KATHOLIEKE UNIVERSITEIT LEUVEN

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# Non-invasive monitoring of mixed cropping systems
## *A case-study in Ratchaburi province, Thailand*

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# Introduction

Contour hedgerow intercropping is a simultaneous agroforestry system which involves planting hedgerows along the contour lines of a slope and is extremely effective in controlling erosion on steep slopes (Morgan, 2004). However, sometimes a negative impact on crop response in the alley has been observed due to competition. To get a more detailed understanding of the competition for water, 2- or 3-D monitoring of the water fluxes in the soil-plant-atmosphere system is necessary. Electrical resistivity tomography (ERT) may be an appropriate tool for this. This research investigates the potential of ERT, a non-invasive monitoring technique, to monitor spatial-temporal dynamics of the water content (WC) dynamics in such a mixed cropping system on a sloping field in Thailand.

# Methodology

## Field site

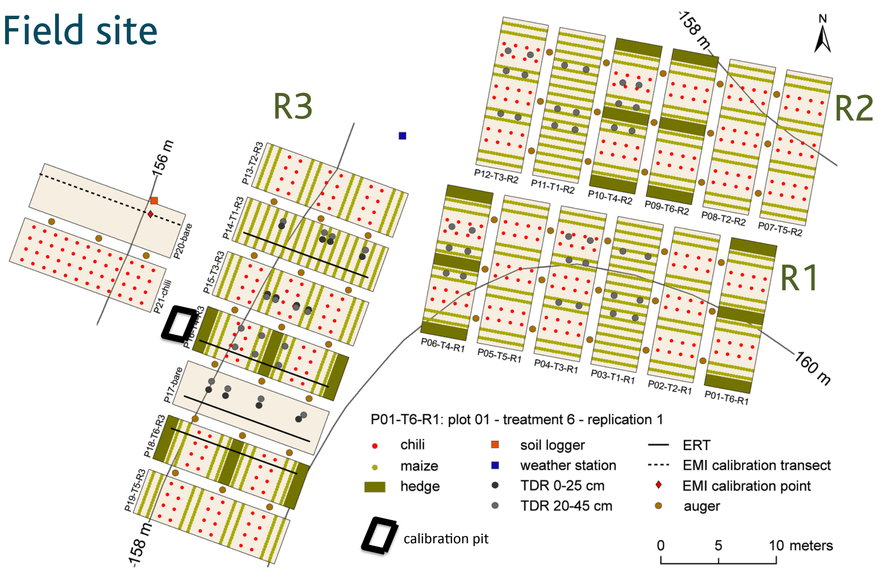



Fig 1: Overview of the field site. 3 Replications (R) with 6 agricultural treatments were in place. The ERT measurements took place in R3 (see black lines along the slope in 4 plots: bare, monocrop, intercrop and intercrop without fertilizer).

## Data processing

Resistance [Ω]
**R**

*Geometric factor*

Bulk apparent resistivity (Ω.m]
**$\rho_{a,b}$**

*Smoothness constrained inversion*

Bulk resistivity/conductivity [Ω.m / S.m]
**$\rho_b$ / $EC_b$**

*T-correction (crop specific!)*

T-corrected bulk conductivity [Ω.m]
**$EC_{b,25}$**

*Empirical calibration relation*

Water content [-]
**WC**

## Calibration pit

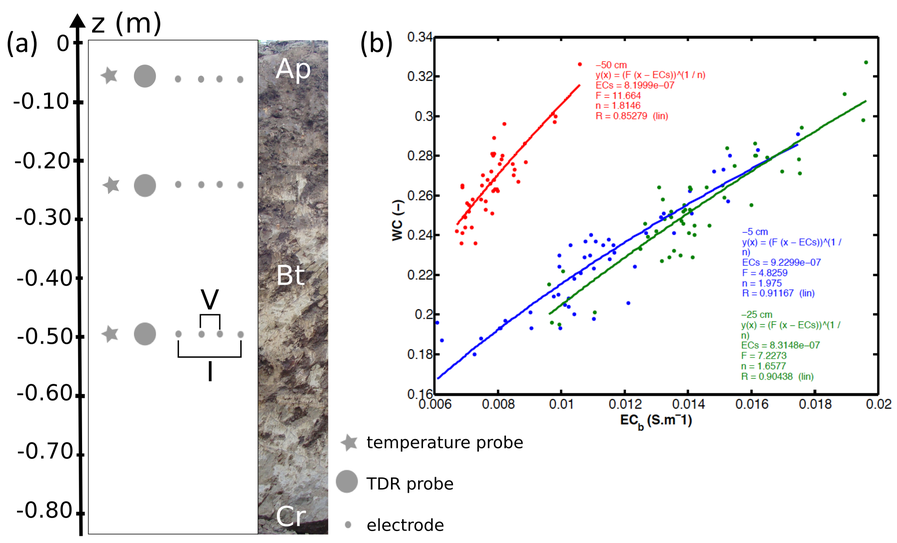



Fig 2: (a) Calibration pit with electrodes in Wenner configuration. Temperature was used to correct the electrical conductivity (EC) for temperature. (b) Then an empirical calibration relation (WC-EC) was established for each depth.

# Results

## Soil moisture (ERT)

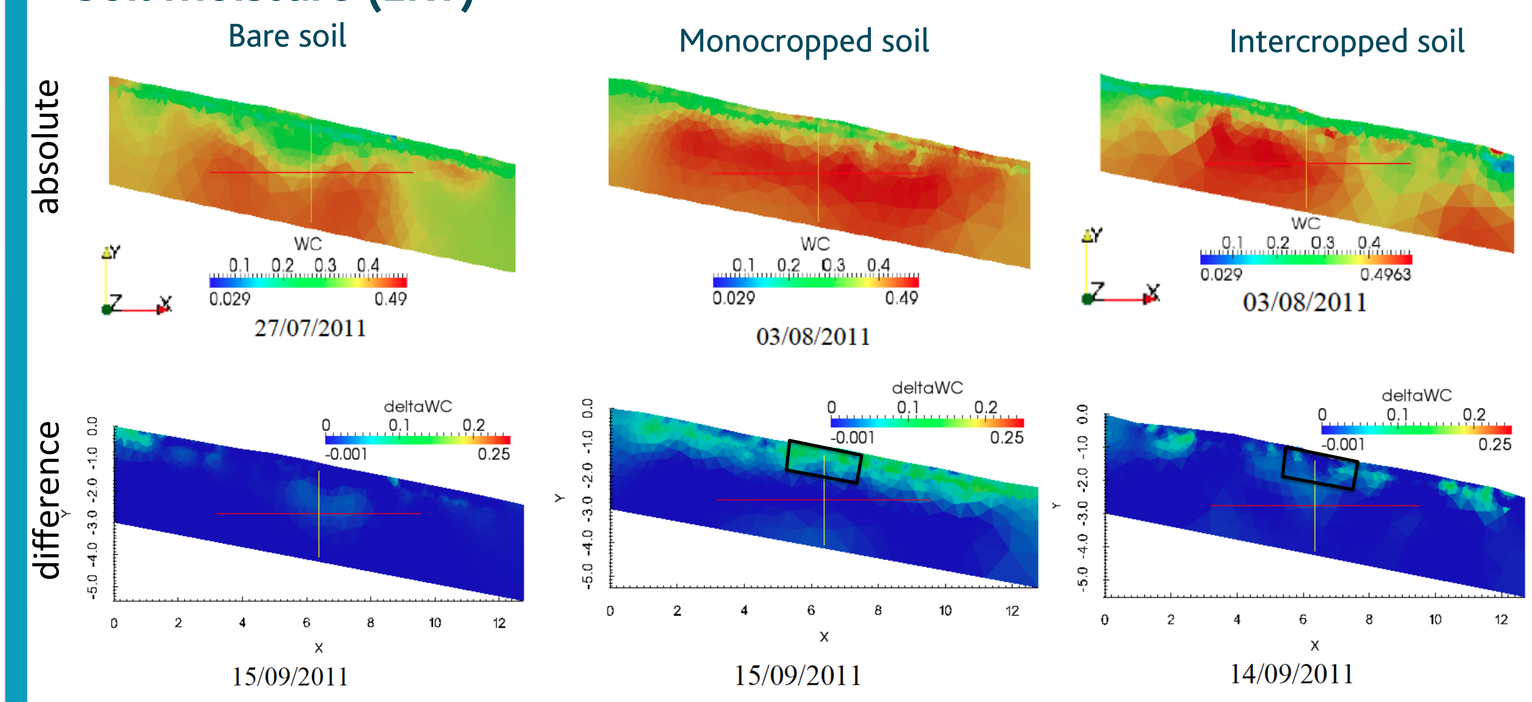
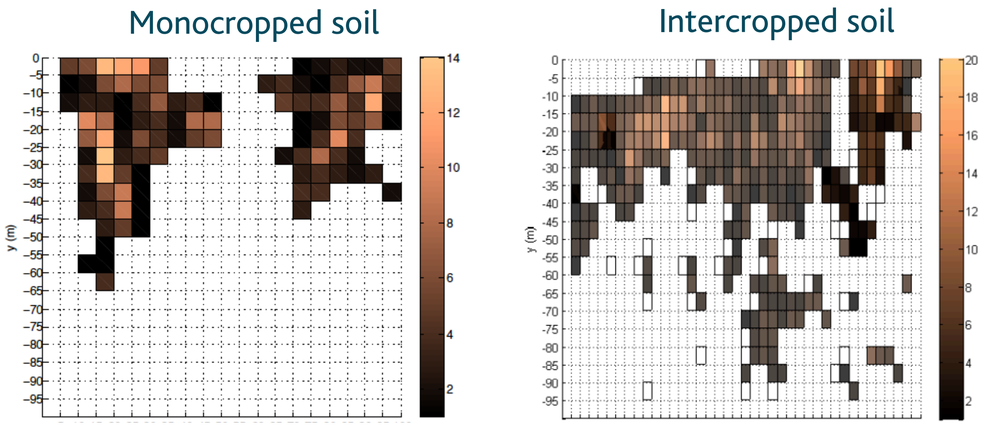



Fig 3: First results of the ERT measurements for bare soil (BaR3), monocropped soil (T1R3) and intercropped soil (T4R3). The data processing is still ongoing work, but from the absolute images the depth of the regolith clearly emerges and reveals strong heterogeneity in soil depth. (Remark: the indicated water content in the regolith should not be interpreted, since there is no calibration established for this layer.) The difference images show the deviation of the indicated timeframe from the reference image above. They reveal patterns of water depletion which are different for the different cropping systems. The boxes indicate where the root counting was performed.

## Root distribution

Fig 4: Root density profiles taken in soil pits at the end of the growing season. The roots were counted using a grid with cell size of 0.05mx0.05m The dark coloured cells represent maize plants, whereas the light cells represent Leuceana roots. The roots of the Leuceana hedge develop much deeper than the maize roots and grow laterally in the region of the maize roots as well.




# Conclusions & Outlook

Preliminary results of this ongoing work show that **distinct patterns of water depletion** can be recognized in different cropping systems. This means that ERT can be used to obtain quantitative field data on soil moisture distributions and dynamics.

The biggest challenge of the ERT measurement technique to monitor spatial and temporal dynamics in soil moisture and water flux distribution is the **dependency** on a number of variables and soil properties which may **co-vary in space and time**. **Site-specific calibration** of the relationship between water content and electrical conductivity remains very important and indicates the diverging behavior of different soil horizons.

Combination of different measurement techniques remains necessary to quantitatively interpret ERT images.

It must be noted that under tropical conditions, the use of ERT became challenging in very dry periods, since the **loss of electrode contact** with the soil sometimes deteriorates the data quality. An adequate data error analysis becomes indispensible under such conditions.

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