BOOK OF ABSTRACTS

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I.   SESSION DESCRIPTION

ID: S1

Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Hosts:

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Hosts:	Peter Zander	Leibniz Centre for Agricultural Landscape Research	pzander@zalf.de
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Abstract:

Biodiversity and ecosystem service (ESS) governance of agricultural landscapes needs to account for agricultural land use, landscape structures and the relevant stakeholders. Agricultural activities dominantly impact the environment and are continuously adapting to drivers, i.e. economic incentives, scientific and technological developments, socio-political framework, climate change etc. This complex of drivers will probably continue to act unabated in the future, while its importance varies regionally. Since the conservation of biodiversity in agricultural landscapes is essential for maintaining their functionality and adaptability, a landscape perspective of the agricultural system to safeguard an ecological infrastructure, the related farmland biodiversity and its functions (ESS) under current and future driving forces is needed.

In this context, the European research project SALBES (Scenarios for Agricultural Landscapes' Biodiversity and Ecosystem Services) applies the planetary boundary framework and defines a safe operating space (SOS; Steffen et al., 2015). It is tested as binding guideline for environmental policy making and considered as principle to manage agricultural landscapes, as a theory, concept and policy objective, based on integrated, implementation oriented, stakeholder guided, IT supported, evidence-based analyses. This is elaborated and tested in four case study areas in

Europe, for evidence-based specifications of a "safe operating space" for sustainable landscape development.

This session provides a platform for discussing the project's approach and other scenario building and modelling tools that tackle these issues at landscape level.

Goals and objectives of the session:

Presenting the SALBES approach for ESS modelling in the agricultural sector and providing a platform for other research teams. We argue that the integration of three components is essential to safeguard the functionality and adaptability of the biodiversity and related ecosystem services in agricultural landscapes: The green landscape infrastructure, adaptive management schemes, and multi-actor approaches.

Planned output / Deliverables:

Series of research articles in special issue.

Related to ESP Working Group/National Network:

Sectoral Working Groups: SWG 1 – ES in Agricultural production systems

II.   SESSION PROGRAM

Date of session: Thursday, 10 June 2021
Time of session: 9:30 – 14:45

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
9:30 9:45	Sérgio	Pedro	University of Coimbra	Public policy toolbox for a transition to sustainable food systems
9:45 10:00	Erik	Hunter	The Swedish University of Agricultural Sciences	Using the Cascade Framework to understand grassland policy logic and ES across Europe
10:00 10:15	Daniela	Alba-Patiño	Universidad de Almeria	Assessing impacts of ecological restoration on human well-being across Mediterranean cultural landscapes
10:15 10:30	Roxanne	Suzette Lorilla	National Observatory of Athens	Using machine learning to analyze the effects of agricultural practices on ecosystem services
11:00 11:15	Florian	Danzinger	University of Vienna	Regional Green Infrastructure functionality assessment as a foundation to develop evidence-

Time	First name	Surname	Organization	Title of presentation
				based strategies and action plans through stakeholder involvement
11:15 11:30	Nöelle	Klein	Agroscope	Towards an ecologically adapted agriculture: the role of landscape structures
11:30 11:45	Riho	Marja	Centre for Ecological Research	Effectiveness of agri-environmental management on pollinators species richness is more dependent on ecological contrast than on landscape structure or land-use intensity
11:45 12:00	Ildikó	Arany	Centre for Ecological Research	Beekeepers can help keeping safe operating boundaries for agriculture
12:00 12:15	Jana	Kachler	Helmholtz-Centre for Environmental Research	Co-production of ecosystem services: how much evidence is out there?
13:30 13:45	Tobias	Conradt	Potsdam Institute for Climate Impact Research	Aligning principally incompatible spatiotemporal data for agricultural yield prediction and ESS modelling
13:45 14:00	Nicola	Elleaume	University Grenoble Alps	Adapting fodder production to climate change in the Alps: A Bayesian analysis to explore robust adaptations despite uncertainties
14:00 14:15	Margot	Neyret	Senckenberg Bik-F	Landscape deintensification results in higher and more equitable ecosystem service supply
14:15 14:30	Martin	Schönhart	University of Natural Resources and Life Sciences	Participatory scenario design for ecosystem services and biodiversity modelling at landscape level
14:30 14:45	Sonja	Kay	Agroscope	Spatial modelling of farmland economics, biodiversity, and ecosystem services in agricultural landscapes in Switzerland

III.   ABSTRACTS

Abstracts are ordered based on the session program. The first author is the presenting author unless indicated otherwise.

1. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Public policy toolbox for a transition to sustainable food systems

Presenting author: Sérgio Pedro
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Considering the present food system, in its global and local dimensions, as a central element to be addressed for the necessary path for the sustainability of the planet, the proposed contribution aims to analyse the feasibility of promoting the transition to sustainable food systems through the implementation of public policies to support ecosystem services resulting from the agricultural activity that promote climate change mitigation. In this context, the concept of ecosystem services is mobilized and materialized critically from the perspective of Political Ecology, through an exemplary geographical case study analysis on the biodiverse agricultural landscapes of the sub-region of Viseu Dão-Lafões*, Portugal. The contribution adopts an interdisciplinary methodological framework that combines research tools from the natural and social sciences to identify the available options in the public policy toolbox for the promotion of agricultural production methodologies and farming systems that can enable climate change adaptation and mitigation. The impact and leverage margin of such policy toolbox will be measured through the modelling of alternative scenarios of farming systems and public policy changes for the promotion of regenerative agriculture in line with the UN Koronivia Joint Work on Agriculture, the Paris Agreement and Agenda 2030.

Keywords: ecosystem services, agriculture, sustainable food systems, climate change

Using the Cascade Framework to understand grassland policy logic and ES across Europe

Presenting author: Erik Hunter

Other author(s): Carl Johansson, Jozefine Nybom, Sophie Tindale, Rosa Gallardo Cabos, Pedro Sánchez Zamora, Belén Caño Vergara, Simone Quatrini

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The ecosystem services (ES) provided by Permanent grasslands (PG) are heavily influenced by policies such as CAP and Natura 2000. Using different tools such as subsidies, regulations and education, policy can directly influence how land is managed in order to promote specific ES. Policy may also indirectly influence land management by increasing (consumer) demand for specific ecosystem services or by providing direct payments for desired ecosystem services. According to the Mellenium Ecosystem Assessment, up to 60% of the ES evaluated were either unsustainable or degraded, suggesting inefficiencies in the policy logics across Europe. Consequently, we argue that there is an urgent need to understand the policy logics in place in order to address their shortcomings in achieving sustainable PG management and the desired flow of ES. To map policy logics across Europe, we employed a Policy Delphi to identify 24 policies seen as influential for PG management, of which 15 were unique to the five case study countries. 50 different criteria were used to map each policy—entailing an in-depth analysis of publicly available government sources documenting the aims, objectives, targets, monitoring systems, outputs and outcomes of each policy instrument. Finally, the 'cascade framework' was used to analyse the entry points, intermediary actors, mechanisms and pathways through which policies deliver their intended effects on PGs. This resulted in a database containing rich qualitative data that provided insights into the policy logics employed across Europe, as well as their shortcomings, that influence the management of permanent grasslands and the flow of ecosystem services.

Keywords: cascade framework, permanent grassland policy, ecosystem services

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Assessing impacts of ecological restoration on human well-being across Mediterranean cultural landscapes

Presenting author: Daniela Alba-Patiño

Other author(s): Antonio J. Castro, Vicenç Carabassa, Mónica Expósito-Granados, Inés Gutiérrez-Briceño, Marina García Llorente

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Mediterranean cultural landscapes are increasingly facing extreme climatic events that intensify the risks of desertification and loss of ecosystem services (ES). Ecological restoration is a crucial to reduce ecosystem vulnerability and strengthen socio-ecological resilience. Here we aim to implement the ES framework to quantify and value the impacts on human well-being associated to almond tree restoration in cultural landscapes of SE Spain. We conducted a social sampling with 350 respondents to explore perceptions and preferences for ES provided before and after the ecological restoration. Results indicated that the restoration induced changes in preferences and perceptions for ES, such as an increase in the number of ES, and more relevance of regulating and cultural ES. We also found that preferences for particular ES were associated with the maintenance of specific components of human well-being such as security and regulating ES. This study helps to make visible the linkages between ecological restoration and human wellbeing in Mediterranean cultural landscapes

Keywords: ecological restauration, ecosystem services, well-being, social indicators, natural capital

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Using machine learning to analyze the effects of agricultural practices on ecosystem services

Presenting author: Roxanne Suzette Lorilla

Other author(s): Vasileios Sitokonstantinou, Charalampos Kontoes, Alkiviadis KoukosIlias Tsoumas

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Over the years, agricultural intensification in Europe has resulted in the loss of farmland biodiversity and degradation of ecological processes, threatening the conservation of ecosystem services that underpin agricultural productivity itself, such as pollination of crops and soil erosion control. To tackle these challenges, the Common Agricultural Policy (CAP) sets out to achieve sustainable agriculture in the EU, in a way that rural communities are socially, economically, and environmentally benefited. In particular, through the post-2020 CAP, the EU encourages individual Member States to better tailor the implementation of the standards (e.g. simplified greening rules) to their local particularities. In this context, this study has been developed, aiming to identify the spatial and temporal variability of ecosystem services in response to agricultural practices, as a prerequisite tool for effective agricultural management and planning. A comprehensive approach combining ecosystem services modeling and machine learning techniques was developed, to assess whether agricultural management practices may have influenced the functioning of ecosystems causing both synergistic and trade-off relationships. Earth Observation (Copernicus Land Monitoring and Climate Services) based indicators were used to quantify six ecosystem services, namely, nutrition biomass, erosion prevention, climate regulation, air quality regulation, lifecycle maintenance, and pollination potential, which were used to classify the study area into different groups with specific patterns of synergistic and trade-off relationships. Exploiting a series of yearly Land Parcel Identification System (LPIS) data for North Belgium (Flanders) and hence the knowledge of the cultivated crop type at the parcel level for a 10-year period, we created a set of explanatory variables representing agricultural practices, such as crop rotation and diversification. Our approach can offer decision-makers and farm managers with important information to design sustainable agricultural strategies in local specific areas, eventually achieving the CAP's main environmental goals, including protecting natural resources and enhancing biodiversity.

5. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Regional Green Infrastructure functionality assessment as a foundation to develop evidence-based strategies and action plans through stakeholder involvement

Presenting author: Florian Danzinger
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Green Infrastructure (GI) defined as a strategically planned network of natural and semi-natural areas is a key strategy in the European biodiversity strategy and the landscape connectivity agenda. To implement this approach in Central Europe's (CE) landscape planning policies the Interreg project MaGICLandscapes (ML) tried to operationalise the GI concept in CE, to provide land-managers, policy makers and communities with tools and knowledge, at different spatial levels. Based on the example of the Austrian case study area, the aim of this work is to present an easy-to-use approach, starting from producing a highly-detailed regional GI database. By compiling regional cadastral and agricultural information, highly detailed data on the water network as well as forests, this detailed representation of the GI network allows to enhance the regional applicability and acceptance of GI initiatives. Additionally, it provides a crucial foundation for assessing the quality of local GI to develop evidence-based strategies and action plans through stakeholder involvement to direct future actions and investment in GI. In this work we demonstrate GI assessment methods that focus on functionality in terms of connectivity and provision of landscape services and furthermore communicate and facilitate the adoption of those assessment methods and the strategies derived from them by institutions through participatory approaches. The additional analysis and mapping of landscape service supply offered by these GI elements, built on expert-based assessments to score each service through a capacity matrix,

may therefore complement the information basis for the sustainable planning of GI in the case study area by visualising focus areas, which provide or are in need of capacities of certain landscape services. The results provided planning and environmentally oriented institutions with information and methods as well as action plans and strategies that recognise landscape ecological functions and landscape services and identify opportunities for enhanced multifunctionality.

Keywords: green infrastructure, connectivity, landscape services, mapping, stakeholder involvement

6. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Towards an ecologically adapted agriculture: the role of landscape structures

Presenting author: Noëlle Klein
Other author(s): Felix Herzog, Adrienne Grêt-Regamey, Philippe Jeanneret, Maarten van Strien, Sonja Kay
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An increasing human population and food demand call for a more efficient agricultural production and intensified agricultural practices. Mechanised farming depends on larger fields and uniformity, leading to increased landscape homogeneity which results in biodiversity loss. The halt of this loss is of major importance for the functioning of farmland ecosystems and provisioning of services provided by species. Thus, green structures are promoted through European agricultural policies and similar schemes in many countries. A major restriction to these policies is the limited knowledge on their actual efficiency to foster biodiversity, while it is often overseen that not only their composition and quality, but also their spatial configuration is important for most mobile species. Region-specific information on these relationships as well as methods to predict them for agricultural decision making remain rare. In this study, birds and butterflies have been monitored in two contrasting agricultural landscapes in Switzerland. To

investigate the role of landscape structure for biodiversity, we define and quantify composition and configuration of structures on different spatial scales. Detailed agricultural management (field level) and structural variables (landscape level) have been associated with the animal data, illustrating varying effects between different species guilds and different landscape structures. The outcome will help to add a novel landscape component to e.g. the current Swiss Agricultural Life Cycle Assessment for biodiversity (SALCA-BD) to improve prediction of land-use impacts on biodiversity. In addition, the data complements the lack of regional knowledge on the role of specific landscape structures for different guilds of mobile species in the study regions. This is of high importance for local prioritization of land-use management options (such as an efficient placement of structures) in order to foster environmental stability of agricultural landscapes and develop sophisticated future land-use policies favouring productive agriculture through ecologically sustainable management of agricultural landscapes.

Keywords: agricultural landscapes, biodiversity, landscape structures, life cycle assessment

7. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Effectiveness of agri-environmental management on pollinators species richness is more dependent on ecological contrast than on landscape structure or land-use intensity

Presenting author: Riho Marja
Other author(s): David Kleijn, Teja Tscharntke, Alexandra-Maria Klein, Thomas Frank, Péter Batáry
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Agri-environment management (AEM) programs started in the 1980s in Europe to mitigate biodiversity decline, but the effectiveness of AEM has been questioned. We hypothesize that limitation of AEM effectiveness is caused by a lack of a large enough ecological contrast between

AEM and non-treated control sites. The effectiveness of AEM may also be moderated by landscape structure and land-use intensity. Therefore, we examined the influence of local ecological contrast, landscape structure, but also regional land-use intensity concurrently in a meta-analysis of 62 European pollinator studies. Pollinators are important group providing ecosystem service increasing remarkably the crop yield. Our meta-analysis documented for the first time that the effectiveness of AEM for pollinator species richness is more strongly related to local ecological contrast than to landscape structure or regional land-use intensity. The results showed the highest AEM effectiveness in intensive land-use regions and simple landscapes with large ecological contrast. Lowest effectiveness of AEM was found in extensive land-use regions, in complex landscapes and at sites with small ecological contrast. Comparison of simple vs. complex landscape showed that under the same ecological contrast and land-use intensity conditions, the AEM effectiveness was always stronger in simple than in complex landscape. Especially, this was confirmed in intensive land-use regions. Large contrast is probably most sustainable solution for increasing pollinator diversity in regions, which are dominated by intensive land-use with cleared or simple landscape structure. However, our results indicated also that in species-rich habitats, small contrast AEM can also play indirectly a very important role for pollinators. For instance, extensively used species rich grasslands are currently often preserved largely because of support from agri-environmental subsidies despite the fact that species richness is rarely increase per se, but habitats are enhanced by subsides.

Keywords: agri-environmental schemes, biodiversity, ecosystem services, flower strips, meta-analysis

8. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Beekeepers can help keeping safe operating boundaries for agriculture

Presenting author: Ildikó Arany
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Intensification of agricultural production can cause significant increase in yield outputs but at the same time massive loss of biodiversity in agricultural regions. One of the most spectacular indicators of this loss is insect biomass and/or diversity including honeybees. Health condition and production yields of honeybee colonies have gone through a considerable decrease in recent decades in Europe. Hungary is the country in Europe with one of the highest honeybee density, where economic output of beekeeping is mostly based on honey production from black locust and a few agricultural crops. Beekeeping is a special branch of agriculture as it is not linked to one single locality but can use – and reflect – the complexity of a landscape. Through transhumance, beekeepers can continuously adapt to their surroundings in terms of its actual crop structure, management regime and weather condition, trying to provide circumstances that are beneficial for honey production as well as bee health throughout the season. In 2020 and 2021 a series of interviews have been made with 30 Hungarian beekeepers about their perceptions on past and present status of bee pastures in Hungary, as well as possibilities for its future improvement. Our presentation introduces the first results of these interviews such as the role of main and minor crops as bee pastures, effects of agricultural management techniques including the use of pesticides, stubble management, CAP greening measures, the role of green infrastructure including weed and habitat diversity as well as past and present tendencies of all these conditions and beekeepers' suggestions for future improvements. We are convinced that beekeepers, being exposed to many environmental factors at the same time, can be key stakeholders in identifying and – using honeybees as actual indicators – keeping safe operating boundaries for agriculture in Hungary and elsewhere.

Keywords: stakeholder interviews, agricultural bee pasture, honey yield, bee health

9. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Co-production of ecosystem services: how much evidence is out there?

Presenting author: Jana Kachler
Other author(s): Roman Isaac, Berta Martín-López, Aletta Bonn, María Felipe-Lucia
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Ecosystem services do not flow directly from natural capital to benefit humans but are the result of the complex interplay between natural and anthropogenic capitals. This is usually referred to as co-production. Anthropogenic capitals comprise human, social, physical, and financial capital, such as knowledge and skills, social networks, machinery, and subsidies. Despite the richness of studies on ecosystem services, and the increasingly recognized role of anthropogenic capitals to contribute to ecosystem services, only limited knowledge on the precise combinations of natural and anthropogenic capitals in ecosystem service co-production is available. Understanding which combinations of capitals generate which ecosystem services is crucial to identify the best land management strategies and avoid trade-offs between ecosystem services. We brought together existing evidence on the co-production of ecosystem services through a systematic literature review. Publications dealing with co-production explicitly, but also implicitly (i.e. by revealing the co-constitutive character of people and nature) were analyzed. We determined the current research gaps and limitations of existing studies and set-up a research agenda. The results demonstrate (1) to what extent the co-production of ecosystem services is acknowledged in science, (2) which data, data collection, and analytical methods are employed to detect co-production in empirical studies, and (3) which constellations of natural and anthropogenic capitals generate which ecosystem services. Based on the results, we will present conclusions for land-management strategies and provide guidance for follow-up research on co-production of ecosystem services.

Keywords: ecosystem services co-production, natural capital, anthropogenic capital, trade-offs, systematic literature review

10. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Aligning principally incompatible spatiotemporal data for agricultural yield prediction and ESS modelling

Presenting author: Tobias Conradt

Affiliation: Potsdam Institute for Climate Impact Research, Germany

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In the framework of an ongoing research project about biodiversity of agricultural ecosystems under climate change, future yield prospects of crops currently grown in different European regions had to be modelled. The multiple regression approach applied for that purpose (ABSOLUT – a detailed description has just been submitted to Geoscientific Model Develeopment) requires principally two data sources: time series of observed agricultural yields in sub-regions (districts) of the modelling domain and monthly weather variables with their observation period and spatial disaggregation matching the yield data. Results for two case studies – Estonia and Germany – will be presented with respect to data availability and preprocessing issues. For example, Germany's meteorological service (Deutscher Wetterdienst, DWD) freely provide readily interpolated monthly grids of 1 km resolution for a couple of variables while Estonia's Riigi Ilmateenistus currently have only station measurements available through their website. On the other hand, district-wise yield data are available for just ten common crops in Germany while the Estonian statistics authority reports district yields for no less than 70 categories including Garlic and Gooseberries – a comprehensive coverage probably relevant for ESS and biodiversity assessments. For projections of the future also climate scenario data are needed, typically gridded products which often come in uncommon projections like the rotated pole coordinates of the EURO-CORDEX modelling domain. How to resample meteorological variables from these to the regions of interest will be touched as well as general problems with data of administrative regions whose boundaries change over time. Already existing approaches for uniform grid representations of spatial data (e.g. based on the pan-European ETRS89-LAEA map projection) are finally presented and endorsed.

Keywords: data availability, International harmonization, preprocessing, spatial representation

11. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Adapting fodder production to climate change in the Alps: A Bayesian analysis to explore robust adaptations despite uncertainties

Presenting author: Nicolas Elleaume

Other author(s): Sandra Lavorel, Johan Ozwald, Bruno Locatelli

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Grassland ecosystems provide important ecosystem services in mountains, especially for agricultural activities dependent on fodder production. These activities are essential in mountains because of their contributions to local economies, culture, and identities. However, as alpine ecosystems are among the most exposed to the consequences of climate change, the future of grassland biomass production is highly uncertain: while an extended growing season could be an opportunity, more frequent and intense summer drought could also reduce the availability and quality of the fodder. Here, we analyze the impacts of climate change on grassland ecosystems with a Bayesian Belief Network built from empirical data (long term monitoring campaign of grassland biomass production in the French Alps) and expert knowledge (to complement empirical data). The model simulates several climate change scenarios and several adaptation actions, such as changes in agricultural practices or land use allocation. Bayesian Belief Networks explicitly integrate uncertainties in the modeling process. Here we integrated several sources of uncertainties including epistemological uncertainty linked to our lack of knowledge of a system, future irreducible uncertainties (as future global emissions of greenhouse gases) and uncertainty linked to natural random phenomenon. Several adaptation actions were conceptualized and tested in the network in order to explore how adaptation could be designed to reduce the negative impacts or increase the positive ones despite uncertainties. Using the probabilistic nature of the Bayesian belief network, results show which adaptation actions show the best robustness (understood as measure of insensitivity of the system to the sources of uncertainty). We discuss the implications of the results for adaptation to climate change in grassland ecosystems and mountain agricultural systems. We also discuss the relevance of a robustness analysis to compare adaptation actions in an uncertain context.

Keywords: adaptation, climate change, uncertainty, grassland, robustness

12. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Landscape deintensification results in higher and more equitable ecosystem service supply

Presenting author: Margot Neyret

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Increasing pressures on dwindling land resources require land governors to identify landscape strategies that simultaneously deliver multiple benefits that best meet the demand of a range of land users. Here, we investigate the effect of land use and land management change scenarios on ecosystem service multifunctionality for multiple stakeholder groups. Our approach relies on comprehensive ecological data for 11 provisioning, cultural and regulating ecosystem services, collected in 300 grassland and forest plots in three regions of Germany, with detailed data on ecosystem service demand collected from 14 interest groups of the same areas. We combine this data in landscape simulations to identify an optimal landscape composition, that maximises multifunctionality for the whole community while maintaining or improving equity in the community (i.e., the consistency in how the demand of different groups is met). We show that while a range of scenarios would significantly increase multifunctionality compared to the current situation, most of these strategies would also strongly increase inequities. Thus, when considering both multifunctionality and equity, the current situation is very close to the optimum. However, small gains can still be achieved through deintensification – e.g., decreasing crop cover, intensifying grasslands and favouring natural forests – which slightly increased multifunctionality without compromising on equity. Overall, the presented approach allows to identify land-use strategies that optimise ecosystem service supply at the landscape level while minimising conflict between stakeholders, and could thus be applied to a wide range of systems to promote the sustainable use of ecosystems.

Keywords: multifunctionality, landscape simulations, land management, land use

13. Type of submission: Abstract

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Participatory scenario design for ecosystem services and biodiversity modelling at landscape level

Presenting author: Martin Schönhart

Other author(s): Monika Suškevičs, Katrin Karner, Claudia Bethwell, Florian Danzinger, Michael Glemnitz, Felix Herzog, Sonja Kay

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Ecosystem service and biodiversity (ESB) modelling at landscape level requires assumptions on exogenous model input parameters. Scenarios are bundles of consistently defined qualitative and quantitative parameters eventually complemented with storylines. They are a powerful tool for stakeholder interaction, model results communication, and landscape planning. Hence, stakeholder participation in scenario design processes may improve the robustness of results, increase its acceptability among stakeholders and supports dissemination of results. Scenarios are a core component of the European ERA-NET BiodivERsA project SALBES (https://salbes.eu/). They include four main components, i.e. the climate, the socio-economic framework conditions of land use, potentially available land use management practices, and local biodiversity actions that may impact land users' choice of practices. A unique feature of SALBES is its use of the Shared Socio-economic Pathways for European agriculture and food systems (Eur-Agri-SSPs; https://eur-agri-ssps.boku.ac.at/). Since these Eur-Agri-SSPs are based on the global SSPs, SALBES can consistently embed its landscape level scenario analysis into global climate change research efforts. The SALBES scenarios encompass three time frames. Near future scenarios (2030) are developed to support policy adaptations and land use management to improve ESB in the short run. Distant future scenarios (2050 and 2080) shall support adaptations in long term management of agricultural land use and related policies. Ex-ante analysis reveals actions and timelines to establish safe operating spaces e.g. by safeguarding green infrastructure and adapting agricultural management. SALBES scenario design is based on a shared protocol. It encompasses several feedback loops between scientists and stakeholders including three regional workshops per case study. We present preliminary results from this process with a specific focus on the nested scenario structure, methodological procedures for participation, the potential value and limitations of the scenarios in ESB modelling, and the theoretical foundations to identify a safe operating space at landscape level in participatory scenario contexts.

14. *Type of submission: Abstract*

S. Sectoral Working Group sessions: S1 – Modelling ecosystem services for defining a safe operating space in European agricultural landscapes

Spatial modelling of farmland economics, biodiversity, and ecosystem services in agricultural landscapes in Switzerland

Presenting author: Sonja Kay

Other author(s): Takamasa Nishizawa, Noëlle Klein, Johannes Schuler, Felix Herzog, Peter Zander

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Agricultural landscapes produce not merely food and fodder, but also provide various ecosystem services for people; farmers and society. The "optimal" interaction between agricultural production and preservation of biodiversity as well as protection of natural resources are much discussed in practice and science. E.g. current research emphasized that monocultures and landscape homogenisation reduce long-term benefits, while biodiversity rich landscapes have a positive effect on agricultural yields. Integrated tools and models assessing the impact of landscapes changes on ecosystem services are needed to understand processes and enable stakeholders to actively manage their landscapes. This need will increase because of potential changes due to climate change, economic transformations, or political decisions. Thus, our aim was to spatially integrate available biodiversity and bio-economic farm models, apply these in landscapes and study the interaction between farming practices and biodiversity to safeguard important landscape elements and facilitate future decision-making. Taking Schwarzbubenland, a traditional cherry orchard region in north-western Switzerland, as an example, we collected management information on farm and production systems, added biophysical data (soil, climate, etc.), mapped habitats and landscapes elements, and studied bird and butterfly data on transect walks. The MODAM model, a multi-objective decision support tool for agro-ecosystem management, was used to simulate land-use changes under farmers´ rational behaviour considering a set of management options as well as biophysical conditions. We clustered the

existing farms into five types using the K-means method according to farm size and production type. The SALCA-Biodiversity model, which was developed on life-cycle methodologies, was applied for biodiversity valuation resulting from different farming practices and spatially simulated land-use changes. The study revealed biodiversity values and the reaction of essential habitats to farming practices, providing information on how farms cost-effectively perform under different management settings. The outcomes will be presented and validated in a participatory approach with local stakeholders.