

The influence of the spatial distribution of agricultural conservation practices on hydrologic balance variables in a small basin

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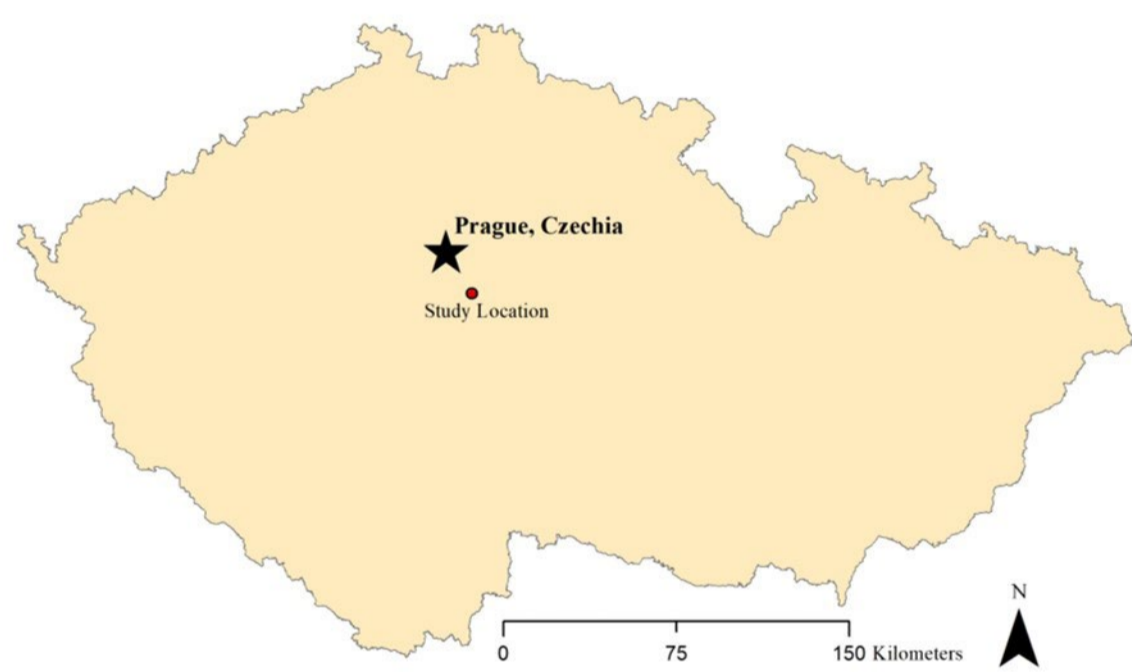


Goal

To document effects of the spatial distribution of agricultural conservation adoption on hydrological balance shifts in the Nučice experimental basin

Study Location

The Nučice experimental basin (0.52 km²) is a rural and agricultural watershed managed by two different farmers who grow winter wheat, mustard, or rapeseed depending on the year



Conservation Agriculture

The goal of conservation agriculture is to make soils self-sustainable (recycling water and nutrients in the system)

Efforts include:

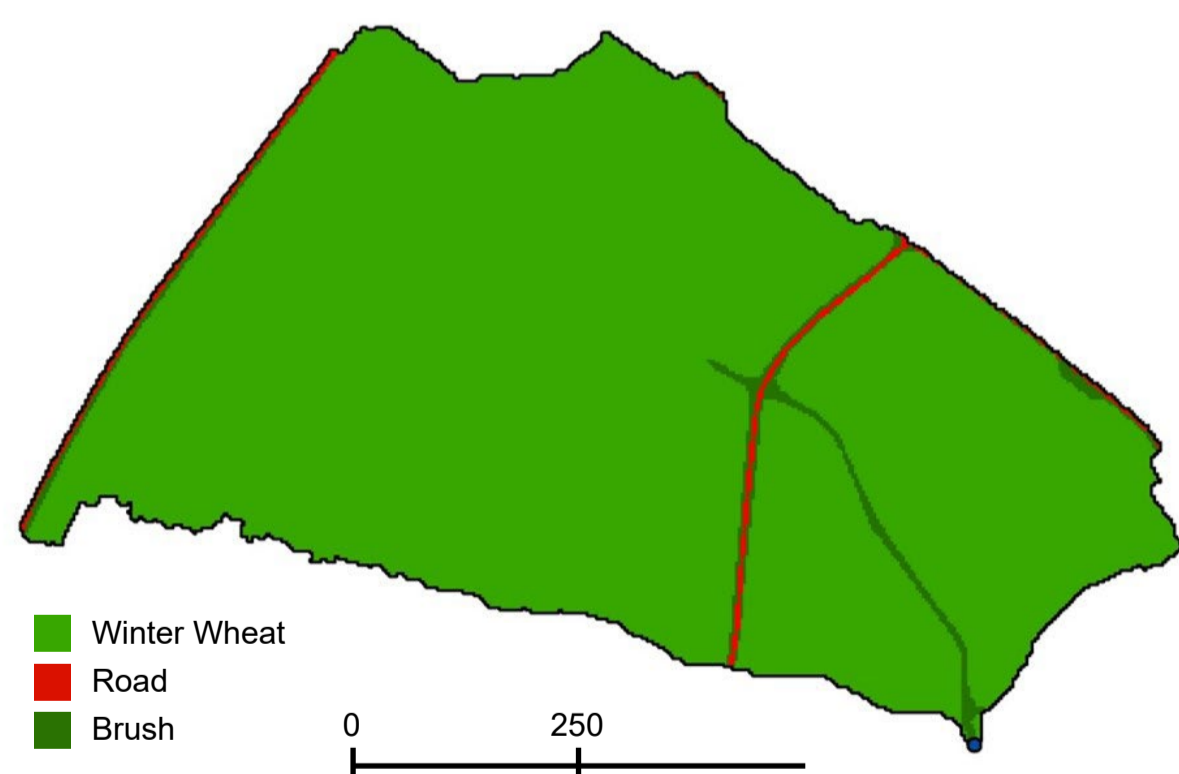
- Year-round organic matter cover
- Minimal soil disturbance
- Diversification in crop rotations

Benefits:

- Increases water holding capacity
- Reduces irrigation needs
- Reduces surface runoff
- Flood mitigation
- Reduces erosion

Techniques:

- No/reduced tillage
- Mulching
- Crop residue or cover crops



SWAT

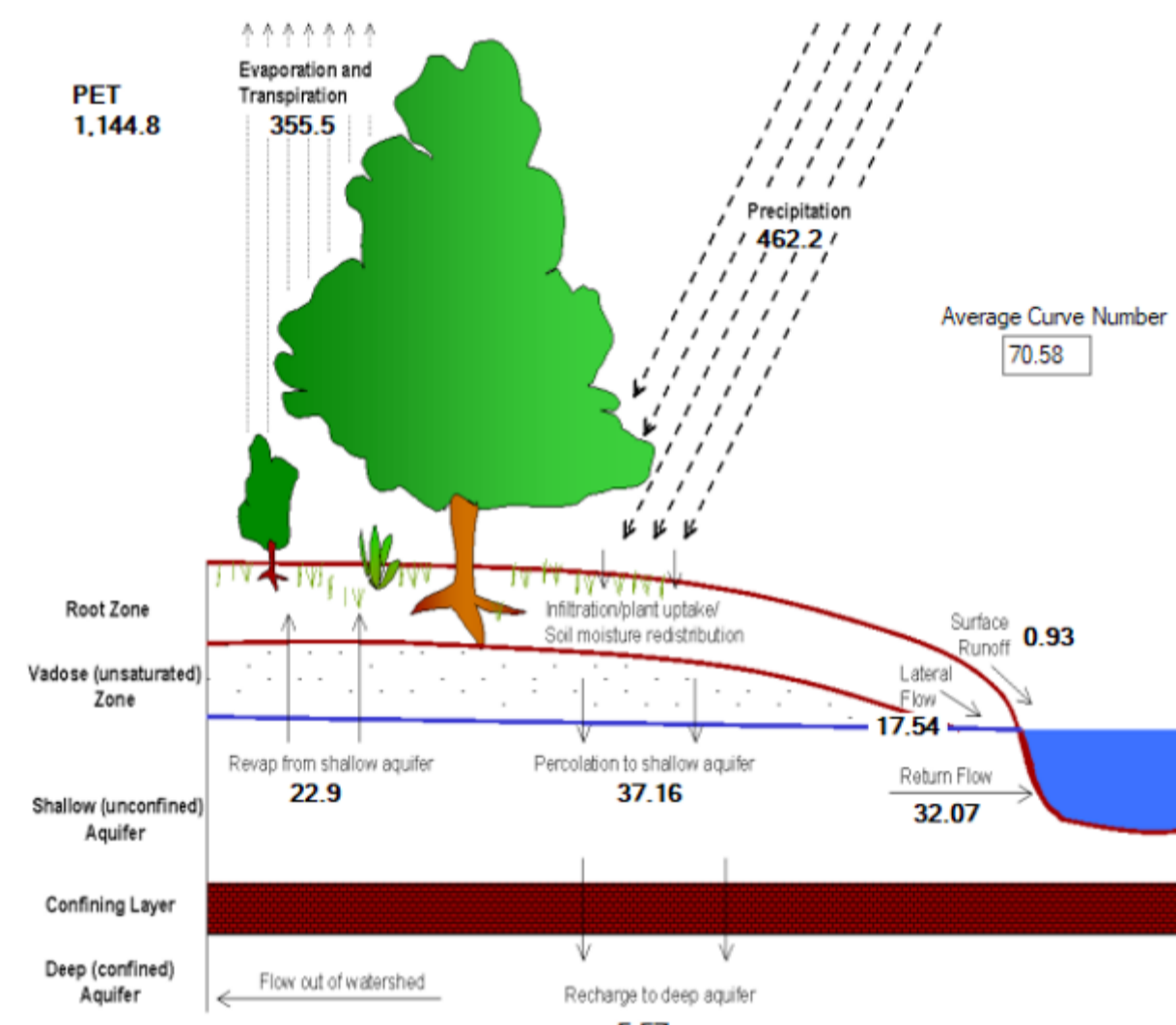
A semi-physically based, semi-distributed, basin-scale hydrological model that divides a basin into hydrologic response units (HRUs) which are defined by unique combinations of land uses, soils, and slope classes.

Nučice SWAT model:

- Precipitation and temperature data from on-site gauge
- Daily time-step
- Warm-up: 2011-2013
- Model run: 2014-2019

Methods

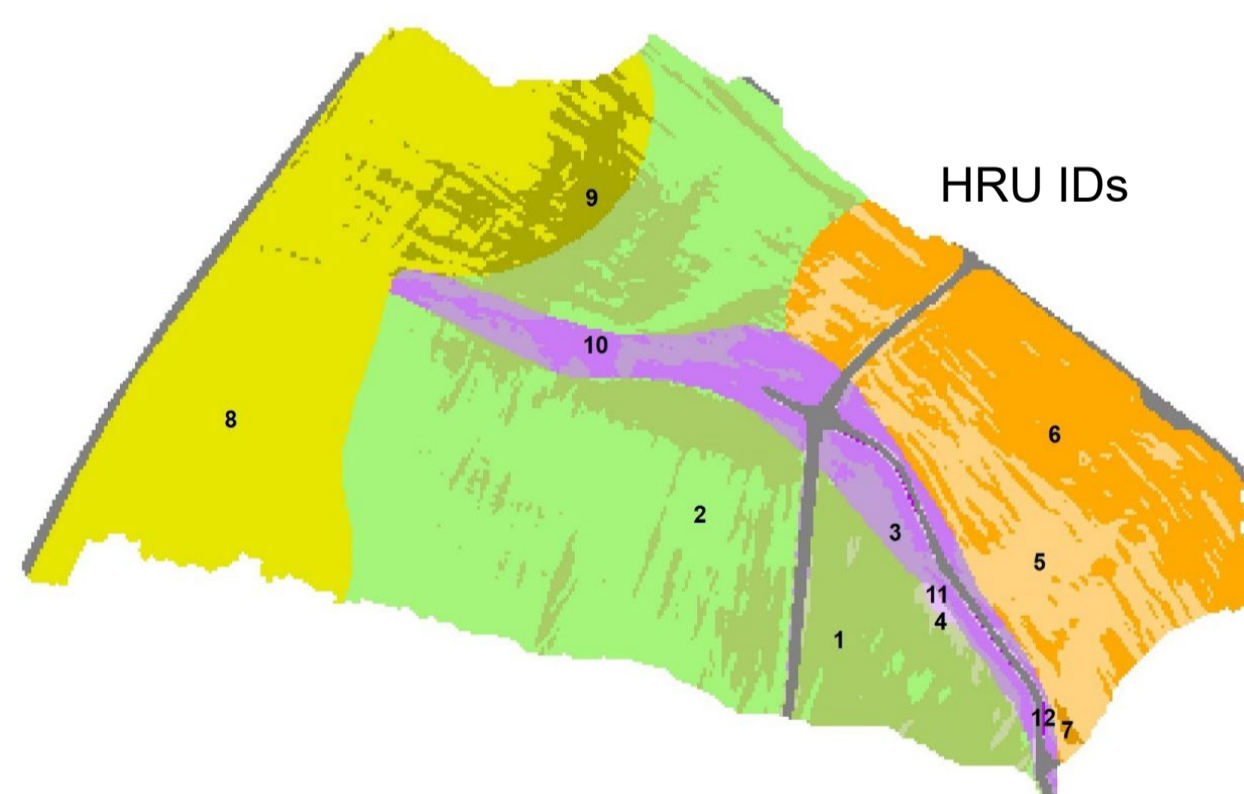
Model selection based on evapotranspiration (ET), surface runoff, and baseflow ratios. Discharge calibrated using SWAT-CUP with data from 2018-2019



Scenario analysis comparison of conservation agriculture adoption:

- No tillage, 2-9 t/ha residue
- Scenario 1: HRUs 1 & 5 (24.7% total area adoption located in **lower** basin)
- Scenario 2: HRU 2 (25.7% total area adoption located in **mid** basin)
- Scenario 3: HRU 8 (23.9% total area adoption located in **upper** basin)

Paired t-tests comparing default outputs to scenario outputs



Results

Sediment concentration at outlet projected greatest reduction per unit area change with **lower** basin adoption

Total soil yield projected greatest reduction per unit area change with **lower** basin adoption

No substantial changes in:

- Total water yield
- Percolation
- Soil water
- Surface runoff

	Default	Lower	Mid	Upper
Sediment concentration at outlet (mg/kg)	19.0	18.5 1 : 9.5	18.3 1 : 7.6	19.0 1 : 1
Total soil yield (kg/ha)	0.162	0.155 1 : 5.7	0.148 1 : 3.0	0.162 1 : 1

Ratios are % parameter change : % area adoption
The higher the ratio, the more sensitive the response

Discussion & Conclusions

Sediment transport parameters are sensitive to conservation agriculture adoption location in basin

Many parameters unaffected

- Scale is likely too small
- Nučice already has very low surface runoff

Would likely see more drastic response:

- At a larger scale
- With a greater diversity of land uses

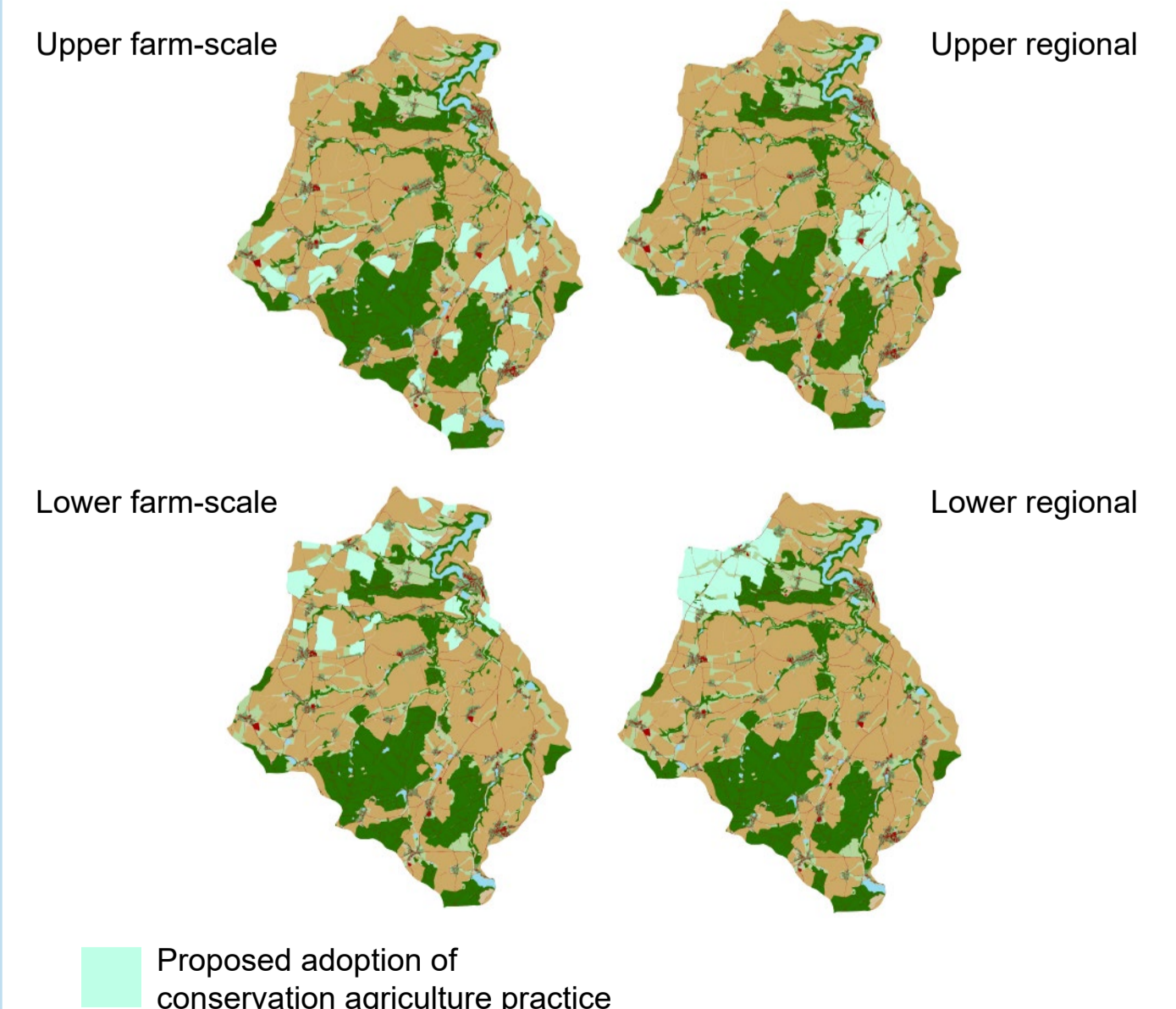
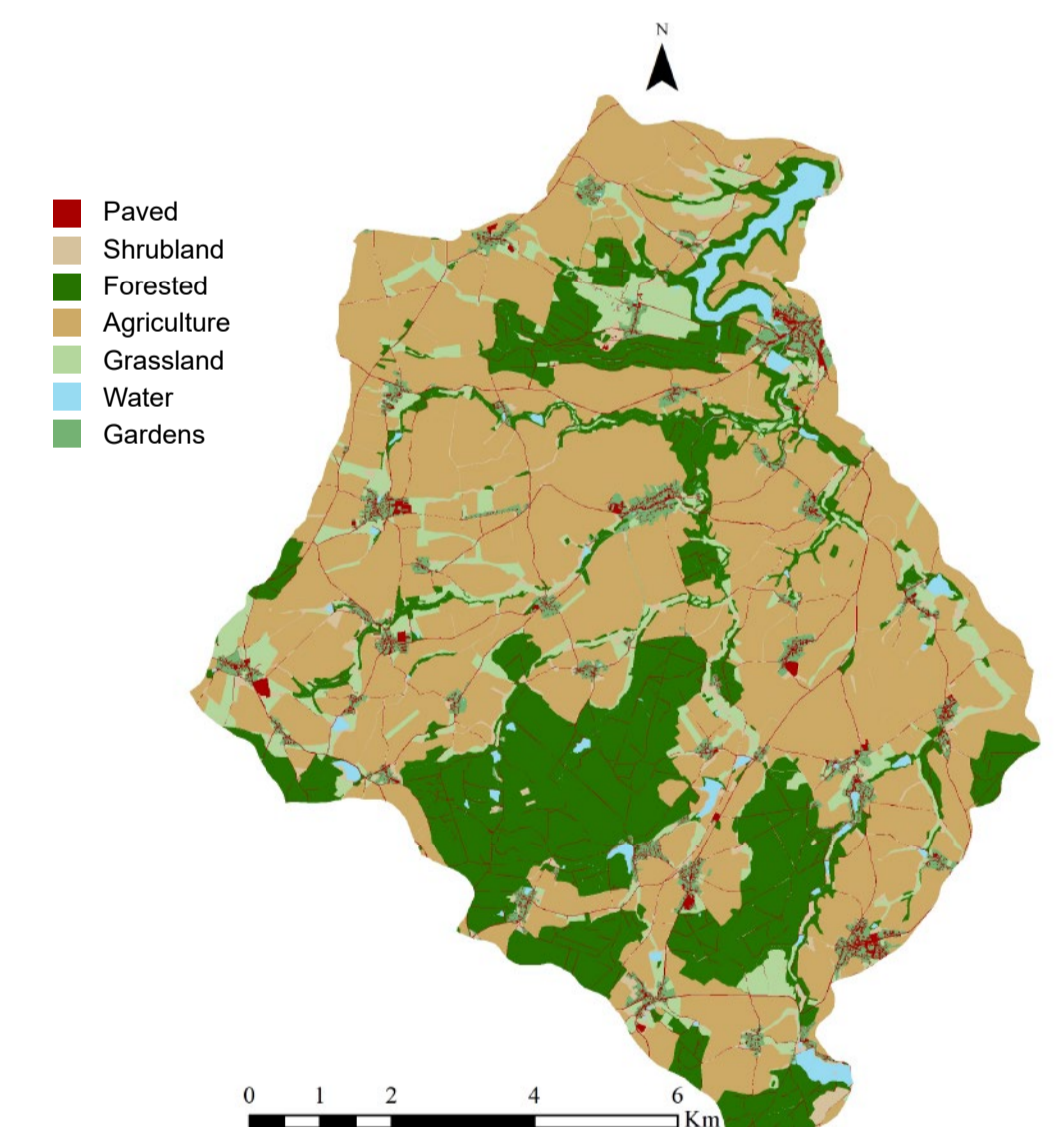
Further study important for watershed managers, farmers, and policy makers



Future Directions

Ongoing model calibration and upscaling efforts to 100+ square kilometers (Vrhclice Basin, Czechia):

- Compare regional vs farm-scale adoption
- Compare effects of adoption location within basin, upper vs lower
- Expectations: regional-scale implementation in the lower basin will have the greatest effect on water balance parameters



Acknowledgement

Presented research has been performed within project H2020 No. 773903 SHui, focused on water scarcity in European and Chinese cropping systems