Participatory scenario modelling of ecosystem services and biodiversity in the Wienerwald region

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Abstract – **The biosphere reserve Wienerwald aims to act as a model region for sustainable development. Yet, species-rich habitats were degraded or lost to a large extent due to land use changes in the past decades. Underlying drivers of such land use changes are uncertain. We aim to understand current challenges of sustainable regional development in the Wienerwald, develop regional development pathways and assess the pathways with respect to the impact on land use, ecosystem services and biodiversity under climate change. We develop nested scenarios in a participatory process and apply an integrated modelling framework consisting of bio-economic farm models and models for biodiversity and ecosystem services. First results show the importance of subsidies and market drivers (e.g. input and output prices) for past land use change. The future development pathways, hence, mainly deviate for these drivers. The vicinity to Vienna determined several developments in each scenario.**

INTRODUCTION

Land use change contributes globally to the unprecedented biodiversity loss, deterioration of ecosystems and the climate crises (IPCC 2019, IPBES 2018). The latter poses itself a risk for future agricultural land use, ecosystem functioning and biodiversity. The biosphere reserve Wienerwald (WW) region in Austria aims to act as a model region for sustainable regional development, e.g. halt biodiversity loss while allowing sustainable economic activites in the region. The region is characterized by forests (70%) and grassland (12%). Extensively managed grasslands, i.e. with maximally two annual cuts, provide a valuable habitat and contribute considerably to the high biodiversity in the region. Yet, the area of extensively managed grassland declined from 11,140 ha to 4599 ha during the period of 2015 to 2021. Most of these former extensive grasslands were intensified, others abandoned. Future land use changes are uncertain and generally depend on a multitude of drivers, such as the development of markets or policies. Scenarios allow to account for underlying uncertainties of the development of drivers. Scenarios can also be useful to challenge stakeholder discussions on sustainable regional development pathways and inform policy- and decision-making (Wright et al., 2013).

We aim to (i) understand arsing challenges related to sustainable regional development characterising the current situation in the WW region, (ii) develop plausible regional development pathways for the WW region for 2050 in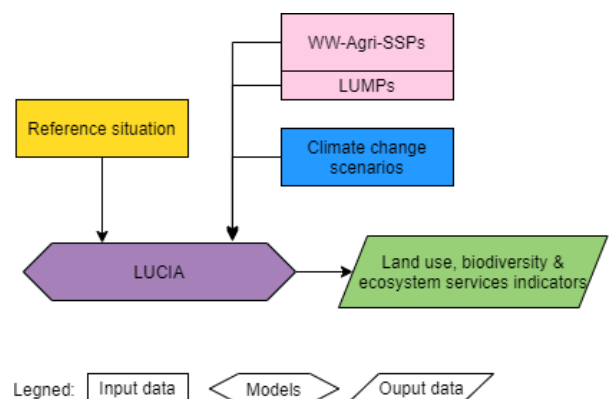 a participatory process and (iii) assess the impact of the pathways on agricultural land use, land cover, ecosystem services and biodiversity. The presented research is part of the international research project SALBES, in which scenarios for four European case study regions are developed and assessed.

METHODS

We conducted interviews in the WW in order to contribute to research aim (i). We have interviewed in total eleven farmers, representatives from farming associations, nature protection NGOs, administration, as well as civil engineers with a background in landscape planning and biodiversity. These interviews and additional statistical data have informed the story of the present, which builds the basis for the participatory scenario development. The following figure 1 gives on overview on the conceptual model for achieving the research aims (iii) – (iii).

Figure 1. Conceptual model of the scenario workflow in SALBES

LUCIA is an integrated modelling framework consisting of bioeconomic farm models and models for ecosystem services and biodiversity available at the entire project consortium. LUCIA will be used to assess first the reference situation informed by the

story of the present and then participatory future regional development pathways, i.e. socioeconomic scenarios, and climate change scenarios until 2050. The socioeconomic scenarios are developed within the SSP logic and are consistent with the larger scale Eur-Agri-SSPs and the AT-Agri-SSPs. The AT-Agri-SSPs describe five scenarios for the Austrian agriculture and food system (AFS), developed along the two axes of challenges for climate change mitigation and

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challenges for climate change adaptation. The AT-Agri-SSPs describe the average Austrian development of 79 drivers of the AFS. We have discussed the framework conditions described in the AT-Agri-SSPs with regional stakeholders from the WW in an online workshop. The stakeholders identified those drivers, that deviate regionally from Austrian averages. LUCIA furthermore requires details not yet provided by the AT-Agri-SSPs, such as the development of arable farms or ruminant farms in the WW. The interview and workshop results were used to build the WW-Agri-SSPs, consisting of a short narrative consistent with each AT-Agri-SSPs and a parameter table. These results are sent to the stakeholders and discussed in a second online workshop in May 2022. In total, three WW-Agri-SSPs were developed (WW-Agri-SSP1, WW-Agri-SSP2 and WW-Agri-SSP5). LUCIA also requires a specification of new land use and management practices (LUMPs) consistent with each WW-Agri-SSP. These LUMPS are discussed in the second online workshop as well. Additionally, two different climate change scenarios are assessed with LUCIA: RCP4.5 and RCP8.5.

LUCIA will then be used to assess the impact of the WW-Agri-SSPs and the climate change scenarios on land management, land cover, landscape composition and selected ecosystem services and biodiversity indicators, based on the interview results. Final quantitative LUCIA results are expected to be available in autumn 2022.

RESULTS

The interview results, as summarized in table 1, give an overview on the drivers, which are perceived as most relevant for land use change, changes in the provision of ecosystem services and biodiversity loss in the WW region. Mentioned land use changes were, for instance, a reduced density of sheep/cattle on grassland due to climate change, larger field sizes due to larger machinery or an abandonment of grasslands due to an insufficient ratio of input and output prices. Interviewees mentioned the important role of subsidies for agri-environment-climate measures which still enabled an economically efficient yet very extensive management of grasslands (i.e. one cuts). Grasslands with one annual cut increased indeed in the area, while total grassland with two or less cuts annually declined substantially. All interviewees mentioned food production and recreation as important ecosystem services in the region. Soil fertility, protection of habitats and biodiversity were often mentioned as well, however changes thereof were overall rarely perceived.

The WW-Agri-SSPs deviate in particular regarding policies. For instance, in WW-Agri-SSP1 agri-environmental-climate funding increases strongly, while it is abandoned in WW-Agri-SSP5. Stakeholders defined common developments e.g. for land prices, which increase due the vicinity to Vienna. The framework conditions in WW-Agri-SSP1 describe many opportunities for agricultural production in the WW, while they are less favourable for agricultural production in the WW in WW-Agri-SSP5.

Table 1. Key interview results for the WW region

Driver category (description)	Mentioned impact on…		
	Land use	Ecosystem services	Bio-diversity
Climate change (e.g. less/ seasonally different precipitation)	very often	partly	partly
Technology (e.g. size of tractors, GPS tractors)	often	rarely	partly
Economy (e.g. input and output prices, availability of workers)	very often	rarely	often
Politics (e.g. ÖPUL)	very often	partly	often

Legend: ◔ rarely (1-25%), ◑ partly (26-50%), ◕ often (51-75%) and ● very often (76-100% of interviews)

DISCUSSION AND CONCLUSIONS

The nested scenario approach applied in SALBES allows to maintain comparability among several regional case studies and consistency with larger scale scenarios, while allowing an in-depth analysis of each case study. The scenarios for the WW region revealed the need to account for the sub-national scale as well. In the scenario development process, the vicinity to Vienna appeared to play a major role leading to fewer differences among the scenarios compared to the Austrian or European scale. For instance, recreation in the WW by the inhabitants of Vienna was found to be important in each scenario. The impact of the scenarios on land use, ecosystem services and biodiversity will be revealed with a modelling framework, also accounting for climate change scenarios. The final results will be of particular relevance for regional decision-makers and representatives from the biospheres reserve and administration, who participate during the entire project phase and showed great interest so far.

ACKNOWLEDGEMENT

REFERENCES

IPBES (2018). *The regional assessment report on biodiverstiy and ecosystem services for Europe and Central Asia*. Rounsevell, M. et al. (Eds.).

IPCC (2019). *Climate Change and Land - An IPCC Special Report*.

Wright, et al. (2013). *Does the intuitive logics method – and its recent enhancements – produce "effective" scenarios?* Technological Forecasting and Social Change, 80, 631–642.