IMPACT

PRESERVING ECOSYSTEM SERVICES AND BIODIVERSITY ON AGRICULTURAL LAND

PROJECT

FUNDING

PARTNERS

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Balancing land use requirements

*As agricultural land comes under increasing pressure from competing interests, the **TALE** project is using novel methods to optimise land use strategies and advise governments on policy development*

Agricultural land is in high demand. However, by intensifying existing agricultural land or expanding the land area under production, we risk deteriorating ecosystems and losing valuable biodiversity. This is where the project "Towards multifunctional Agricultural Landscapes in Europe" (TALE) comes in. Its aim is to find ways of optimising the use of agricultural land that maximise its contribution to biodiversity and provision of ecosystem services according to the needs of the society.

The three-year project is funded by the European BiodivERsA initiative, a network of regional and national funding organisations set up to promote pan-European research on biodiversity and ecosystem services – the often overlooked properties of agricultural land that support environmental and human wellbeing, such as nutrient cycling, carbon sequestration and landscape aesthetics. TALE comprises participants from seven research institutes and universities based in five European nations and coordinated by the Helmholtz Centre for Environmental Research (UFZ) in Germany. Its main aims are to identify synergies and trade-offs between ecosystem services and biodiversity and to analyse policy instruments that could help to manage those synergies and trade-offs.

CASE STUDIES

Within the overall objective of optimising land use strategies to maximise a range of outputs and services, the TALE project has a number of sub-initiatives and defined project deliverables. Dr Martin Schönhart, a scientist at the University of Natural Resources and Life Sciences, Vienna (BOKU) in Austria, explains: 'The project's main tasks are to implement a systematic stakeholder integration process to ensure practical relevance of the project results, develop a set of land use scenarios and policies, create optimisation models for decision support, and finally to promote an online learning environment that is accessible to all'. The project outputs include a set of optimised land use models for some case study regions, policy guidance for land users at all levels of government, and a standalone optimisation tool available to anyone with an interest in the best agricultural land management practices.

The team has taken a structured and systematic approach to the problem of land use optimisation. TALE is focusing on five case study regions in Austria, Germany, Spain, Switzerland, and The Netherlands for in-depth analysis. 'This approach is crucial because European landscapes and regional agricultural production are highly diverse and require individual analyses,' explains Dr Annelie Holzkämper of Agroscope, the Swiss centre of excellence for agricultural research. 'The team developed scenarios for each region based on common guidelines for the implementation of scenario workshops.'

STAKEHOLDER ENGAGEMENT

The scenarios were developed in conjunction with the TALE advisory board and stakeholders. Such stakeholder participation was vital to the project. 'It kept the research practically relevant through the sharing of community knowledge, joint development of practical use scenarios and enabled us to validate our results,' notes Dr Emma van der Zanden of the Vrije Universiteit Amsterdam in the Netherlands. Workshops were the main vehicle by which common scenarios were developed and agreed for each of the case study areas.

Project participants included farmers, government and regional officials, water and land management agencies, and other community representatives. They were first introduced to the two scientific starting points for developing a more balanced approach to land use: land sparing and land sharing. The former concept refers to the spatial separation of production and nature conservation on agricultural land, where part of the land is used intensively for agricultural production while the rest is preserved. The latter refers to their integration.

At the workshops, participants were asked to indicate areas suitable for land cover changes or changes in land use management, to describe their related needs, and finally to discuss policy instruments to achieve preferred land use scenarios. The concept of ecosystem services was important when discussing community needs from agricultural land. 'Ecosystem services as a concept helps to raise awareness of the high number of provided services that are not always visible to people,' notes Dr Nina Hagemann of the UFZ. 'Food is an obvious benefit of agricultural land, but stormwater retention, climate regulation and landscape aesthetics are less obvious. Each land use change has an impact on these services and leads to trade-offs which people may not wish to accept once they understand the full implications.'

> *"We have found practical ways to integrate agricultural land use, biodiversity and ecosystem services to mitigate land use conflicts and are keen to share our best practice outputs worldwide"*

MODELLING AND OPTIMISATION

After the participatory scenarios had been developed and refined through the workshops, TALE used biophysical and statistical models to simulate complex landscape processes such as crop growth and fluxes of water, nutrients and sediments. 'The impact of human influences such as urbanisation, agriculture, forestry, water extraction, pollution, recreation and other activities can be evaluated using land use and vegetation maps, climate and soil data and information on agricultural management practices,' elucidates Dr Michael Strauch, a scientific assistant at the UFZ. 'If we change the drivers such as climate or land use, the models can calculate the impact on crop yield, soil erosion, water quality or species distribution.'

Optimisation algorithms were applied to the models to determine the land use pattern for each region that would most effectively provide enough food and fresh water for humans while also enabling nature conservation and biodiversity options at a landscape scale. 'Combining these results with the participatory scenario outcomes allows us to identify optimum solutions for land use and policy mixes given stakeholder-generated constraints and ecosystem preferences,' Strauch confirms. The maps generated are spatially explicit and take into account different management options, such as organic versus traditional farming practices. One case study for the Netherlands – which used the TALE process to identify trade-offs and synergies between dairy farming, fruit production, endangered species habitat and landscape aesthetics – has already led to a positive response from regional policy makers.

ENHANCING ENVIRONMENTAL VALUES

TALE has already yielded important results and outputs with the potential to significantly enhance ecosystems and biodiversity on agricultural land. The TALE project coordinator, Professor Dr Martin Volk of the UFZ, enthuses: 'Different types of agri-environmental policy instruments have been identified and characterised. The policy measures that directly influence agricultural land use and land management in the case study regions have been described in detail, and we have also described the governance structures needed to implement policies. We have found practical ways to integrate agricultural land use, biodiversity and ecosystem services to mitigate land use conflicts and are keen to share our best practice outputs worldwide.'

The project results are being widely published and researchers, students and all interested parties are welcome to delve into the TALE online learning environment and to use the optimisation tool to investigate their own local land use scenarios.

Project Insights

FUNDING

The TALE project is funded through the 2013-2014 BiodivERsA/FACCE-JPI joint call for research proposals, with the national funders German Federal Ministry of Education and Research (BMBF), The Austrian Science Fund (FWF), Netherlands Organisation for Scientific Research (NWO), Spanish Ministry of Economy, Industry and Competitiveness and the National Research Programme 'Sustainable Use of Soil as a Resource' (NRP 68) of the Swiss National Science Foundation.

PARTNERS

• Helmholtz Centre for Environmental Research – UFZ (Germany) • University of Natural Resources and Life Sciences (Austria) • Institute for Rural Development Research (Germany) • Vrije Universiteit Amsterdam (The Netherlands) • IMDEA-agua (Spain) • Research Centre for the Management of Agricultural and Environmental Risks (Spain) • Agroscope (Switzerland)

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PROJECT COORDINATOR BIO

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PROJECT

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Impact Objective

- Disentangle and quantify the multifaceted links between agricultural production, biodiversity and ecosystem services in different European landscapes
- Support the design and evaluation of policy options that can help reconcile conflicting demands on agricultural land

Preserving ecosystem services and biodiversity on agricultural land

***Professor Dr Martin Volk** and **Dr Nina Hagemann** describe the challenge of securing food production while still supporting ecosystem services provision and biodiversity conservation by agricultural land*

Professor Dr Martin Volk

Dr Nina Hagemann

What do you see as the main problems and issues facing land use and agriculture?

MV: Agricultural land has several functions including food production and supply of many other ecosystem services. In addition, it plays an important role for biodiversity, since it provides habitat for plant and animal species that deliver services such as pollination and pest control. However, agricultural land is coming under increasing pressure. One of the main challenges facing Europe and other countries is the global increase in human population. An increasing population and related consumption patterns will lead to a significant demand for land, e.g. for agriculture, housing and infrastructure as well as greater land use intensity to feed people. Both land cover change and intensification might further degrade different ecosystems and biodiversity. An additional challenge for the future is climate change, which is expected to reduce our ability to grow food in different regions of the world.

How will the project help society better balance competing demands for agricultural land use?

NH: The different demands for services that people want from agricultural land leads to conflicts of interest and trade-offs, as not all ecosystem services can be provided at the same time and in every location. In the TALE project we define ecosystem services following the Millennium Ecosystem Assessment as 'the benefits people obtain from ecosystems'. The increasing demand for agricultural products requires an improved understanding of these trade-offs and the potential synergies between biodiversity, food and energy production and other ecosystem services.

The TALE project contributes to land use decision making by identifying and quantifying the trade-offs and synergies between competing land use interests; developing scenarios for future land use using a range of different policy priorities; identifying optimal land use strategies; and analysing existing policy measures to assess their effectiveness to support these strategies. TALE is analysing several case studies across Europe using both qualitative methods (including participatory-developed scenarios) and quantitative methods (for instance, using our multi-objective optimisation software, CoMOLA).

Why is TALE involving land use stakeholders and the local community in the development of scenarios and land use strategies?

MV: For us, it was vital to design and implement a systematic stakeholder integration process at an early stage. We wanted to incorporate expert knowledge within the project and provide an opportunity for two-way communication between scientists, policymakers and the community during all project phases. In this way, we could ensure the practical relevance of our results. These stakeholders have therefore had a central role within the process and ensured that the local challenges, knowledge, perceptions and other important aspects of each case study region were not overlooked. We expect these stakeholders to also be main beneficiaries from the knowledge we gather, including optimisation of land use patterns. The initialised dialogue among different groups of stakeholders in the case study regions can be valuable even beyond TALE.

Do you hope this work will support the design and evaluation of policy options?

NH: One of the first steps in TALE has been to analyse what effects different policies have with respect to influencing land use, and which challenges may arise with their application. For instance, some policy instruments require an overwhelming amount of paperwork for farmers and administrators, or are just ineffective in terms of environmental and nature protection. This information can be directly used as a basis for informed decision making at different governance levels, even across national boundaries. For instance, good practice policies from one case study region may inspire governmental processes in another region. One important output is an innovative online learning environment that is accessible to experts, students and lay individuals.