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Flood risk – Prevention and Impact on Agricultural Lands

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Abstract

Recent extreme weather events have resulted in an ongoing discussion on the issues of land use and compensation payments within Austrian agriculture. Building on a functional evaluation system for agricultural lands as developed within the Interreg IIIB project "ILUP", the national project "Agriculture and Flooding" has as its goal to classify the flood-protection contribution and flood sensitivity of agricultural lands. This, in turn, enables the recommendation of targeted measures for potentially improving flood situations, as well as an estimate of their implementation costs. In addition to the digital soil map, other fundamental sources used for the project are the digital flood risk map, IACS land-use data and works by the Institute for Land and Water Management Research. Reference values and marginal returns sourced from the Federal Institute of Agricultural Economics also flow into the cost estimates for the recommended combination. The results will contribute to an understanding of the multifunctionality of agricultural lands and to the setting of priorities on a regional scale regarding packaged flood-prevention and damage-minimization. However, the results at hand can only serve as one step toward regional flood protection projects, whose development will require the cooperation of all interest groups.

Keywords and JEL codes

Agriculture, Multifunctionality, Sustainability, Flood Risk; Q24, Q25, Q54, Q56

1 Introduction and Approach

Building on a functional evaluation system for agricultural lands as developed within the Interreg project “ILUP” [4], the project “Agriculture and Flooding” – a sub-project within the group “Spatial Planning” under the overall national project “Flood Risk II” – has as its goal to classify the flood-prevention contribution and flood sensitivity of agricultural lands. This, in turn, enables the recommendation of targeted measures for potentially improving flood situations, as well as an estimate of their implementation costs [3]. In addition to the digital soil map, other fundamental sources used for the project are the digital flood risk map, IACS (=Integrated Administration and Control System) land-use data and works by the Institute for Land and Water Management Research [1, 2]. Reference values and marginal returns sourced from the Federal Institute of Agricultural Economics also flow into the cost estimates for the recommended combination of measures (see Figure 1).

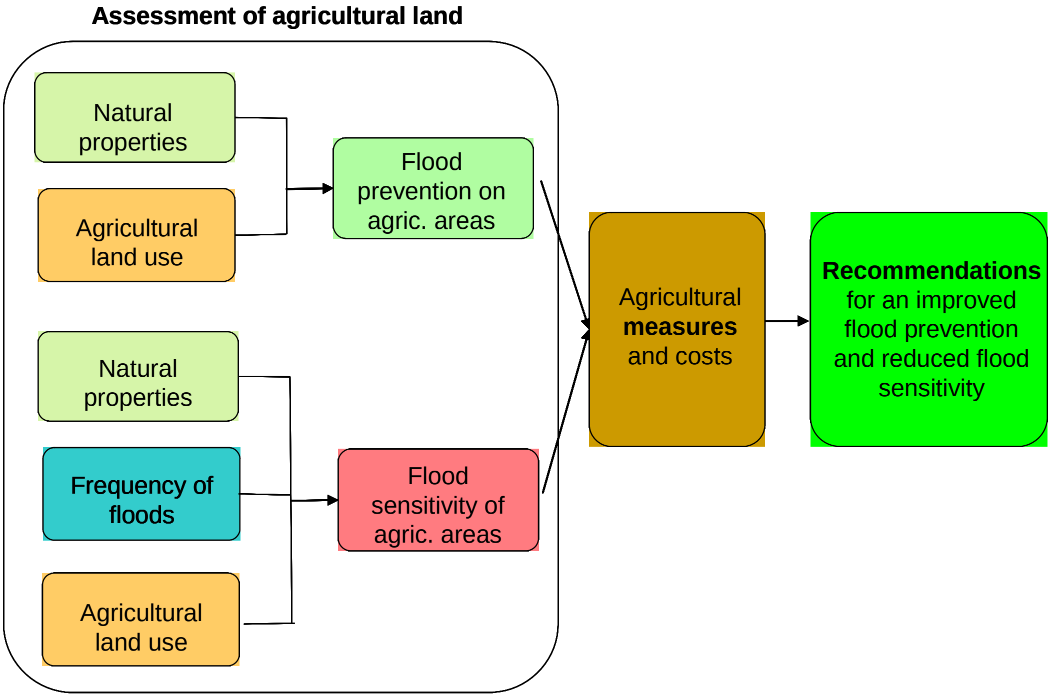

Figure 1: Schematic Approach

2 Ascertaining the flood-protection function on agricultural lands

Agricultural lands within catchment areas impact the emergence of flood events through their surface run-off waters. If cultivation has been properly adapted, the fields are able to contribute to flood prevention (only up to a certain amount). Agricultural land also may serve directly as flood plains, with the extent of related damages depending on the land’s flood sensitivity.
A natural contribution of agricultural lands to **flood prevention** exists due to the land’s natural spatial conditions: Soil characteristics, climatic conditions and topology determine the extent of surface run-off, while the latter is also influenced by management (type of crop, type of cultivation, work processes). GIS overlays of the useable field capacity and of the erosion risk associated with agricultural use enable the classification of lands according to their contribution to flood prevention. A high flood-prevention contribution exists when, for example, a level land surface with water-retentive soil and favorable precipitation is used as grassland. By contrast, crop lands generally exhibit higher surface run-off values, and the risk

of a high surface run-off is greater for certain types of row crops in particular: e.g., crops for which the soil remains uncovered for long periods, but also for crops with a late harvest, for which the intermediate green covering of fields becomes more difficult. Steep land gradients, unfavorable soil characteristics and untimely weather events may also lead to higher run-off. Figure 3 below shows the flood-prevention contribution of catchment areas in the sample community of Seitenstetten, Lower Austria. As actual indicators for the classification of the "natural flood prevention" served the useable soil field capacity and the risk for soil erosion – both derived from the digital soil map. For classification of the whole "agricultural flood prevention" in addition the land use per parcel - classified in an ordinary ranking due to effects on water retention – has been merged by means of a portfolio method (see figure 2 as example).

Agricultural land use:			
Grassland	middle	high	high
Arable land	low	middle	high
Risk crops on arable land	low	low	middle
Natural flood prevention:	low	middle	high

Fig. 2: Classification scheme for flood prevention on agricultural areas

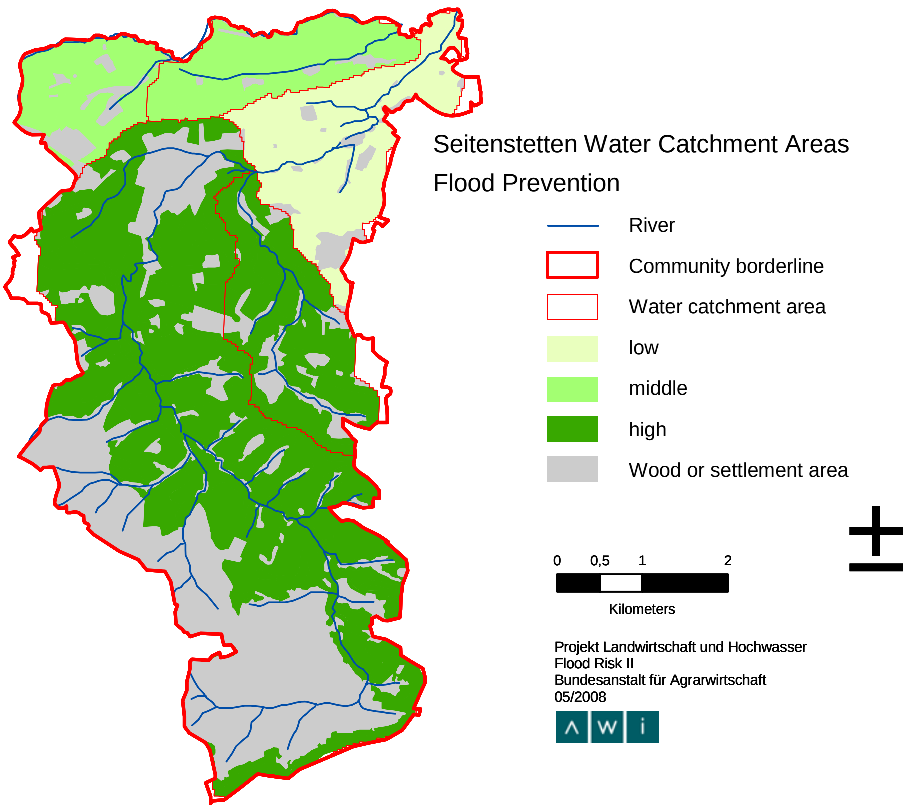

Figure 3: Flood-prevention contribution of agricultural lands in water catchment areas of the Austrian community Seitenstetten

When it comes to evaluating the **flood sensitivity** of agricultural lands, the flood frequency is equally taken into account to identify those lands that are especially at risk, as it is primarily the latter that should be adapted in their use (see Figure 3). Within flood zones, a higher percentage of risk crops – i.e., risk with respect to high surface run-off – are often cultivated on such lands, and these risk crops (e.g., corn, sugar beets and sunflowers) additionally yield higher marginal returns. Therefore, by changing the crop rotation, it is possible to positively influence surface run-off, while at the same time reducing the economic damages in the event of flooding. On the other hand in years of no flooding the yield for farmers is reduced in most cases.

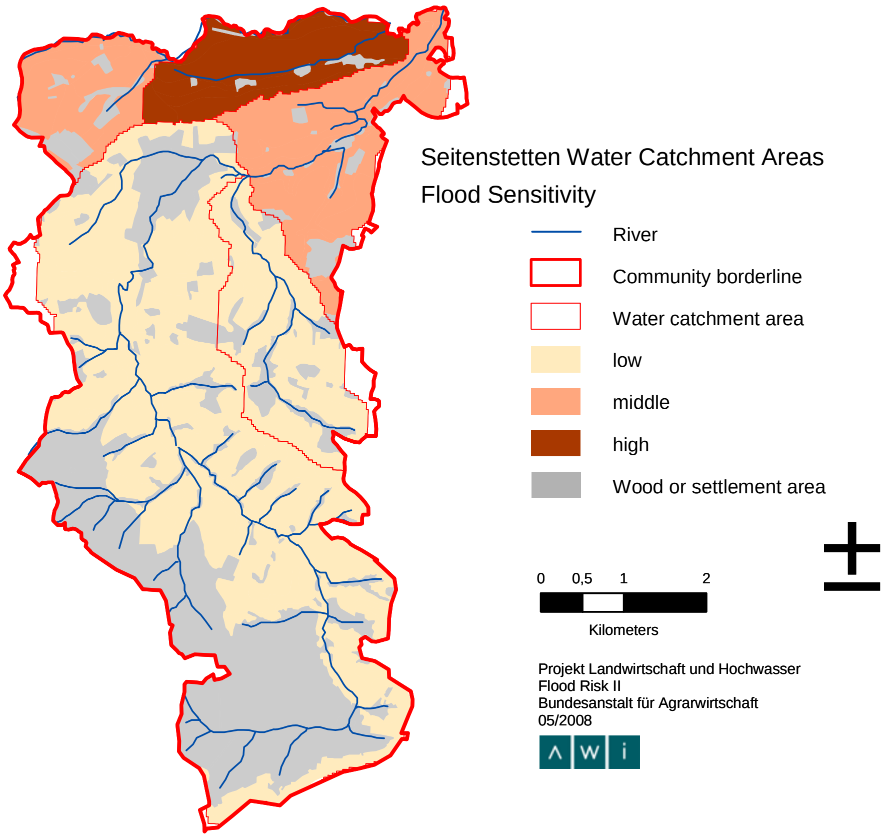

Figure 3: Flood sensitivity of agricultural lands in water catchment areas of Seitenstetten

3 Economic evaluation of changes in land use

The relevant literature, as well as research and evaluation reports on agri-environmental measures, suggest that there are measures available for improving both soil and water retention on agricultural lands. These include a variety of different cultivation techniques, such as mulch or direct seeding, cover crops or switching to lower-risk crops, or converting arable fields into grassland or even abandoning agricultural use of the land altogether (see Table 1).

Table 1: Effects of selected measures of the Austrian Agri-Environmental Programme on soil and water retention and their annual costs (source: Own calculation)

Measures of the Austrian Agri-Environmental Programme	**Retention of**		**Annual costs in €/ha**
	soil	**water**	
Environmental friendly management of arable land and grassland	low	low	85-110
Erosion protection - perennial crops	high	high	125-300
Green cover on arable land	high	low	130-190
Green cover buffer strips on arable land	high	low	16-120
Mulch and direct seeding	high	middle	40
Catch crops in corn	high	middle	50
Abandonment in project regions	high	high	300-1000

Depending on such factors as crop yield, producer prices, the business situation and work processes used, farmers may experience various disadvantages from flood-prevention related changes in land use. However, changes in cultivation must not always be accompanied by higher costs and, in fact, may instead lead to lowered costs, e.g., changing from autumn ploughing without a green cover to direct seeding in temporary green cover (see Table 2).

Table 2: Additional economic costs for changes in the use of agricultural land to improve flood situations (source: Own calculation)

Measures of land use change	**Annual costs in €/ha**
Change from winter barley to grassland	360,-
Change from forage cereals to grassland	324,-
Change from Triticale to grassland	309,-
Change from forage wheat to grassland	279,-
Change from autumn ploughing wihtout green cover to ploughing with temporary green cover	159,-
Change from corn to forage cereals	158,-
Change from autumn ploughing without green cover to direct seeding in temporary cover crops	-22,-

4 Measures for improved flood protection and their costs in the sample community

Within the sample community of Seitenstetten, water catchment areas exhibiting either a low contribution to flood prevention or high flood sensitivity were identified as relevant areas for the application of measures. The GIS generated land use balances permit ascertaining on how much land within the catchment areas, and also on which land specifically, changes in use would seem advisable. The measures to be set are in accordance with the evaluation of individual lands. Thus, for example, areas exhibiting high flood sensitivity shall have stronger measures applied than those with only a medium sensitivity. The community Seitenstetten covers an area of 30 km² from which 65% are agricultural land. In sum, the resulting changes in land management are as follows:

- Conversion from silage corn to grassland on an area of 110 hectares,
- conversion from grain corn to feed grain with intermediate cover crops on 22 hectares,
- catch crop planting on 44 hectares of arable fields.

The costs for converting to the above types of cultivation amount to an approximate total of €44,000,- annually. In return, the package of measures could lead to lowering the flood sensitivity classification from high to medium in the affected catchment areas, at the same time increasing the flood prevention contribution from low to high. These costs could be compared with alternatives, such as, for example, the construction and maintenance costs for technical flood protection systems, or simply the compensation costs for farmers in the event of flood-related damages, based on the probability of occurrence.

5 Conclusion

Recent extreme weather events have resulted in an ongoing discussion on the issues of land use and compensation payments within Austrian agriculture. The basic results developed within the sub-project "Agriculture and Flooding" will flow into the overall project "Flood Risk II," while furthermore contributing to an understanding of the multifunctionality of agricultural lands and to the setting of priorities on a regional scale. An objective appraisal of the economic implications associated with adapting land use should also facilitate decision making regarding packaged flood-prevention and damage-minimization measures. However, the results at hand can only serve as one step toward regional flood protection projects, whose development will require the cooperation of all interest groups.

Implementation of the recommended measures could be carried out via different instruments and at various levels, to be decided through the political process. Among the official, state-regulated instruments available are legislation, taxes, levies and subsidies, while private instruments would include agreements (e.g., usage contracts, land purchases and leases), funds and endowments, and tradable rights. Within the scope of private-sector administration, public authorities could, for example, enter into usage agreements with land owners (e.g., contractual flood protection), purchase flood-plain land or establish dedicated compensation funds for flood events.

Governing authorities could, for example, assimilate "flood-compatible land cultivation" as an additional cross-compliance provision. To do so, however, would first require nation-wide analyses of the current state of cultivation practices in water catchment and flood plain areas, as well as deriving generally accepted criteria for flood-compatible land cultivation. An alternative course of action would be to introduce new subsidy programs or expand existing ones – such as ÖPUL (the Austrian agro-environmental program) - that includes regionally and locally targeted packages of measures earmarked for flood protection. Nevertheless, as per the urgency of measures, it remains necessary to consider that participation in the aforementioned types of programs is on a voluntary basis and thus their true effect will also depend on uncontrollable circumstances (e.g., national and international price developments for agricultural products, energy prices, etc.).

6 References

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