Sveučilište u Zagrebu
Agronomski fakultet

# Agricultural impact on groundwater vulnerability to nitrate in northern Croatia

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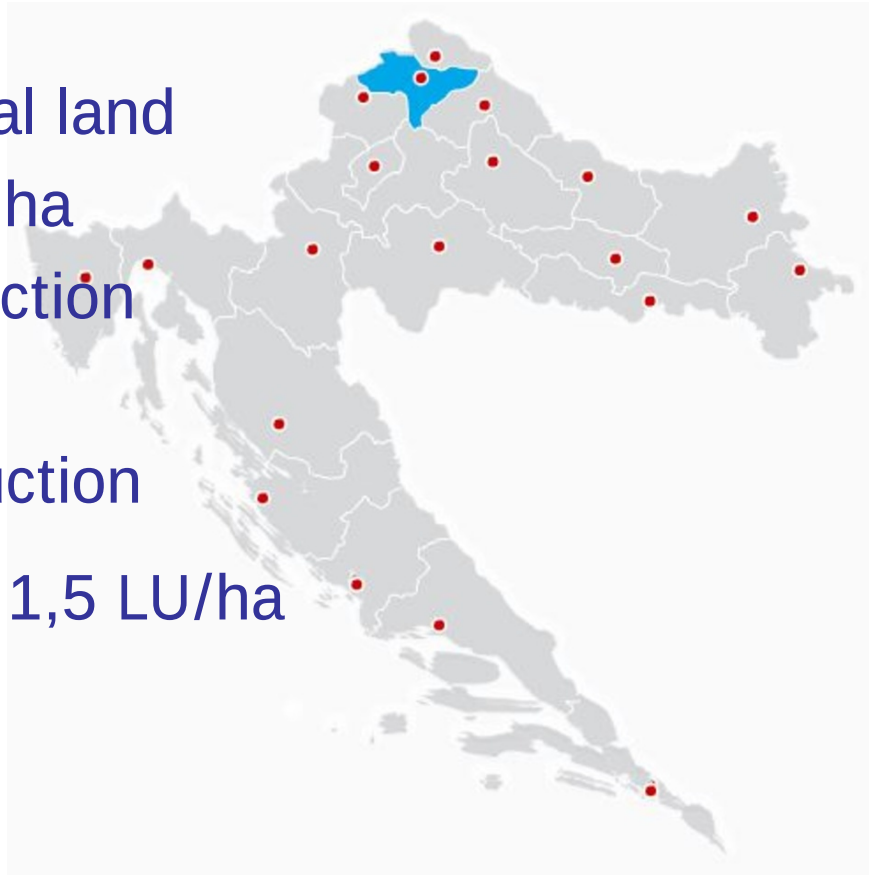
- nitrate leaching to groundwater is major concern throughout intensive agricultural area
- when it comes to measures for nitrate leaching reduction, then climate characteristics or natural soil properties can not be controlled ⟷ land use and land management can be adapted to the given natural conditions

- to implement regulations from the Nitrate Directive in Croatian rural sector detailed research was set in Varaždin County:
  - (a) 59% of County agricultural land
  - (b) average parcel size: 0,23 ha
  - (c) 85% of agricultural production is crop production
  - (d) intensive vegetable production
  - (e) chicken and cattle farms: 1,5 LU/ha





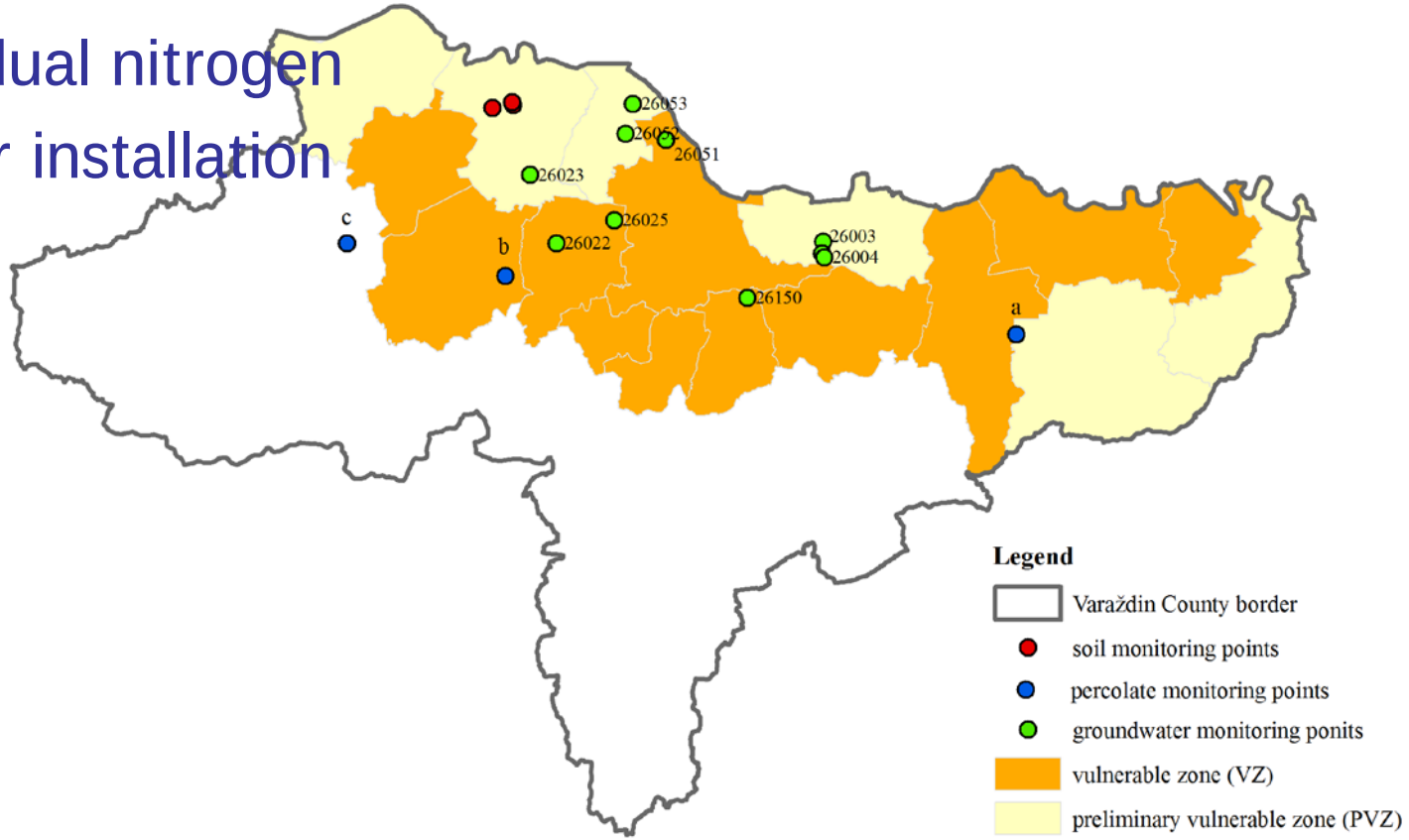
# Objectives

- to put available scientific information on nitrate leaching from agriculture in the study area in relation to land use, land management, climate and soil, by setting up the field lysimetric trial
- to identify practical breeding methods responsible for high nitrate leaching in the study area

- land use databases
  - ARKOD and CLC 2006 analysis and comparison
- groundwater nitrate concentrations

  soil residual nitrogen

  lysimeter installation






# Lysimeter installation

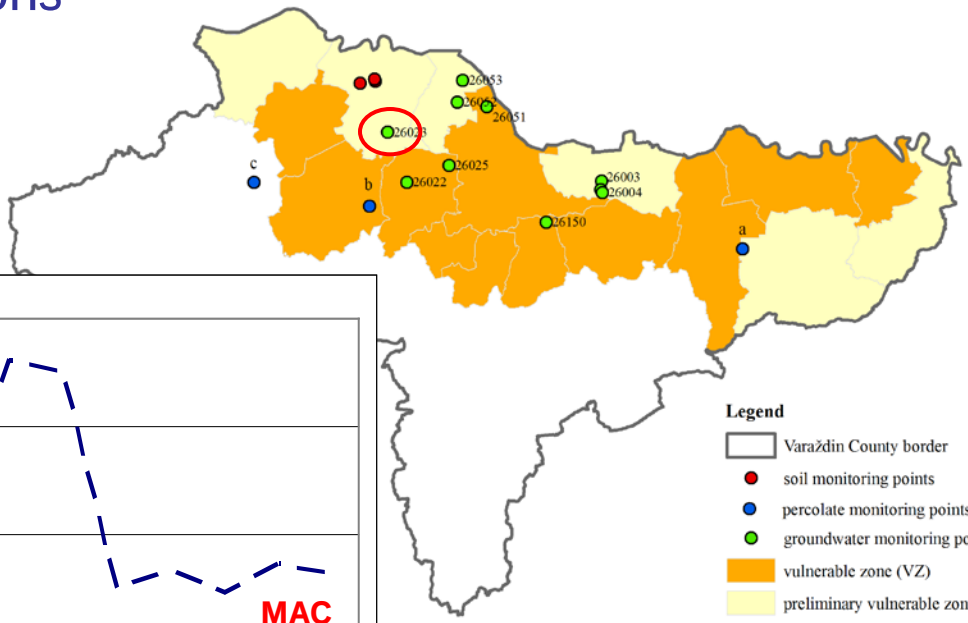


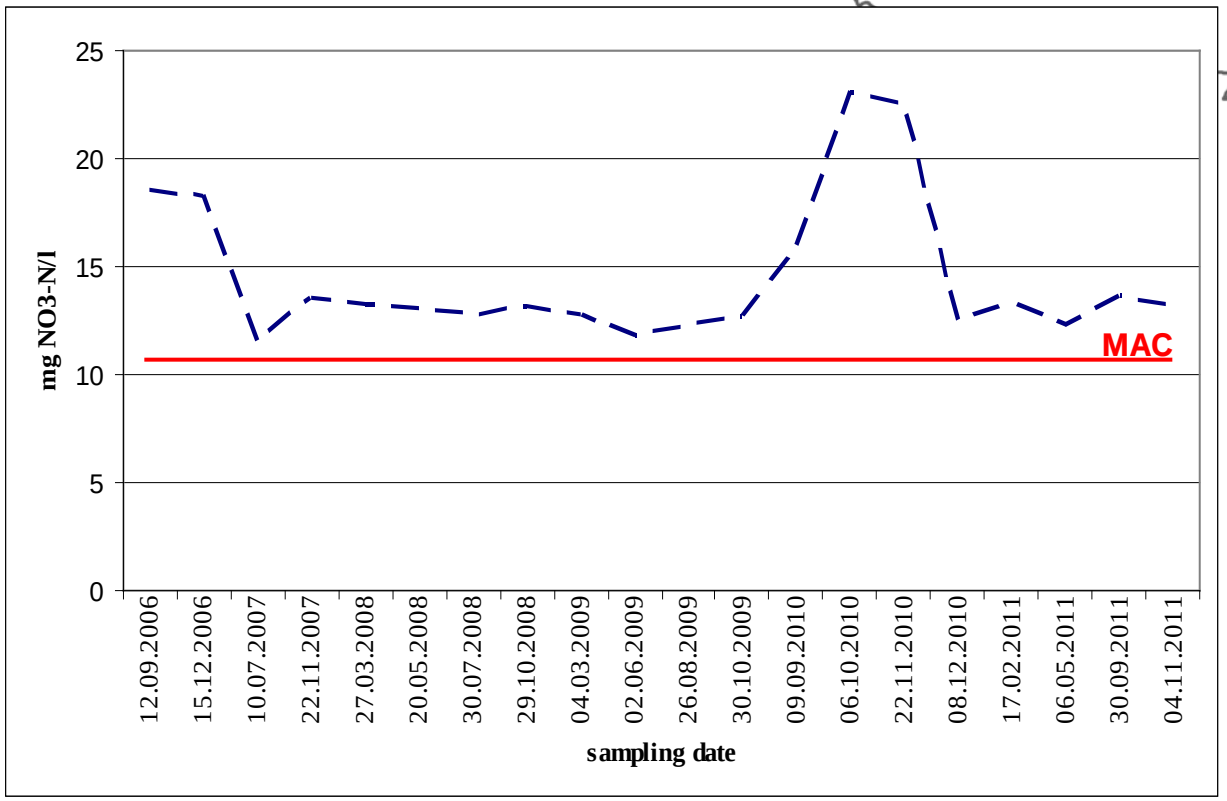


**Table 1.** Data on agricultural land use according to ARKOD and CLC 2006

| Land use | ARKOD | |
|---|---|---|
| | percentage of VZ area | percentage of PVZ area |
| arable land | 32,51 | 32,08 |
| greenhouse | 0,05 | 0,03 |
| meadow | 4,14 | 2,99 |
| pasture | 0,13 | 0,07 |
| vineyard | 0,49 | 0,63 |
| fruit species | 0,46 | 0,43 |
| nut species | 0,18 | 0,11 |
| mixed permanent species | 0,01 | 0,02 |
| different land use | 0,22 | 0,12 |
| **total** | **38,19 %** | **36,48 %** |
| | **CLC 2006** | |
| | **percentage of VZ** | **percentage of PVZ** |
| non-irrigated arable land | 3,37 | 4,04 |
| vineyard | 0,00 | 0,66 |
| pastures | 10,85 | 3,67 |
| complex cultivation patterns | 50,51 | 47,36 |
| land used for agriculture with significant areas of natural vegetation | 5,15 | 5,67 |
| **total** | **69,88 %** | **61,40 %** |

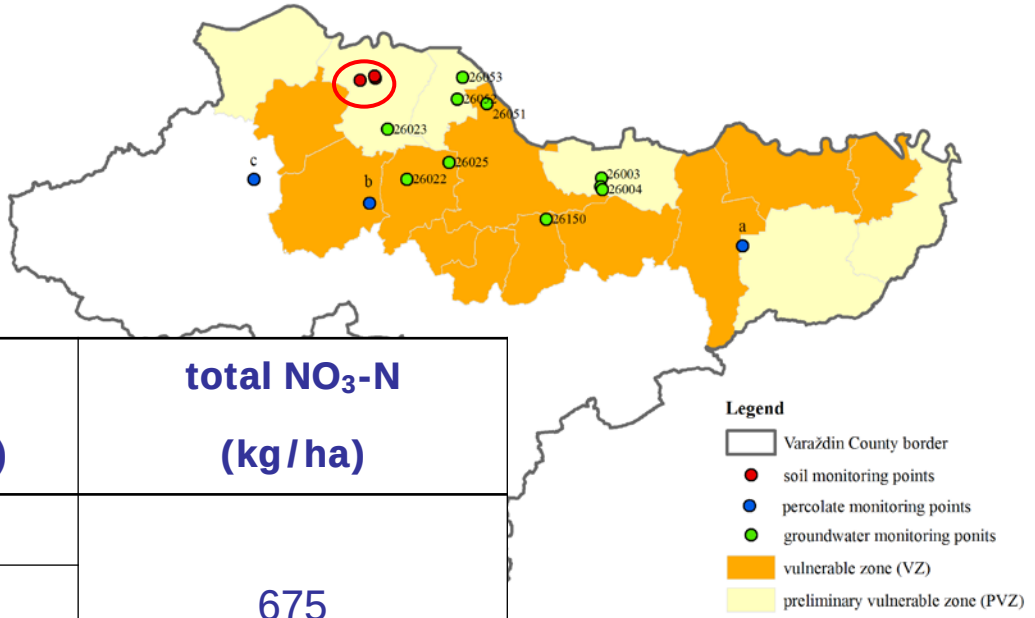
# groundwater nitrate concentrations





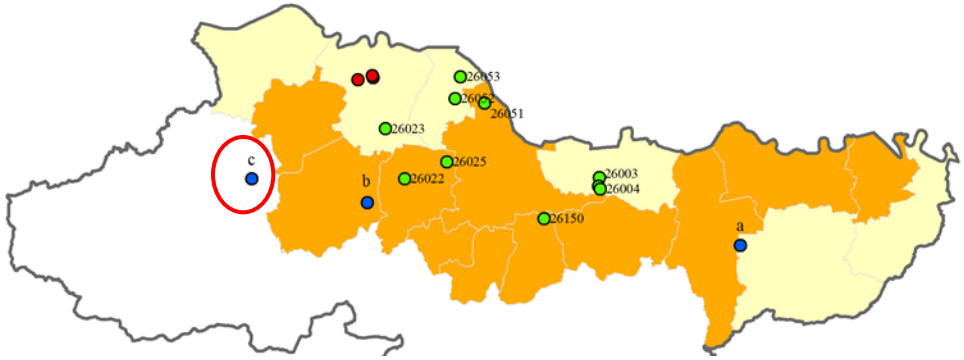

# soil sampling results

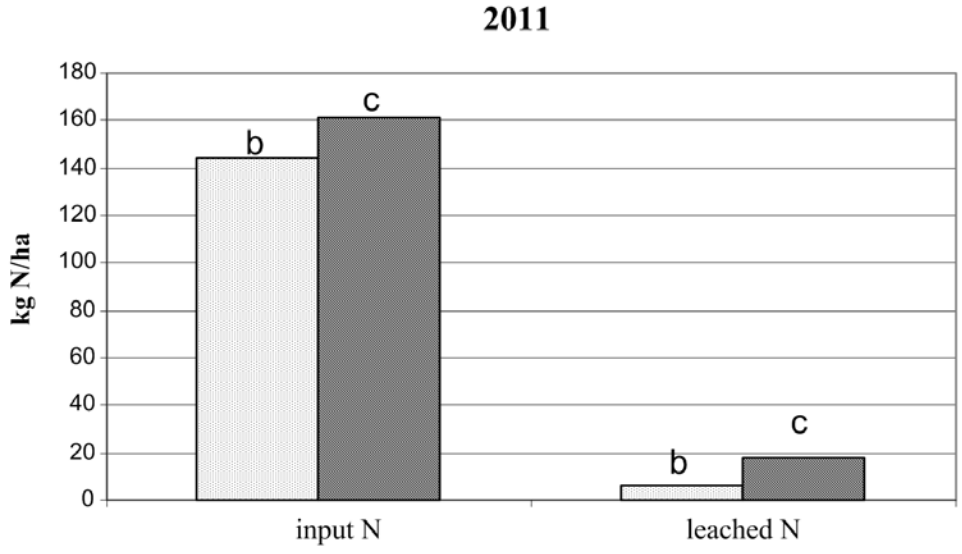


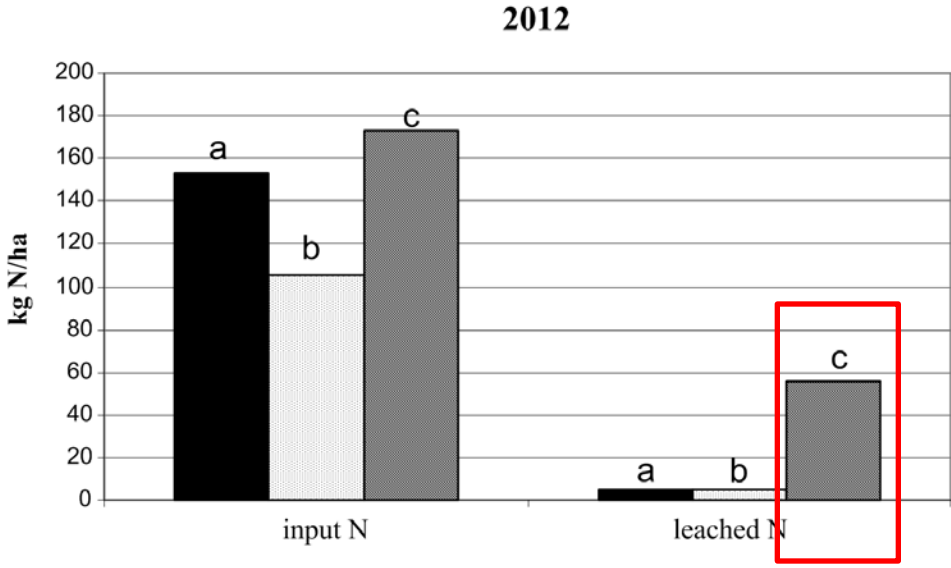

| Parcel no. | Depth (cm) | $NO_3$-N (kg/ha) | total $NO_3$-N (kg/ha) |
|---|---|---|---|
| 1 | 0-30 | 378 | 675 |
| | 30-60 | 201 | |
| | 60-90 | 96 | |
| 2 | 0-30 | 88 | 130 |
| | 30-60 | 29 | |
| | 60-90 | 13 | |
| 3 | 0-30 | 172 | 256 |
| | 30-60 | 63 | |
| | 60-90 | 21 | |




# leachate amount





- land use database analysis confirmed groundwater nitrate vulnerability in research area
- the same analysis showed no difference between land use within PVZ and VZ
- the same conclusion is conducted from groundwater monitoring results
- total N content in 1 m soil profile within research area was up to 700 kg/ha in 2012
- leached N amount varied from 3% to 32%



- there is evident high agricultural impact on groundwater vulnerability to nitrates
- higher nitrate leaching causes mineral fertilization
- quantities of residual N in soil and high percolate concentrations of $NO_3$-N indicate on necessity for precision in fertilizers application and soil and water management strategies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# Thank you!