ГЛАВНЫЕ РЕДАКТОРЫ: Виктор Г. Сычёв и Лотар Мюллер

НОВЫЕ МЕТОДЫ И РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ ЛАНДШАФТОВ В ЕВРОПЕ, ЦЕНТРАЛЬНОЙ АЗИИ И СИБИРИ

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Глава III/71: Моделирование влияния агрохимикатов и других мер по управлению рисками в наземном агробиоценозе: подход RISKMIN

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ABSTRACT. The RISKMIN Model was a research project of the German Federal Office of Consumer Protection and Food Safety to develop a landscape-based mitigation approach for assessing different measures and their effects on agrobiodiversity. Based on an interdisciplinary cooperation between different research groups in Germany two representative landscapes were chosen as pilot regions. Based on a very high resolution landscape analysis and a comprehensive survey of the biodiversity in these regions a simulation of different risk mitigation measures was realized by reference to potential scenarios. The resulting effects could be quantified and visualized with the help of geographic information systems (GIS). Main results are that the most effects on landscape level are the extensification of the land use, but on the other hand, that the combination of in crop and off crop measures does have the most effects for the landscape elements with the highest ecological values.

Резюме. Модель RISKMIN является исследовательским проектом Федерального управления по защите прав потребителей и безопасности пищевых продуктов Германии по разработке ландшафтного подхода к снижению негативных последствий и для оценки различных мер и их воздействия на агробиоразнообразие. На основе междисциплинарного сотрудничества между различными исследовательскими группами в Германии в качестве пилотных регионов были выбраны два репрезентативных ландшафта. Основываясь на ландшафном анализе с очень высоким разрешением и всестороннем обзоре биоразнообразия в этих регионах, было проведено моделирование различных мер по снижению риска с учетом возможных сценариев. Полученные результаты можно количественно оценить и визуализировать с помощью географических информационных систем (ГИС). Основные результаты заключаются в том, что наибольшее влияние на ландшафтный уровень оказывает экстенсификация землепользования, но, с другой стороны, сочетание мер в области растениеводства оказывает наибольшее воздействие на элементы ландшафта с самыми высокими экологическими ценностями.

KEYWORDS: biodiversity, ecological values, landscape classification and analysis, risk assessment, mitigation measures, GIS

Ключевые слова: биоразнообразие, экологические ценности, классификация и анализ ландшафта, оценка рисков, смягчающие меры, ГИС

INTRODUCTION

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. Therefore when dealing with biodiversity related aspects the analysis of landscapes and not of single fields is important. EFSA published different opinions and scientific papers in the context recovery and recolonisation. In these opinions a clear relationship between landscape and risk is formulated. “There is, therefore, an important interplay between homogeneity of agricultural practices over spatial scales, and the potential for recovery from stresses. Landscape features therefore may need to be assessed when assessing the potential for external recovery. This is clearly problematic as it indicates that not the assessed product or species per se
may be decisive for the recovery from impact, but the properties of the environment in which these products or species are having an effect. This is challenging from a regulatory perspective” ([1]).

It is widely accepted that species diversity and habitat quality is dramatically decreasing in Germany. The loss of habitats and intensity of agricultural land-use are one of the main accepted reasons for this. 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) [2]. Environmental stressors (like pesticides) act on the landscape level [3]. This adverse effect is relevant within national as well as EU legislation.

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 the combination of landscape elements and 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”.

In the German multidisciplinary project RISKMIN, sponsored by the German Federal Office of Consumer Protection and Food Safety these approaches were investigated and tested for two pilot regions in Germany [4]. This publication gives a short overview about methods and results of the RISKMIN project.

**MATERIAL AND METHODS**
RISKMIN is an interdisciplinary cooperation between geographers, ecologists, ecotoxicologists and risk managers. At first a conceptual approach (fig. 1) of the RISKMIN model was developed, in which six modules are differed. This modular approach offers the opportunity to handover data and information between the work packages.

![Conceptual approach of the RISKMIN Model](image)

The modul **Field** as practical in field survey covers the important, regionally-relevant types of biotopes of agricultural landscapes from in-crop like cropland and meadows and off-crop like hedges, fallow cropland and fallow meadows.

The modul **Meta** is based on a comprehensive literature research and covers the most important factors affecting the agrobiodiversity like farming practices, pesticide and fertiliser use.

The modul **Geodat** delivers a high resolution landscape classification following the approach of NatFlo, published by Tintrup et al. 2015 [5] and Trapp et al. 2015 [6] as input for the indicator based mapping of the structural diversity in the agricultural landscape resulting in landscape elements and land cover.

In the moduls **Status Quo** as well as in the moduls **Projection RiskMin** and **Recomm** the linkage of the automated analyses of landscape structures with measures of biodiversity, mobility of populations, and impacts of (pesticide) risk management measures is conducted.
To each of the landscape elements (LE) mapped in the module Geodat an ecological value, derived from impact regulation between 0 and 100 is assigned which reflects the relative natural value of the respective element in the agricultural landscape, which is closely related to the biotope type. An integrated landscape ecological value is calculated as the sum of all values of the single LE by the module Status Quo, which is then corrected for intensive agricultural use for LE nearby the in-crop areas. This value is basis for mitigation on landscape level. The module Projection then identifies risk mitigation measures (RMM) of different mechanisms, defines most promising RMM and implements rules for mechanisms of melioration on landscape level. The effects of different RMM and the most effective ones are then calculated and interpreted in the module Recomm. The modules Field and Meta deliver information and data whenever necessary and lacking for the main thread of the project.

The model landscapes and GIS-based classification of their elements
Two different types of landscapes have been chosen for the development of the concept, that should be valid and applicable at least to Germany, however, the principle is transferable to all agricultural landscapes throughout Europe. The ‘Horbacher Börde’ in the natural area ‘Vennvorland and Aachener Hügelland’ is well wooded, grassland-dominated cultural landscape that is considered comparable well-equipped with structural elements that host biodiversity, even though not of high ecological value. The ‘Vorderpfalz’ in the natural areas ‘Haardtrand-Weinstrasse and Vorderpfälzer Tiefland’ is a purely viticulturally characterised landscape with small fields and a high degree of different landscape structures combined with an intensive land use.

In the two landscapes, all structural elements have been identified by the software ‘ecognition’ and the vegetation has been surveyed by the combination of digital surface and the digital elevation models with high resolution aerial photographs with infrared channel (method: ‘NatFlo [5]). After then, height, width, area and descriptive statistics for each of the LEs was calculated and used in combination with geo-referenced land-use information and statistical assignments for the definition of up to 50 different ecologically relevant LE-Types.

The LE-types have been classified into 13 main categories and have been further differentiated to characteristic eco-values by intensity of use, age, extent, proportion of typical plant species and others (fig. 2). The ‘landscape-wide eco-value’ is then calculated as the status quo sum of all eco-values of the LE in the respective landscape section.

The analysis of the data from the field surveys found some generalizable rules how LE-biocoenoses could contribute exchange to a similar LE-type and how this could lead to an upgrade of the actual state of a landscape element. We describe the effect of introducing more, new or better equipped LE-types that host biodiversity into a given landscape and how would less intense use affect the state of biodiversity. We give recommendations which measures would be best suited considering the specific boundary condition in as landscape and where they would be placed best for effectiveness.

RESULTS AND DISCUSSION
The methodology is considered well established but needs calibration by data from different landscapes. The model that was derived from the RISKMIN project puts the discussion on landscape-based RMM a
fine step forward. The RISKMIN concept is an option for risk managers especially to optimize RMM on a local to regional level alongside with national programs for sustainable land use. The following figure 3 visualizes an example of one of the landscape related simulation and compares the Status Quo and the Scenario 1 (= extensification of arable land). Therefore you can see in detail how many fields would be extensified and with the help of georeferenced data you can quantify the effect by calculating the sums of the overall ecological values.

**Figure 3:** Visualisation of one landscape related simulation: Comparison between the Status Quo and one extensification scenario.

One important result of the RISKMIN project is that the ‘regulations’ RMM do not much impact the total landscape ecological valences due to the small amount of area of ‘high-value off-crop structures’ compared to in-field area. Therefore the ‘extensification’ of large in-field areas has the highest absolute impact on the total landscape ecological valences.

On the other hand the other important result can be described by ‘type-related affectedness’. This means that the combination of in field and off field mitigation measures linked in landscape contexts have more effects than spatial singular measures, e.g. narrow margins would benefit most.

**CONCLUSIONS**

1. With respect to landscape level, different RMM need to be calibrated to different landscape types. Landscape related mitigation measures are more effective than measures without respect to the environmental conditions and the neighbourhood relations in spatiotemporal context.
2. Most effective is a more extensive landuse, but implementing different kinds of mitigation measures in crop and off crop to support synergistic effects and building up a network could lead to similar results.
3. In future, the effects could be validated by on-site monitoring of the biodiversity or of the quality of landscape elements and a region specific assessment should be applied by defining “general principles” for different types of landscapes.
4. Heat-maps of biodiversity hotspots or sinks could be helpful for risk managers deciding on the most efficient measures to be implemented.
REFERENCES

Chapter III/72: A DSS MODEL FOR THE GOVERNANCE OF SUSTAINABLE RURAL LANDSCAPE
Глава III/72: Модель DSS для управления устойчивым сельским ландшафтом

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ABSTRACT. This paper presents a model based on the integration of a geographical multi-criteria analysis and advanced GIS-based geo-processing tools aiming at identifying farms’ and rural landscape’s evolutionary paths. The model integrates information about natural characteristics, cultural aspects of the past and present, and socio-economic aspects of farms, since agriculture is the main driver of change for rural landscape. Farm strategies are influenced by internal factors but also by external factors, such as market conditions and policies; which both are drivers of landscape changes, while policies could have also the role of response to problems of landscape maintenance and improvement. The identification of future landscape scenarios is based on the integration of past evolution, landscape sensitivity and farmers’ adaptation capacity to market and policy changes. A first version of the model was tailored and tested in the Municipality of Castiglion d’Orcia (Tuscany, Italy), belonging to one of the most well known UNESCO cultural landscapes of Italy.