TRANSITION PATHWAYS TO SUSTAINABLE LOW-CARBON SOCIETIES

LAND USE & BIODIVERSITY

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Challenges towards more biodiversity friendly landscapes

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Context

Biodiversity has been declining steadily over the last decade. Habitat loss due to land use change is often considered to be a primary driver for biodiversity decline (Pereira et al. 2012), next to land degradation and fragmentation, disturbance, climate change and pollution. The pressure on land use will increase, as global population is expected to increase from around 7 billion in 2010 to 9.2 billion by 2050, increasing food consumption by 1.7 times and wood consumption by 1.3 times (Vuuren van & Kok 2012). These developments will lead to further habitat and biodiversity loss. In Europe, other factors that could influence future biodiversity include the increase in urban areas and infrastructure (e.g. roads), changes in forest cover (substitution of native forest), farmland abandonment, and intensification of the agricultural sector. To deal with current and future pressures of land use, and its impacts on biodiversity, a diverse set of measures is required.

The EU FP7 project PATHWAYS explored the possibilities for transitions to a low-carbon, biodiversity-rich, sustainable Europe by combining the analysis of different scientific approaches: integrated assessment modelling, socio-technical transition analysis, and case studies and participative action research. Integrated assessment modelling can provide a macro perspective, linking future goals to short-term actions. Integrated assessment modelling also allows linking different policy issues, such as biodiversity protection and climate change. Socio-technical transition studies seek to explain long-term shifts, taking account of a broad set of institutional, economic, social, and cultural factors, including those enabling behaviour change and adoption of new technologies. Participative action research, finally, engages with concrete projects at the local and regional scale involving diverse social actors such as citizens, businesses, civil society organisations and (local) government, with the aim of fostering innovation and upscaling innovative sustainability solutions.

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Available for downloading at http://www.pathways-project.eu/

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Key Messages

There are multiple aggregated measures of biodiversity

Biodiversity has different functions and as a result different indicators can be used to measure biodiversity. Moreover, even when a specific definition is chosen, the impacts of key driving forces, such as land use, on biodiversity are complex. For instance, the impact of land use does not only depend on the amount of land used, but also on the type of land use and the specific pattern. Furthermore, the way in which the land is used, its intensity and extent, can impact biodiversity differently.

The PATHWAYS project analysed two alternative pathways that are consistent with achieving the long-term goals for climate and biodiversity. In Pathway A the current regime remains strong, and incumbent actors mainly search technology substitution responses to the current challenges. In pathway B, new actors come in creating a total regime shift with more radical response strategies. For land use and biodiversity, Pathway A can be translated in a future with highly efficient agriculture, separation of nature and agriculture, precision farming, genetically modified crops and livestock, and enclosed environments for animal husbandry. In Pathway B, land-use and biodiversity goals might be met by lower meat and dairy consumption and reduction of waste. Moreover, in this scenario agriculture and nature protection could be combined creating mosaic landscapes, with ecological reserves in high-production areas.

Different strategies can be pursued to preserve biodiversity

One strategy to preserve biodiversity could be to invest in intensive farming to fulfill increasing food demand, which will reduce the amount of land needed for food, opening up opportunities for land to be used for other purposes (Figure 1). Species associated with "natural areas" (e.g., forest species and other non-farmland species) will expand as more habitat becomes available, mostly due to farmland abandonment. Farmland species will see their range constricted to the more intensively used areas, and those more sensitive to change will disappear. In short, changing to a more intensive farming system will cause a loss of farmland and a gain in forest and other non-farmland species. In contrast, a strategy aimed at extensive agriculture and integrating farming with biodiversity functions will favour farmland species, while forest species might decline (Figure 2). In the end, it is a political/societal choice on which strategy the focus will be.

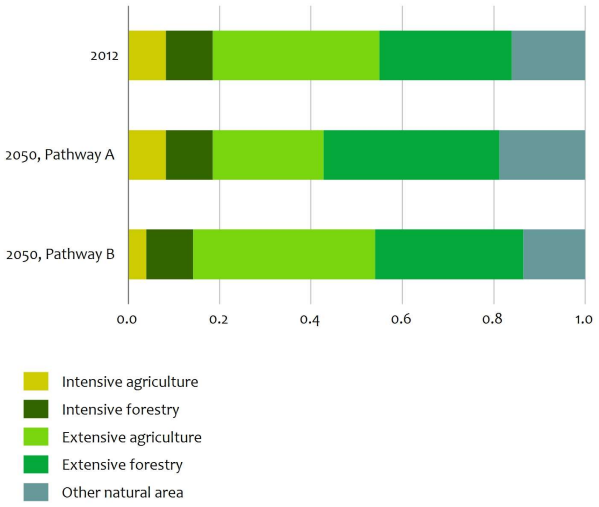
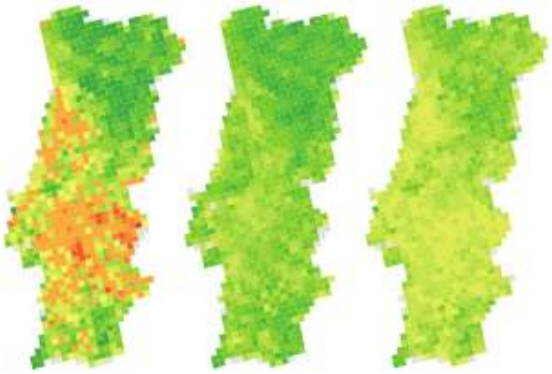


Figure 1 *Shares of different land use classes in Portugal. Source: Results from the PATHWAYS project. For an explanation of the two pathways, see text box on this page.*

Forest species



Farmland species

Figure 2 *Maps of change in species richness by 2050 in Portugal. The maps on the left represent a scenario where current trends of land use remain as they are (leading to further decline); the maps in the center represent Pathway A; the maps on the right represent Pathway B. Red colored cells indicate a mean loss of species relative to 2010, and green-colored cells an increase. Source: results from the PATHWAYS project. For an explanation of the pathways, see text box on page 2.*

It is important to focus on a wide range of different functions and indicators

Species diversity is key for a rich and diverse set of ecosystem services (Mace *et al.* 2012), therefore it is essential to aim for a diversity of habitats in order to sustain higher levels of biodiversity. Although it is unavoidable that there will be some loser species independently of the chosen plan of action, conservation efforts should be implemented to safeguard these species and/or strategies to maintain their habitats requirements within the landscape, thus minimizing losses. For instance, the impact on farmland species could be mitigated by maintaining patches of extensive agriculture, or by reintroducing large herbivores to limit secondary succession.

Optimal biodiversity strategies depend on the local situation

As indicated above, there are different strategies in preventing further loss of biodiversity. It is clearly not preferable or even possible to implement the same measures everywhere in Europe: the national and sub-national landscape context needs to be taken into account in the development of policies promoting a given conservation measure. For example, in the Netherlands, a land-sharing strategy seems to produce strong biodiversity benefits, as the agricultural landscape is already very intensive. In contrast, in Portugal, land-sparing strategies present interesting opportunities, as there is enough margin for intensification on existing agriculture areas. However, even here further details need to be looked at. For instance, a sparing strategy is likely to only benefit biodiversity in the centre and north of Portugal, regions currently under large-scale farmland abandonment pressure. In contrast, most of the south of Portugal is characterized by a well-established agro-forestry system (i.e. land sharing). This multifunctional landscape not only supports high levels of biodiversity and ecosystem services, but plays a very important role in the Portuguese economy. Therefore, it is important to select the preferable measure in

terms of improving the state of biodiversity, considering not only the biodiversity outcomes but also the existing social-economic context of the region. The latter implies that for successful implementation, both stakeholders and practitioners should be engaged to improve social acceptance of land use and biodiversity measures.

Biodiversity strategies are more likely to be successfully implemented if they also contribute to other societal goals

Land use is related to a large number of different functions, and thus the interest of many actors (including farming, tourism, housing, nature protection, water management). While strategies may look optimal from a biodiversity perspective alone, it will be hard to implement them if they are not combined with other functions. This is for instance shown by the "Room for rivers" program in The Netherlands, where biodiversity benefits are combined with the need to protect the country against river flooding. Greening of cities to improve livability and health is another good example of a strategy that combines several functions.

A radical transition in land use is not expected to happen in the coming decades

The speed of transitions in land use is limited by natural characteristics, as well as existing lock-ins. Therefore, changes are expected to only occur slowly, such as in the case of land tenure and agricultural production regimes. Similarly, rural depopulation trends are hard to reverse and ecological restoration processes are slow. The inertia in land use has important consequences. For instance, if restoration is costly (e.g. for land-owners) and its positive effects take several years to emerge, it might be difficult to convince the public that a shift is needed. Still, to achieve results in the next decades, it is important to start implementing sustainability measures early and develop them quickly – such as measures to improve agricultural productivity and efficiency.

Biodiversity depends more on policy decisions in other areas than in nature. Therefore, integration of 'biodiversity' concerns with other areas of decision-making is needed

Biodiversity futures critically depend on policies with respect to agriculture, spatial planning, energy use, mobility, housing, recreation, water management, and climate change. This means that broad strategies are needed to reach biodiversity goals. This is challenging for the analysis of biodiversity strategies as these will need to take account of the interactions. Moreover, in policy making it means that biodiversity goals cannot be implemented just by nature policies.

EU policies on land-use activities such as agriculture have large impacts on national policies

While each country has its own specific opportunities and challenges, indicating the importance of national policies, national policies need to be formulated within the boundaries set by European policies. The CAP (Common Agriculture Policy) is an important EU wide policy instrument. To allow more biodiversity friendly land-use decisions, European policies should account for the diversity of landscapes. As biodiversity is not bounded by national borders, it is important to have a European approach towards biodiversity. A European approach can also take account of cross-border issues (for example, if one country decides to

quit production of animals, it is likely that another country will produce more). When looking at biodiversity and land use from a European perspective, decisions can be taken in which areas the focus will be on agricultural production and which areas are more suitable for developing nature.

A successful biodiversity strategy will require strong commitments from policy-makers

Depending on the local situation and policy choices, biodiversity policies might require deep transformations. These could include reform of agro-environmental subsidies, changes in dietary patterns, further agricultural intensification, and changes in current demographic patterns in rural areas (increasing attractiveness of rural areas by e.g. public infrastructure, tax benefits). These considerations highlight the crucial role of actors, at every level of society. One of the major drivers as well as locked-in forces is society. Ultimately, transitions can be operated if relevant actors change their commitments, strategies, investments, and behaviors. It is essential to observe a joint effort of society, government, NGOs and other institutions for change to result in a more sustainable use of the land, and lowering the impact on biodiversity.

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About the PATHWAYS project

The EU FP7 project PATHWAYS is a unique project that explores the possibilities for transitions to a low-carbon, sustainable Europe. The essence of PATHWAYS is that it combines the analysis of different scientific approaches: integrated assessment modelling, transition science research, and participative action research. By combining and coordinating information from these different approaches for selected cases, PATHWAYS aims at providing better policy advice for European, Member State and local policy-maker.

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