a useful tool to characterize and monitor shallow water tables for salt intrusion.
- Top soil resistivity is closely related to land-use with low values indicating salinization.
- Saline water intrudes the shallow aquifer seasonally from the rivers in the east and west and via tidal movements and sea level rise from the south.

Results and Discussions

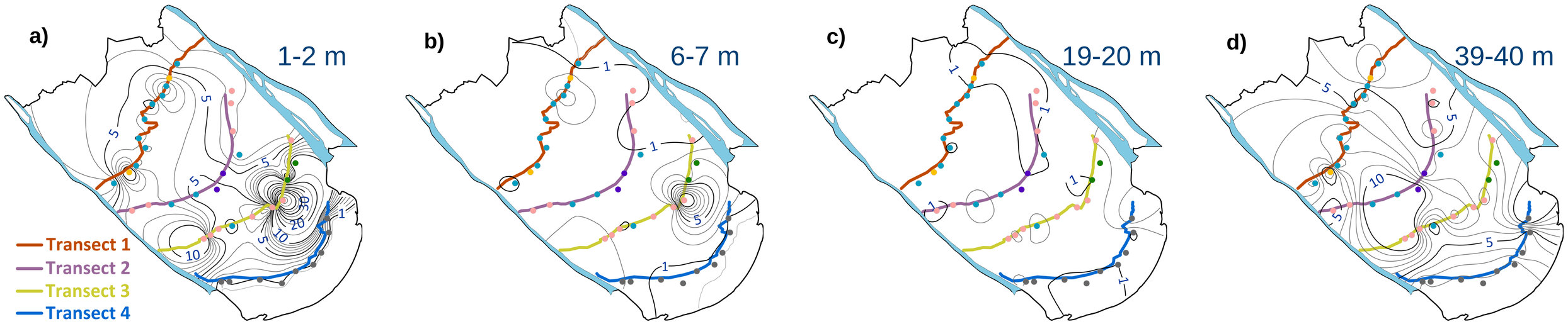


Figure 1. Maps of the horizontal distribution of electrical resistivity for the Tra Vinh provinve at four different soil depths. The contour interval is 1 Ω.m for resisistivity < 10 Ω.m, and 5 Ω.m for resisitvity > 10 Ω.m

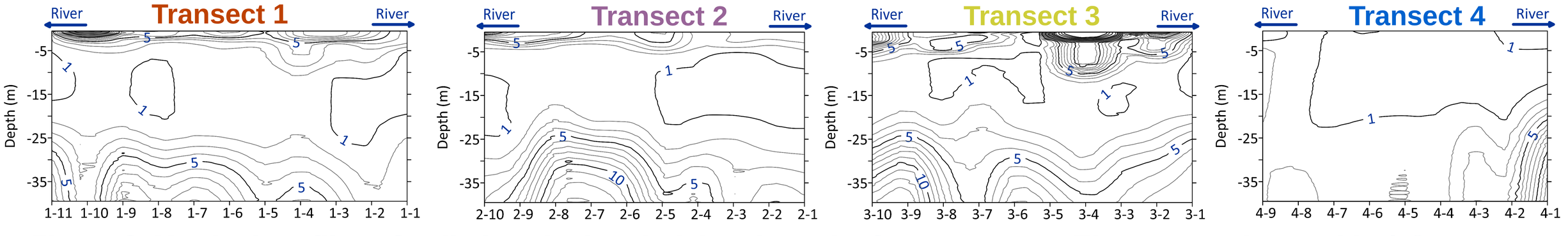


Figure 2. Vertical profiles of soil electrical resistivity along the four transects. The contour interval is 1 Ω.m

- Salinity profiles at 40 locations located on 4 contour line-based transects allow mapping of subsoil salinity in different depths (Fig. 1).
- ➢ With little effort and on a regular basis ARESII could be a useful tool to monitor shallow water tables for salt intrusion.

- Top soil resistivity (R) varies from 0.15 – 138 Ω.m. (Fig.1a) and is closely related to land use. Low R values prevail at shrimp farms in the south and triple rice in the Northwest.
- ➢ R values below 5 indicate potentially saline water. But, R is low when soil texture is fine and increases when soil water content is low and texture is coarse.

- Potentially saline water tables were identified between 6 and 20 m depth throughout the province (Fig. 1 b,c).
- ➢ Saline water seems to intrude the shallow aquifer (1) seasonally from the rivers from east and west and (2) with tidal movements and sea level rise from the south.

Materials and Methods

Electrical resistivity tomography method was applied for investigating soil salinity profiles approximately 300 m in length at 40 locations following geological transects to map salinity gradients in the study area. ARES II device (GF Instruments) was employed for soil salinity exploration in rice paddies down to a depth of 40 m by using 4 m electrode spacing. The resistivity results were interpreted by the inversion software Res2DInv (Aarhus Geosoftware) and visualized as contour maps by combining Surfer software (Golden Software) and QGIS.