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Productivity Evaluation of Maize Based Soil Conservation Systems on a Tropical Hillside

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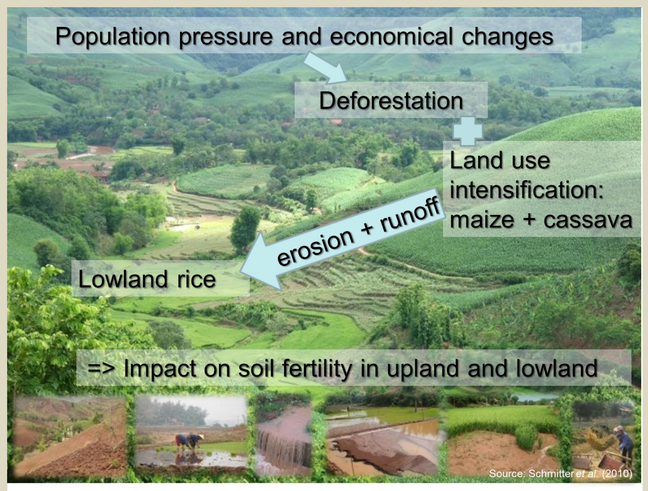
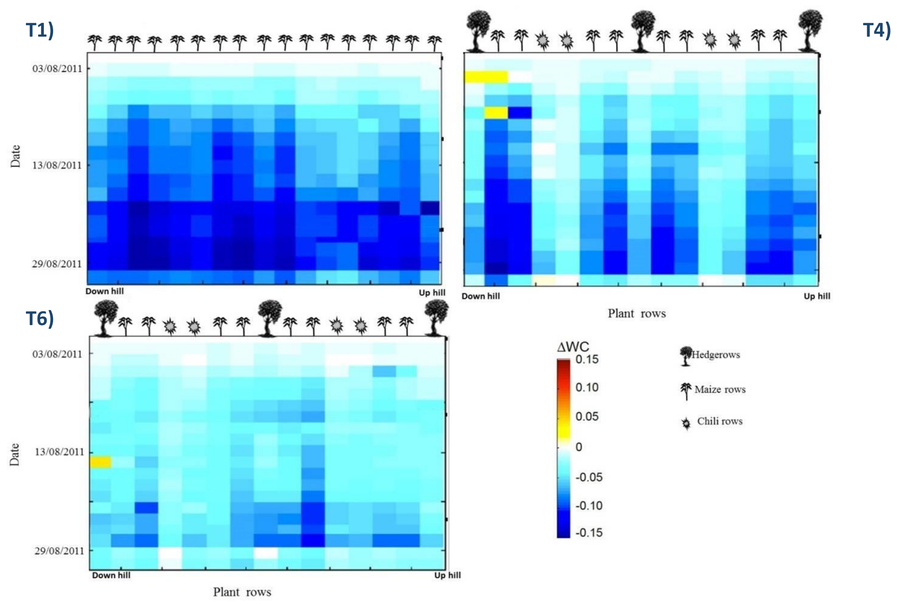
Research questions

- How can we assess competition at the crop-soil-tree interface?
- Is a combination of electric resistivity tomography (ERT) and stable isotope discrimination useful in identifying causes of competition in complex cropping systems?
- How can we mitigate competition in alley cropping?



Consequences of land use change in SE Asia

Relative soil moisture depletion measured by using ERT

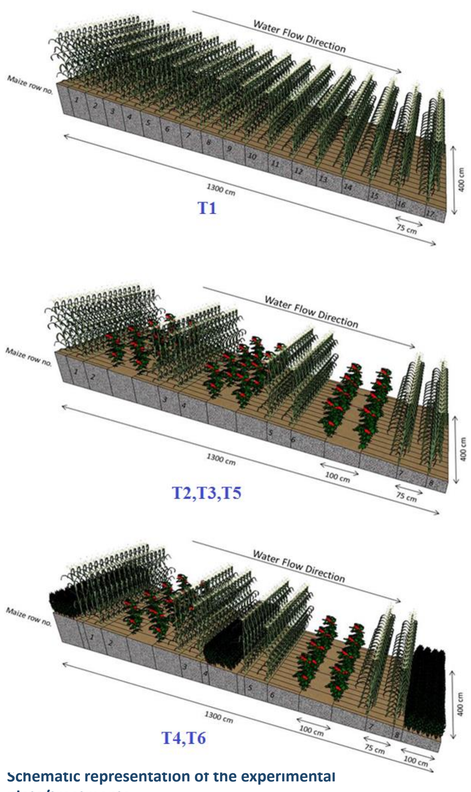


Measurements were carried out from August to September, 2011 in T1: maize sole cropping, tillage, and fertilization (farmers' practice, control; T4: maize-chili intercropping, minimum tillage, fertilization, Jack bean relay cropping, and leucaena hedgerows; T6: as T4 but without fertilization *(Hussain et al. 2015)*

Material and Methods

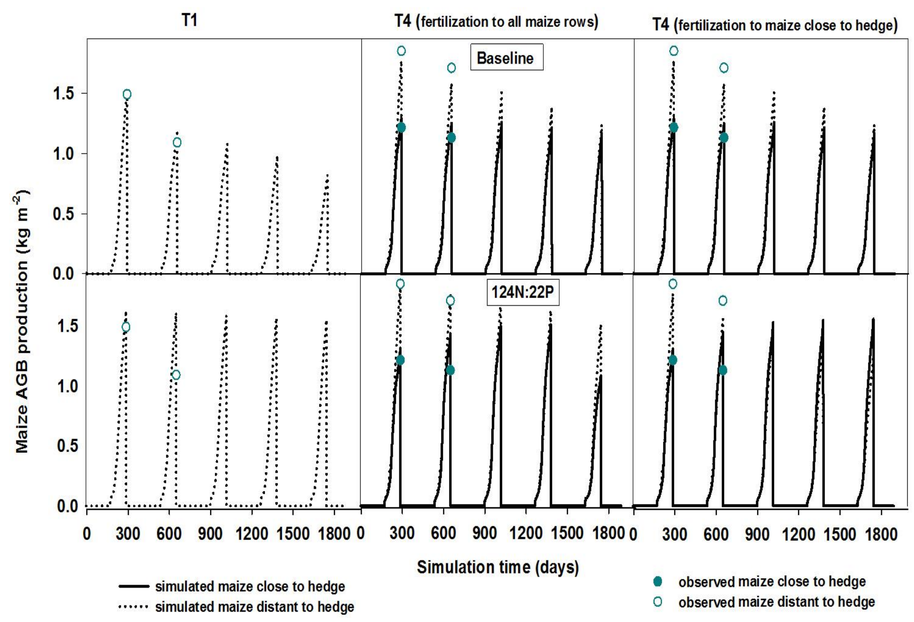
- Site: Ratchaburi province, Thailand (13°28´ N and 99°15´ E)
- Slope gradient: ~25%
- Fertilizer @ 62-11-36 NPK
- Treatments:
  - T1= Maize sole cropping, tillage, and fertilization (farmers' practice/control)
  - T2= Maize-chili intercropping, tillage and fertilization
  - T3= Maize-chili intercropping, minimum tillage, fertilization, and Jack bean relay cropping
  - T4= Maize-chili intercropping, minimum tillage, fertilization, Jack bean relay cropping, and *Leucaena leucocephala* hedgerows
  - T5= As T3 but without fertilization
  - T6= As T4 but without fertilization

- Stable isotope discrimination
- ERT imaging
- ***Wa***ter, ***Nu***trient, ***L***ight ***C***apture in ***A***groforestry ***S***ystems model



Schematic representation of the experimental plots/treatments

Modeling maize based cropping systems by using WaNuLCAS



WaNuLCAS maize above ground biomass simulation in T1: maize sole cropping, tillage, and fertilization (farmers' practice, control) and T4: maize-chili intercropping, minimum tillage, fertilization, Jack bean relay cropping, and leucaena hedgerows

Results

Maize above ground biomass (AGB), $\delta^{13}C$, light use efficiency (LUE) and land equivalent ratio (LER)

Treatments	AGB ($g\ m^{-2}$)	$\delta^{13}C$ (‰)	LUE_{AGB} ($g\ DM\ MJ^{-1}$)	LER -
T1 (control)	1161 bc	-10.55 a	1.23 cd	1.00
T2	1365 a	-10.47 b	1.56 a	1.17
T3	1242 ab	-10.51 ab	1.44 abc	1.03
T4	1250 ab	-10.49 ab	1.50 ab	1.21
T5	1033 d	-9.28 c	1.13 d	0.88
T6	1076 dc	-9.32 c	1.28 bcd	0.94
	P≤0. 001	*P≤0. 001*	*P≤0. 01*	-

Figures with different small letters indicate significant differences between the treatments

T1: maize sole cropping, tillage, and fertilization (farmers' practice, control); T2: maize-chili intercropping, tillage and fertilization; T3: maize-chili intercropping, minimum tillage, fertilization, and Jack bean relay cropping; T4: maize-chili intercropping, minimum tillage, fertilization, Jack bean relay cropping, and leucaena hedgerows; T5: as T3 but without fertilization; T6: as T4 but without fertilization.

Conclusions

- ERT imaging and stable isotope discrimination improved our understanding of competition at the crop-soil-hedge interface
- Maize ABG, LUE and LER were higher in maize chilli intercropping and hedgerows systems with fertilization than under maize sole cropping
- WaNuLCAS suggested small targeted additional applications of N and P fertilizer to sustain maize production
- This may foster farmers' adaption of alley cropping, contributing to a more sustainable crop production on in mountainous regions

References

Hussain, K., Wongleecharoen, C., Hilger, T., Vanderborght, J., Garré, S., Onsamrarn, W., Diels, J., Kongkaew, T., Cadisch, G., 2015. Combining δ13C Measurements and ERT Imaging: Improving our Understanding of Competition at the Crop-Soil-Hedge Interface. Plant and Soil 393(1-2): 1-20. *DOI: 10.1007/s11104-015-2455-z*

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