Federal Agency
for Water Management

An institution of the Federal Ministry
for Agriculture, Regions and Tourism

Soil erosion in Austria

National calculations using regional data delivering local results for the ÖPUL programme

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Introduction

- Soil erosion of agricultural fields is very diversily distirbuted in Austria (Strauss, 2007; Strauss and Klaghofer, 2006).
- Farmers get a refund for expenses when certain soil erosion measures are applied.
- These funds are organised within the Austrian Programme for an environmentally friendly agriculture (ÖPUL).
- Particularly mulching, greening variants and organic farming is represented in the ÖPUL (in relation to soil erosion).
- We analyse the effect of soil erosion measures that are defined withing the Austria ÖPUL programme.
- Soil loss rates are computed for all agricultural parcels within Austria.
- A focus is given on the spatial distribution of soil erosion hot spots within the main agricultural production zones (cf. Fig. 1).

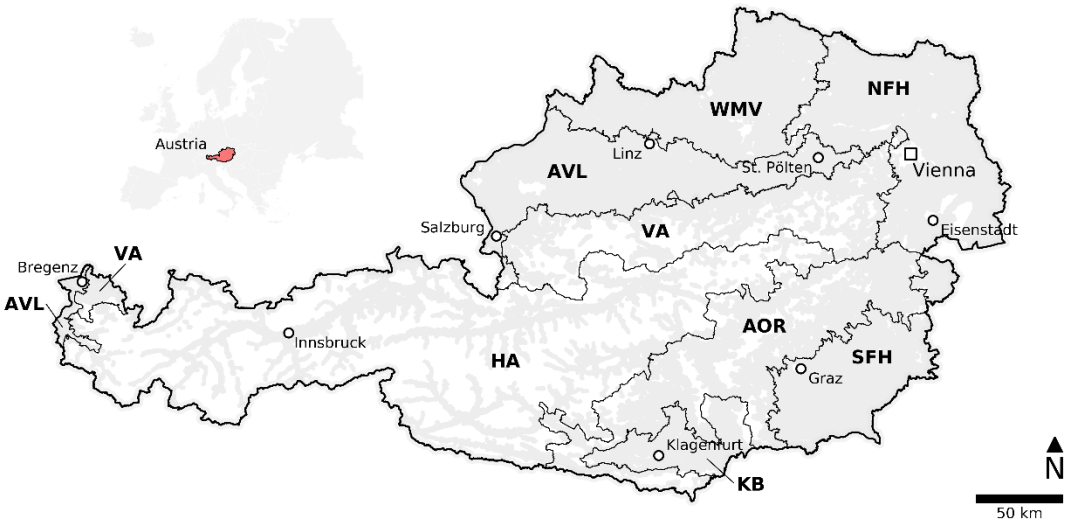

Fig. 1. Austria with its eight main agricultural production zones. Greyish areas indicate arable land.

Objectives

- What is the mean annual soil loss rate for Austria and where are regional differences between the main agricultural production zones (MAPZ)?
- Which one of the both measures is more effective, mulching / strip till or greening?
- Are soil loss rates higher on convential parcels compared to organic parcels?
- What is potential soil erosion reduction induced by the ÖPUL?

Materials and Methods

- The mean annual soil loss for 2016 and 2018 was computed with the Revised Universal Soil Loss Equation (RUSLE).
- *R-Factor*:
  Calculation on 15-minutes data of 170 station in Austria
  Regionalisation with Spartacus precipitaiton data (1x1 km resolution)
- *K-Factor*:
  Gravel-corrected K-Factor calculation based on volumetric silt content information from the Austrian soil map (Bodenkartierung, 1995)
- *LS-Factor*:
  Calculation based on the approaches by Desmet and Govers (1996) and Nearing (1997).
- *C-Factor*:
  Calculation for a biannual crop rotation (2015/16 and 2017/18) based on the INVEKOS and ÖPUL data sets.
  Incorporation of MAPZ-specific crop combination, tillage practices and management dates.

Mean annual soil loss rates for Austria

- Cropland: 5.8 t ha^{-1} year^{-1}
- Grassland: 1.1 t ha^{-1} year^{-1}
- All: 3.9 t ha^{-1} year^{-1}
- 2216 km² classified as extremely susceptible to soil erosion (> 11 t ha^{-1} year^{-1})
- Northern NFH, AVL and SFH identified as soil erosion hotspots (Fig. 2).

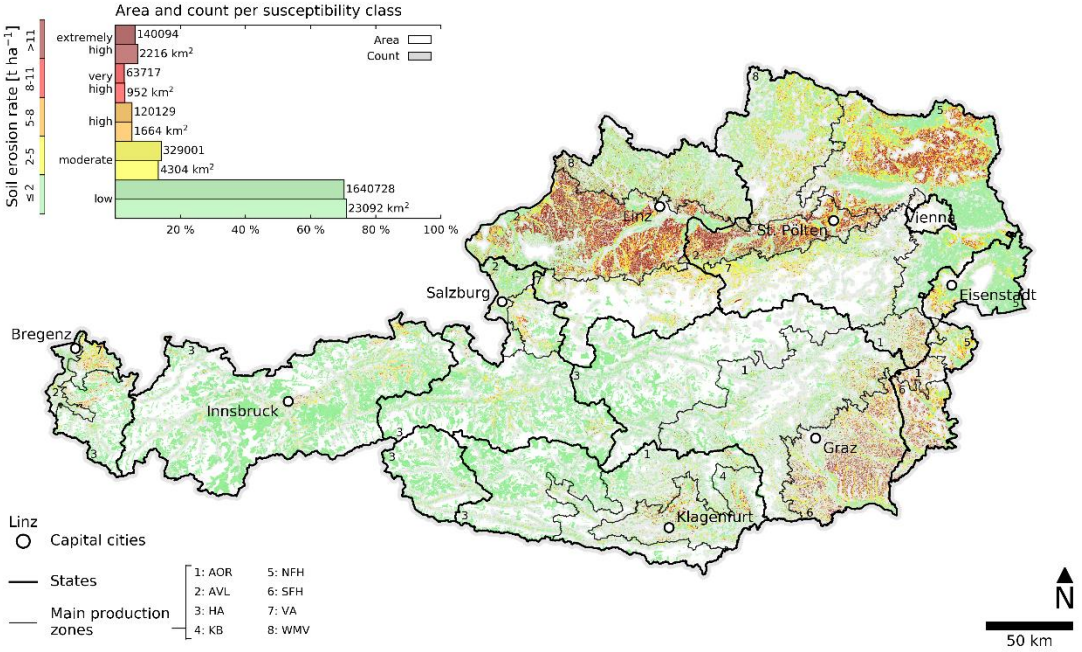

Fig. 2. Mean annual soil loss rates (in t ha^{-1} year^{-1}) for agricultural parcels in Austria. The graph in the upper left shows the portions of total area (in km2) and count of parcels per susceptibility class. Greyish areas indicate arable land.

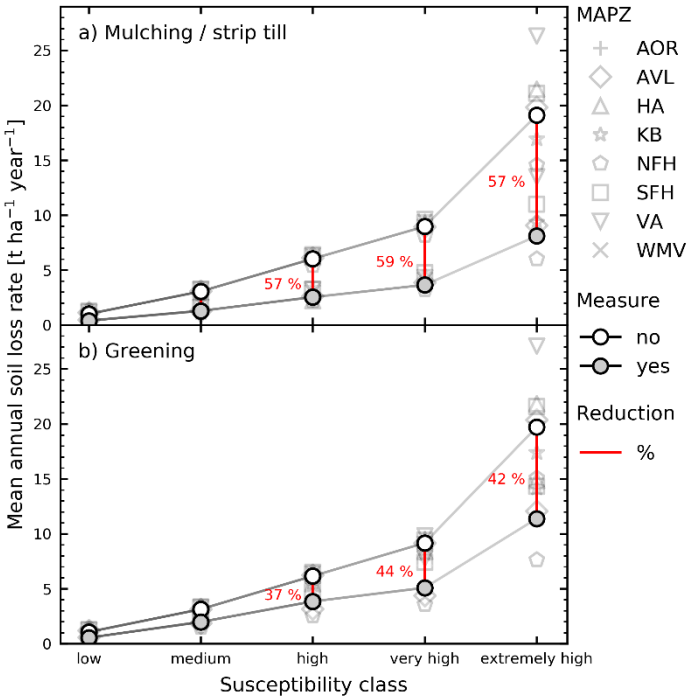

Fig. 3. Reduction of the mean annual soil loss rate for the ÖPUL-measures mulching/strip till (a) and greening variants (b), separated by susceptibility classes (low: 0-2, medium: 2-5, high: 5-8, very high: 8-11, extremely high: >11, all in t ha^{-1} year^{-1}). Reductions in percent are indicated by the red numbers. The single main agricultural production zones (MAPZ) are indicated by the greyish markers.

Effect of mulching / strip till and greening

Mulching

- Mulching / strip till / direct seeding is generally a very useful measure to reduce soil erosion.
- Almost 60 % reduction of soil loss can be detected when mulching is applied (Fig. 3a).
- Mulching is thus particularly powerful for parcels that are located on potentially extremely susceptible soil erosion areas.

Greening

- Greening variants are identified as less effective as mulching.
- A reduction of soil loss of approx. 40 % is expectable (Fig. 3b).
- Similar to mulching, grassland is extensively powerful on parcely with a potential extremely high susceptibility.

Participation

- Albeit both, mulching and greening variants appear to be effective for soil erosion reduction, only very few farmers make use of these ÖPUL-measures (approx. 12 %).
- Thus, the full potential of both measures is by far not reached.

Conventional vs. organic farming

- Soil erosion rates for organic farming are generally lower compared to those for conventional farming (approx. 9 %).
- The soil loss reduction of fields within different susceptibility classes indicate differences for the MAPZ (Fig. 4).
- Particularly the conventional fields in the NFH show far lower soil loss rates compared to organic farmed fields.
- This might be due to different tillage practices for particularly extensively cultivated erosion prone crops (e.g. potatos).
- This indicates a potential different perception on soil erosion measures for both organic and conventional farmers in the NFH.
- In turn, conventionally farmed fields show much higher mean annual soil loss rates compared to organic farming.

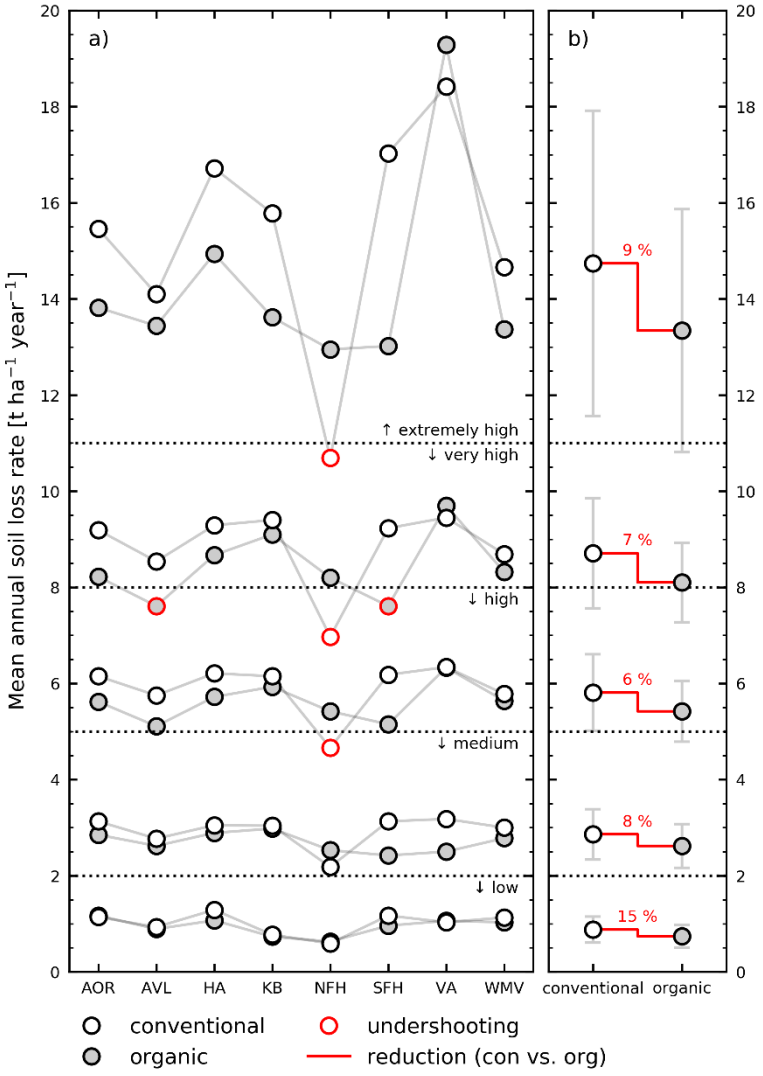

Fig. 4. Mean annual soil loss rates (in t ha^{-1} year^{-1}) for conventional and organic farming, distinguished for the main agricultural production zones (a) and aggregated (b). Both data sets (distinguished and aggregated) are further separated by the susceptibility class, e.g. the two upper lines representing all conventional and organic parcels that are located within the susceptibility class 'extremely high'. The red circle around a marker in (a) indicates that the mean value undershoots the apparent susceptibility class in the respective main agricultural production zone. The red lines and numbers in (b) indicate the reduction of the soil loss rate when organic farming is applied.

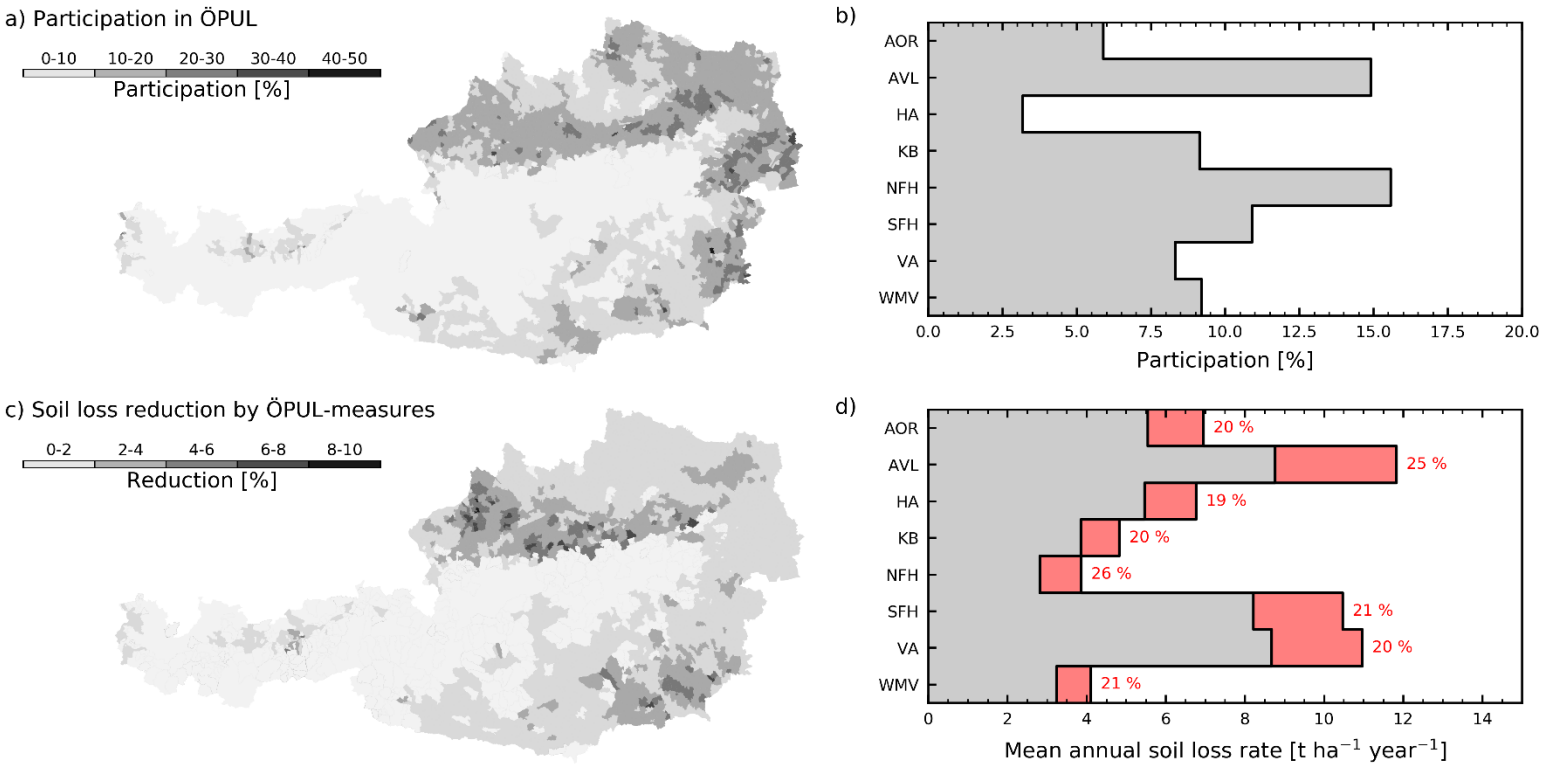

Fig.5. Participation in ÖPUL for Austrian communities (a) and aggregated for the MAPZ (b). The soil loss reduction due to ÖPUL per community and aggregated for the MAPZ is indicated in (c) and (d).

Effect of ÖPUL-measures

- ÖPUL-measures reduce mean annual soil loss rates of 22 % for entire Austria (one-third indicated by Borrelli et al. 2016 and Panagos et al. 2015).
- Measures are extensively applied in the North and North-Eastern MAPZ (AVL, NFH), where soil erosion is severe.
- There is a lack of participation in the erosion prone regions in the South-East (e.g. the SFH; Fig. 5).
- Likewise, ÖPUL-measures indicate a high reduction potential, particularly in the SFH, AVL and NFH.

Conclusions

- Soil loss rates for all agricultural parcels numbers to 3.9 t ha^{-1} $year^{-1}$, whereas cropland rates are 5.8 t ha^{-1} $year^{-1}$ and grassland 1.1 t ha^{-1} $year^{-1}$.
- Mulching and greening exhibit a high potential of soil loss reduction (60 % and 40 %, respectively). However, both are not applied in a large extent (approx. 12 %).
- Organic farming tends to have lower mean annual soil loss rates compared to conventional farming (approx. 9 %).
- ÖPUL-measures reduce mean annual soil loss in Austria of about 22 %.

References

1. Bodenkartierung, Ö., 1995. Bodenkarte und Erläuterungen zur Bodenkarte 1: 25· 000, Kartierungsbereich Mistelbach. Bundesministerium für Land-und Forstwirtschaft, Wien.
2. Borrelli, P., Paustian, K., Panagos, P., Jones, A., Schütt, B., Lugato, E., 2016. Effect of Good Agricultural and Environmental Conditions on erosion and soil organic carbon balance: A national case study. Land Use Policy 50, 408–421.
3. Desmet, P.J.J., Govers, G., 1996. A GIS procedure for automatically calculating the USLE LS factor on topographically complex landscape units. Journal of soil and Water Conservation 51 (5), 427–433.
4. Nearing, M.A., 1997. A single, continuous function for slope steepness influence on soil loss. Soil Science Society of America Journal 61 (3), 917–919.
5. Panagos, P., Borrelli, P., Poesen, J., Ballabio, C., Lugato, E., Meusburger, K., Montanarella, L., Alewell, C., 2015. The new assessment of soil loss by water erosion in Europe. Environmental Science & Policy 54, 438–447.
6. Strauss, P., 2007. Soil erosion by water. Hydrologischer Atlas Österreich 3.
7. Strauss, P., Klaghofer, E., 2006. Status of Soil Erosion in Austria, in: Boardman, J., Poesen, J. (Eds.), Status of Soil Erosion in Austria. Soil Erosion in Europe. John Wiley, London, New York, pp. 205–212.