Effectiveness of soil erosion protection measures in Austrian agriculture

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1. Introduction

More than 60% of Austria's territory belongs to alpine areas exhibiting extremely high relief energies. Therefore, erosion and erosion control have been a major issue for a long time. The focus of activities was and still is on torrent and avalanche control which is a major threat to human life in alpine environments. As a consequence of the great extent of alpine territory, forests (3,260,000 ha) and grassland (1,917,000 ha) both cover larger areas than arable land (1,382,000 ha). Although areas covered by forests and grassland do erode, the amounts of soil loss are generally low, compared to soil erosion rates that may occur on arable land. A set of measures to control soil erosion from agriculturally used land exists. It is however a political and technical challenge to implement these measures.

2. Past activities on agricultural soil erosion control

Plain areas in the Eastern parts of Austria have been recognised as wind erosion risk zones since the 18th century. Already in 1770, the Empress Maria Theresia ordered reafforestation of parts of this zone to stop shifting sand dunes. This is one of the first known attempts at lowland reafforrestation (Wendelberger, 1955). Since the late fifties of the last century wind breaks are increasingly implemented mainly in the federal provinces of Lower Austria and Burgenland, which are most affected by the wind erosion problem. Since then, only in Lower Austria wind breaks of a total length of about 2300 km have been planted which are able to protect an area of about 100,000 ha.

Since the early 1960's, several institutions identified the threats of soil erosion by water and started to monitor and measure soil loss (Bundesversuchsinstitut für Kulturtechnik und technische Bodenkunde, 1969).

During the late 1980's soil protection laws were established. They are within the responsibility of the different Austrian provinces. In these laws, the aim of protection, the "maintenance of a natural soil fertility and of an ecological functioning of soils" is defined. Additionally, the way to reach this aim is defined: a particular conservation measure may be put into practice. However, no explicit rule is included, as to what extent of soil loss is tolerable. Because of this lack of a definition of tolerable soil loss, in general no intolerable soil losses – in terms of legislation – are recognised.

3. Recent activities on agricultural soil erosion control

With the participation of Austria in the European Union first concerted efforts to reduce soil erosion by water at national scale started. The Austrian programme for a sustainable agriculture (ÖPUL) was launched in 1995. It offers environmental contracts to farmers who are willing to implement specific protection measures such as I) soil erosion control in vineyards, II) soil erosion control in orchards and III) soil erosion control on farmland. In its actual form (BMLFUW, 2000) the main measures in these contracts are:

- ⊗ Soil erosion control in vineyards
  Covering the soil using either mulching, straw or cover crops between each row from 1st of November – April 30, or terracing
- ⊗ Soil erosion control in orchards
  Covering the soil using either mulching, straw or cover crops between each row for at least 10 months/year, or terracing
- ⊗ Soil erosion control in farmland
  Conservation tillage (either direct drilling or mulching)

Beside these contracts, some erosion control effects may also be expected as a result of contracts for the growing of cover crops (winter erosion) or landscape restructuring which are not directly for erosion control reasons.

Mulching and direct drilling practices are recognised as effective methods to control soil erosion and runoff. However, reported values of the actual quantitative effect of these best management practices vary considerably in different reports. Therefore, to evaluate effects of implementation of these management practices in national programs to reduce soil erosion, "most probable" values of erosion reduction are needed. As single reports on the topic are not able to provide these mean values we carried out a literature review to pool available information and obtain "most probable" values on effectiveness of these practices to control soil erosion and runoff (Strauss, 2003). As a mean effectiveness, between 66% (mean) and 76% (median) of soil loss reduction where observed. The evaluation also confirmed the high variations obtained for different experiments (Table 1).

n	mean	median	minimum	maximum	standard deviation
160	66	76	-175	100	38

Table 1. Mean values (n = number of evaluated experiments) on effectiveness of mulching and direct drilling to reduce soil loss, expressed as % reduction compared to experiment without soil conservation.

Mulching and direct drilling also reduced surface runoff to a considerable degree. Figure 1 gives a probability distribution of all reported results. Most probable reductions of surface runoff were identified to be in the range of 20%-30%.

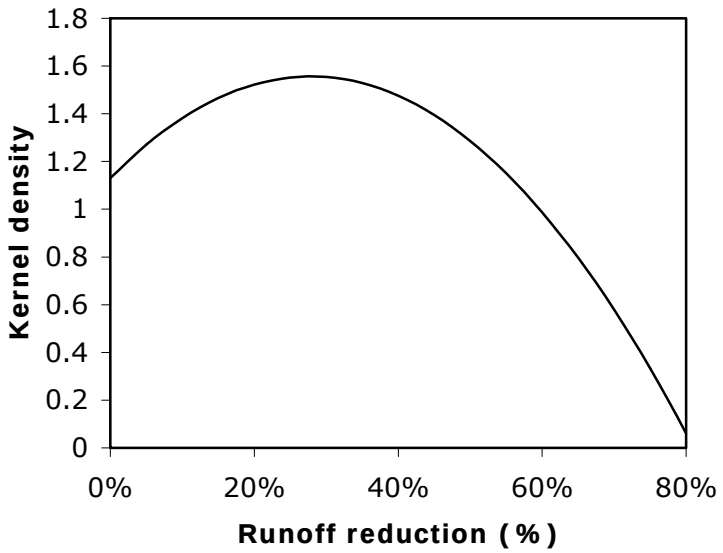

Figure 1. Kernel density estimation of effectiveness of mulching and direct drilling practices to control surface runoff, expressed as % reduction compared to treatments without soil conservation practice

4. Participation in ÖPUL 2000

An evaluation of participation in soil erosion control contracts reveals an increasing trend from 1998 to 2002 (Table 2). In 2002, an area of about 150000 ha was under contract. These results can certainly still be improved. Major drawbacks that farmers see in implementing these practices are the lack of adequate machinery and the additional work load and organisation (Seemann, 2003).

It is however also necessary to compare the participation rates of ÖPUL 2000 to the actual risk in a region. For the province of Upper Austria participation in the ÖPUL 2000 measures to control erosion seems to be targeted to the right regions (Figure 2).

Actually an amount of between 93 and 113 €/ha (different options exist) is given as a subsidy for implementation of the measure "soil erosion control in farmland" and between 145 and 291 €/ha (depending on slope) is paid for the measure soil erosion control in orchards, and between 145 and 799 €/ha (again depending on slope of the area) is paid for erosion control measures in vineyards. Adding up mean values for these contracts gives an amount of about 143 M €, which was invested in 2001 in measures to reduce soil erosion risk on agricultural land.

Main production zone (areas in ha)	Year 1998	2001	2002
High Alpine area		42	49
Subalpine area	119	212	194
Eastern fringe of the Alps	732	1177	1307
Wald- and Muehlviertel	42	3356	3204
Carinthian basin	11	326	508
Alpine foreland	258	32538	32485
Southeastern area of plains and hills	7019	10894	11029
Northeastern area of plains and hills	1149	94539	101186
Austria	**9336**	**143083**	**150035**

Table 2. Participation (ha) in soil erosion control measures offered by the Austrian environmental programme for a sustainable agriculture (ÖPUL 98 and ÖPUL 2000).

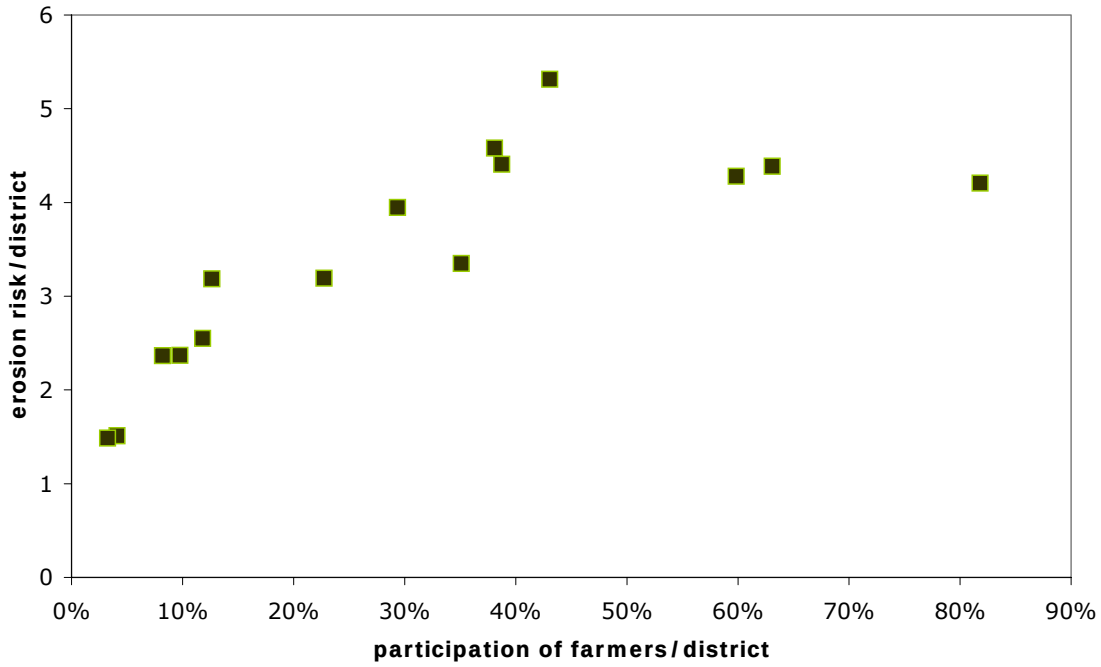

Figure 2. Comparison between erosion risk and percentage of farmers participation in ÖPUL 2000 erosion control measures for districts of the province Upper Austria

5. Conclusion

Agricultural measures to control soil erosion are increasingly implemented in Austrian agriculture. Financial support is given by the Austrian ÖPUL 2000 programme. Within that programme at present erosion control activities focus on terracing, mulching or direct drilling and only small reference is made to watershed management. It has been shown however, that erosion risk may be concentrated at relatively small areas within watersheds (AgriBMPwater, 2004) and erosion control of these risk areas would be highly effective to control sediment production. It would be desirable therefore, to increase possibilities of financial support in the context of watershed management and identification of risk areas.

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