

Introduction

Conservation tillage practices such as mulch seeding or no-till are well known as effective mitigation measures for soil erosion. However, the positive effects of conservation tillage have mostly been demonstrated on relatively small test plots or experiments. The present study aims at confirming such observations on farmers' fields at catchment scale. In a 20-year monitoring programme between 1997 and 2017, mapping of erosion damage was carried out in the Frienisberg region (Switzerland). In addition, data on crops and tillage practices were also collected and data on farmers' participation in conservation programmes were available; allowing evaluation on the impact of these measures on soil loss rates.

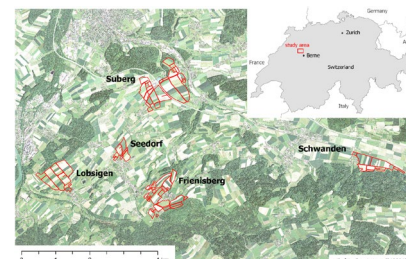


Figure 1. Location of the five study sites

Methods

The study area is located about 20 km northwest of the city of Berne in the Swiss Plateau (Fig. 1). The region falls within the moderate climate zone with an annual average temperature of 8.5 °C and annual precipitation ranging from 1035 to 1150 mm. The investigation area included 203 arable fields with a total area of 263 ha. In a 20-year monitoring programme between 1997 and 2017, accurate erosion damage mapping was carried out. During 115 field inspections, 2165 mapped erosion systems and tillage practices were recorded by an experienced surveyor (Fig. 2).

Two different data sets were available for assessment of tillage practices:

- Participation in conservation tillage programmes at the municipal level.
- Interviews with farmers from all 203 fields in the study area



Figure 2. Strip-till of maize, no-till of sugar beet, mulch seeding of soya bean, no-till of winter wheat, erosion damage mapping, linear erosion feature.

Results

The average soil loss per year was 0.74 t ha⁻¹ yr⁻¹ in P1 (autumn 1997 to autumn 2007), almost four times as much as in P2 (autumn 2007 to autumn 2017) with 0.20 t ha⁻¹ yr⁻¹. The annual variability of soil loss was very high. However, the significant decrease of soil loss can directly be linked to the increased use of conservation tillage (Fig. 3). The share of conservation tillage rose from 1% of arable land in 1997/98 to 53% by 2014/15, and the share of no-till from 1% to 32%, so that a total of 85% of arable land was 2015 cultivated with conservation tillage. The analysis of the second data set on tillage practices confirms these trends (Fig. 4).

The Canton of Berne started to promote mulch seeding and no-tillage in 1996. From 2010 to 2015, the implementation of the Soil Support Programme offered financial incentives for different conservation tillage methods. In 2014, financial incentives for conservation tillage were introduced throughout Switzerland. The high level of conservation agriculture application can be explained by the particularly high sensitivity of farmers to the topic of soil protection in the region; motivation through financial incentives, rising awareness among farmers, innovative farm contractors, knowledge transfer and good extension service of cantonal agencies.

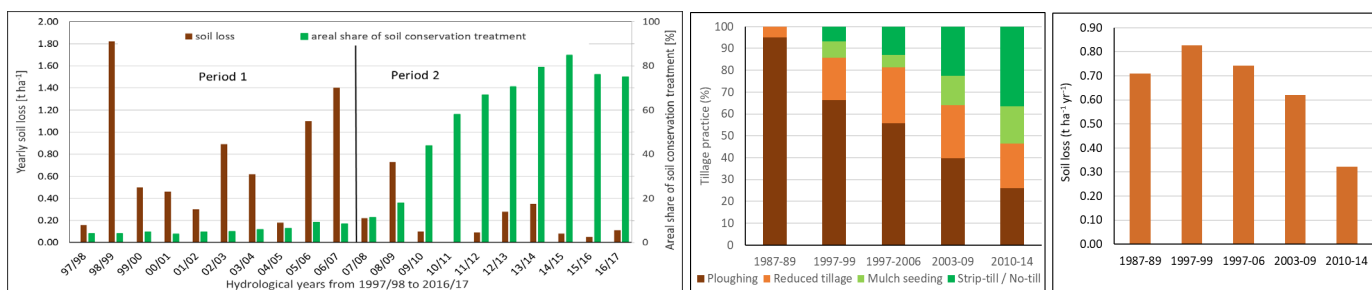


Figure 3. Average yearly measured soil loss (t ha⁻¹) in the study area (265 ha) and area share of conservation tillage practices (%) in the region for hydrological years in period 1 (1997/98 to 2006/07) and period 2 (2007/08 to 2016/17).

Figure 4. Tillage practices of the main crops (left) and average measured soil loss rates (right) for the five investigation periods with information on tillage practices.

Conclusions

- Field measurements show that soil erosion can be significantly decreased by changes in tillage practices.
- This finding underpins that it is possible to achieve high area coverage with conservation tillage under real-life conditions in Switzerland.
- Primarily social and socioeconomic factors determine the extent to which such mitigation strategies are disseminated and accepted.
- Extension services, education, rising awareness, exchange with colleagues and field inspections through a farmer-to-farmer approach are crucial aspects for the adoption of measures.
- The study area should be considered a case example of successful erosion control.

References

- Prasuhn, V., 2012. On-farm effects of tillage and crops on soil erosion measured over 10 years in Switzerland. *Soil Tillage Res.* 120, 137–146.
- Prasuhn, V., 2020. Twenty years of soil erosion on-farm measurement: Annual variation, spatial distribution and the impact of conservation programmes for soil loss rates in Switzerland. *Earth Surface Processes Landf.* 45, 1539–1554.
- Seitz, S., Prasuhn, V., Scholten, T., 2020. Controlling Soil Erosion Using No-Till Farming Systems. In: Dang Y., Dalal R., Menzies N. (eds). *No-till Farming Systems for Sustainable Agriculture*. Springer, 195–211.