Biodiversity and structural diversity in the agricultural landscape – An overall concept relevant for soil risk assessment?

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Biodiversity & risk assessment

Biodiversity is the basic resource maintaining and supporting ecosystem services and functions. Biodiversity is realized at different levels in the complexity of a given **landscape**. It is widely accepted that species diversity and habitats quality dramatically decrease with increasing intensity of agricultural land-use. In recent years indeed a constant decline of the biodiversity of agricultural landscapes is observed, indicated by e.g. birds & butterflies (Aichi targets adopted by the EU) [1]. Environmental **stressors** (like pesticides) act on the landscape level. This advers effect is relevant within national as well as EU legislation (Fig. 1).

→ We need a **landscape-based risk assessment**

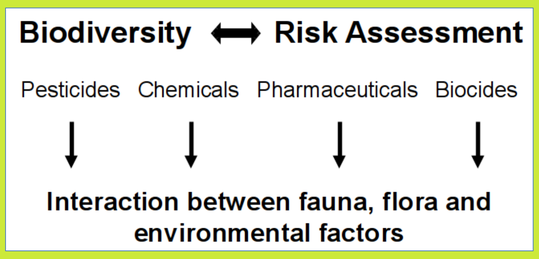

Fig. 1: The relationship of environmental stressors and biodiversity must be accounted for in several domains of risk assessment.

Landscape elements & ecological values

Important questions in landscape risk assessment are (1) how to protect biodiversity at landscape level, (2) how to quantify and assess the impact of land use scenarios and (3) whether there is a state or a known situation, to which the quality of biodiversity can be compared (**reference state**).

Biodiversity depends on (a) the combination of **landscape elements** and (b) the environmental conditions of a landscape area. An **ecological value** is deduced from "biotope valences" made for environmental assessments within the German "impact mitigation regulation" (Fig. 2)

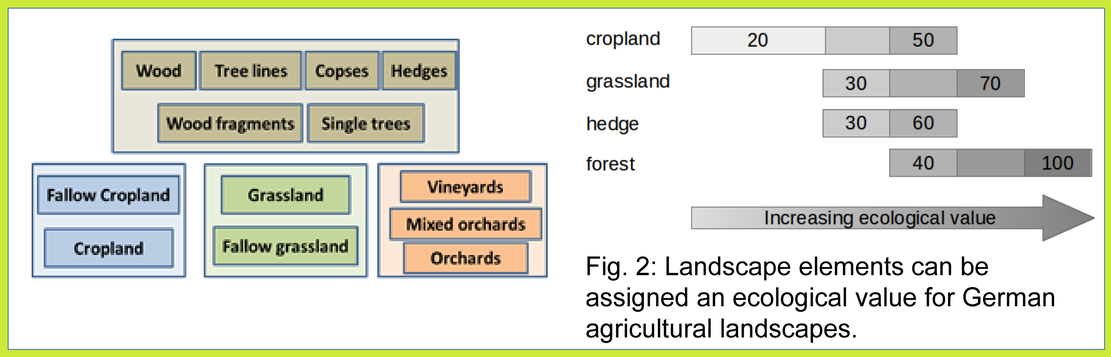

Fig. 2: Landscape elements can be assigned an ecological value for German agricultural landscapes.

A case study for landscape-based risk assessment

The Horbacher Boerde (near Aachen, Germany, Fig. 3) is shown as a case study for landscape dominated by agricultural fields. The effectiveness of risk mitigation actions (Fig. 4) can be quantified by calculating the **sum of all ecological values** over all landscape elements within a region (Fig. 5). Different **scenarios of landuse** can be compared to calculate the **effectiveness of risk mitigation actions** (Fig. 6).

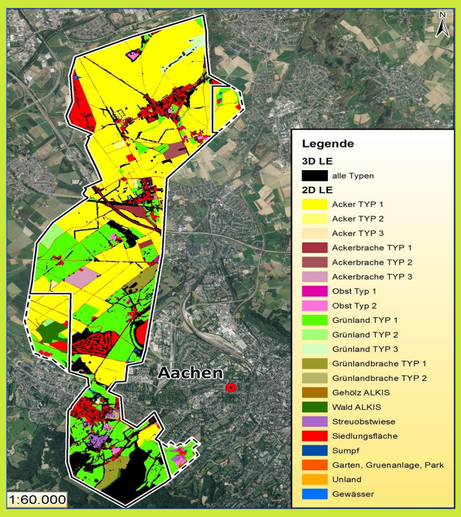

Fig. 3: Spatial distribution of landscape elements in the Horbacher Börde

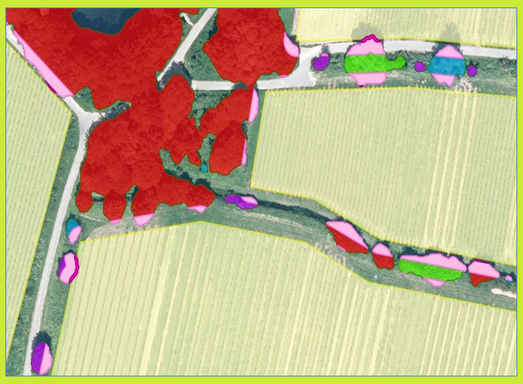

Fig. 4: Rules for downgrading of ecological values of landscape elements in contact to intensive landuse (direct zone 0-1 m —, wider contact zone 1-5 m —)

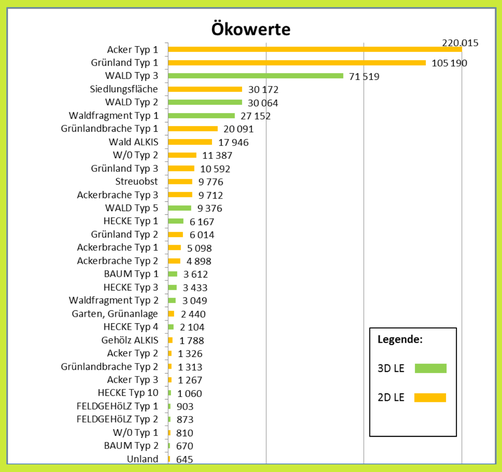

Fig. 5: Resulting distribution of ecological values of all landscape elements in the Horbacher Boerde

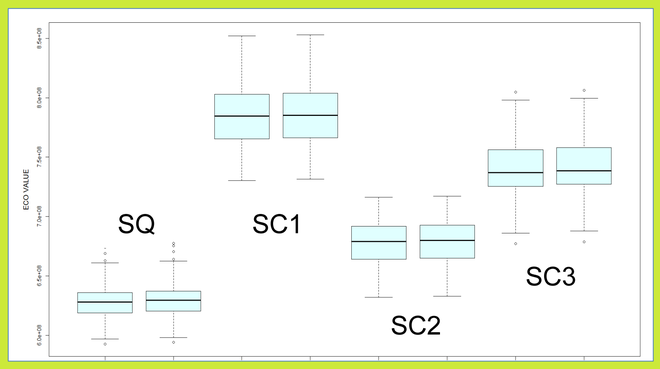

Fig. 6: Resulting sums of ecological values in the Horbacher Boerde for different hypothetical landuse scenarios or risk mitigation actions under discussion (SQ=status quo, SC1=cropland extensification by 50%, SC2=50% cropland fallowing, SC3=grassland extensification by 50%)

Development goals & reference conditions

The landscape profits from less pesticides (as already suggested by plant protection services), but even if the intensity of pesticide use is reduced an automatic recovery of many populations on the landscape level can not be expected. The ecological value of agricultural landscapes should be **actively increased**, e.g. comparable to the EU Water Framework Directive.

Region specific assessment in Germany can be based on the classification of cultivated landscape types (grassland, woody structures, arable land etc.) defined by the German Federal Agency for Nature Conservation (BfN) (Fig. 7). Comparing the ecological value of the status quo with spatial explicit simulations for a given landscape can help to decide about the **effectiveness of risk mitigation actions**.

To achieve this goal **overall concepts** (Leitbilder) are needed to define the best case given agricultural usage within a certain class of cultivated landscape and give information about the regional ecological potential of biodiversity.

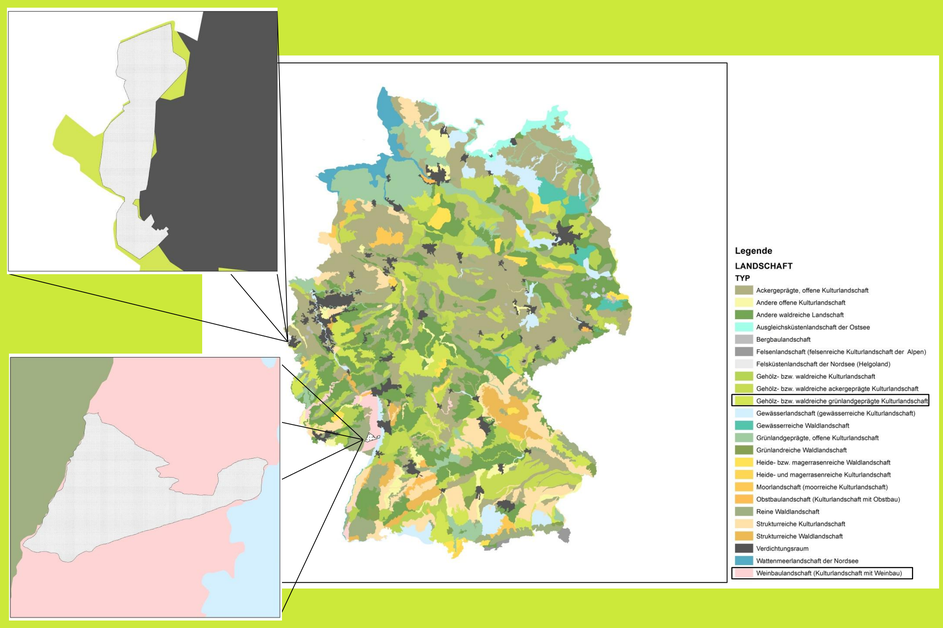

Fig. 7: Distribution of types of cultivated landscapes in Germany (Source: BfN)

Suggestions and implications for landscape-based risk mitigation

Our research in landscape analysis and projection of different scenarios of extensification show that the overall ecological values of landscapes can only be increased significantly by extensification of usage in intensively used agricultural landscapes in Germany. As a development objective we suggest to let 5-15% of the areas lie fallow according to the landscape structure. Such a quote would enable to realize all typical landscape elements in diverse intensities. This structural heterogeneity is indispensable for the promotion of biodiversity in agricultural landscapes. How close we have to get to the overall concepts has to be decided by risk management authorities.

References: [1] European Environment Agency (2013) The European Grassland Butterfly Indicator: 1990–2011. EEA Technical report No 11/2013. pp. 36