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***Prospective Environmental analysis of Land-Use Development in Europe:  
From participatory scenarios to long-term strategies***

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## 1 Introduction

Our environment is changing at faster speed than ever. Decision-making has become far more complex, and uncertain. At the same time, many of today's pressing policy problems are of long-term nature, for example climate change or demographic developments in Europe. Designing policies that are robust in the long run is a crucial challenge for policy-making in the context of earth-system governance.

Over the last years, much progress has been made in understanding future trend developments and related consequences. Many facts about the long-term impacts of climate change or of demographic developments are known by now, for example. Long-term studies have been developed to scan the future of agriculture, transport and energy, climate change and air pollution. More and more governments are starting to assess ex-ante the impacts of their policy proposals (Jacob, Hertin, Volkery, 2007).

However, there are still major shortcomings. Most studies focus only on one sector or one dimension of a problem, miss inter-linkages and feedback or focus on short time-spans. Many studies are built around the extrapolation of current trends to a distant future. While this approach is handy for short-term assessments, it is doubtful, whether it is sufficient for long-term assessments alone. In the long run, trend discontinuities may become the norm, rather than the exception, not to forget surprising disruptive events (like September 11<sup>th</sup> or the abrupt increase in oil prices). Business-as-usual scenarios imply a rather mechanistic worldview that struggles to represent the complexity of future dynamics and its potential for disruptive change.

In an increasingly changing and uncertain world, we need tools to better address discontinuity and map out uncertainties. Developing contrasting scenarios has gained prominence as an approach to analyse the future in a creative, yet structured and integrated way, not only among international companies like Shell, but also among international organisations and governments. The most prominent examples are the IPCC SRES scenarios or the Millennium Ecosystem Assessment scenarios (MEA, 2005).

An analysis of future patterns requires good data and scientific rigour, but also imagination and expertise from different perspective. Scenario development offers a framework to combine such imagination, data, modelling and viewpoints. While scenarios are starting to become a widely used tool, conceptual and methodological issues require further clarification. From our point of view, three main challenges are:

- Managing the participation of key stakeholders in scenario development
- Using scenarios for strategic planning and long-term strategy analysis
- Improving the representation of socio-economic driving forces

*Participatory scenario development* has received much attention in the recent literature. Bringing together a multitude of perspectives and different types of expertise is supposed to enhance the *information basis*, *relevance* and *originality* of the exercise. Feeding different societal perspectives into the scenarios process does not only address relevant policy concerns in a better way, but can also present broader, innovative and more appealing analysis than studies that are based on the views and expertise of one societal or research community only. Broad participation is also supposed to enhance the *credibility* and *legitimacy* of the scenarios.

Scenario development like this creates a “learning space” for policy-makers, societal stakeholders and scientists. This “learning space” allows for challenging assumptions, thinking about different institutional options and discussing potential robust strategies. Such an approach blurs the boundaries between decision-makers and scholars to a certain extent, as they are engaged in a joint learning process. However, in spite of a growing body of literature we are still in the early stages of learning how to deal effectively with participatory scenario development.

Furthermore, scenario development is not an end in itself (Wilson 2000). It is important to *move from scenario development to strategic planning and decision-making*. Surprisingly, however, scenarios are seldom taken to that stage in public policy. If scenarios are developed, they often stay on the shelf afterwards. Cultural barriers can explain the problems to implementation to a certain extent. To our experience, policy-makers often regard alternative scenarios more confusing and less helpful than a clear-cut single-point forecast. Furthermore, admitting not to know where to go can be interpreted as incompetence.

However, part of the problems also lies in the way many scenario studies are conducted. Many studies rightfully aim to provide scientific correct information to decision-makers. However, they often leave out – or say little – about the strategic implications. Furthermore, they often lack well-formulated, compelling scenario storylines. Storylines are often quoted rather perfunctorily as short paragraphs only. The main attention is directed towards the quantitative analysis. Inconsistency between qualitative and quantitative analysis is a quite common phenomenon (Grove, Lempert 2007). Compelling storylines are, however, a major asset of scenarios as it is mainly them that challenge mind-sets and enable to “think outside the box” about new threats, challenges and strategies. From our experience, this function of scenarios is most often welcomed by decision-makers and key stakeholders.

The scope of scenario development has been broadened over the recent years to combine the assessment of changes in the bio-physical environment with simultaneous changes in the socio-economic environment. While this development is to be welcomed, a broader analysis of driving forces also increases problems of maintaining analytical consistency and coherence. This requires a *better representation of socio-economic driving forces* in integrated assessments. From a social science point of view, many studies work with rather simple assumptions regarding governance patterns or institutions. Furthermore, in terms of more formal strategy analysis, we are still in the early phases of learning how to design effective approaches for long-term policy analysis (Lempert 2005).

Creating policy-relevant scenarios is a major challenge, both in terms of informing political decision-making (content) and initializing common learning and networking among policy-makers and key stakeholders (process). Our hypothesis is that the latter is as important, if not more important sometimes, as the first and should receive more attention in future research.

This paper illustrates the three topics discussed (with a stronger focus on the first two ones) above with findings from a participatory land use scenarios project that was recently concluded at the European Environment Agency (EEA). In the PRELUDE project (*PRospective Environmental analysis of Land Use Development in Europe*),

policy-makers, researchers, representatives of interest organisations and independent thinkers from across Europe were brought together to develop five different scenarios how Europe's environment could change until 2035. Their storylines were analysed with the help of quantitative land use simulation models that produce land use/cover maps for the EU-25 plus Norway and Switzerland (*problem analysis*). Subsequently, representatives of European institutions, Member States and interest organisations have been invited to discuss implications for the design of robust policy strategies in three outreach workshops in 2005 and 2007 respectively. The second workshop focused in particular on approaches for preserving high-nature value farmland areas (HNVF) in the EU (*strategy analysis*).

The article is structured as follows: In the next chapter we use a short analysis of the problems related to the change in land use and cover as a starting point for discussing the related requirements of long-term scenario development. Accordingly, we propose a methodological framework for participatory scenario development. In chapter 3 we provide an overview of the approach and findings of the PRELUDE project. Chapter 4 describes our experiences in developing participatory scenarios, while chapter 5 presents lessons learnt in the outreach process. We end the paper by discussing the policy issues that arise from the scenario analysis and the related methodological challenges for research. Due to time constraints this discussion is still rather brief.

## **2 Building compelling land use change scenarios – the case for participatory scenario development**

Changes in land cover and use are a pressing challenge to sustainable development in Europe. Rich mosaic landscapes, often shaped by traditional farming practices, are part of the common cultural and natural heritage of Europe. They contain many hot spots of biodiversity. As an attraction for tourists, they also play an important economic role. Land is a limited resource in Europe. The need for resources and space and the capacity of the land to absorb and support this need can lead to use conflicts. Change in land cover and use can endanger the integrity of natural resource systems and the output of ecosystem goods and services, which can impact on the well-being of people (EEA, 2006: 6).

A range of policies has been set up at the European level and within the Member States, most notably the European Landscape Convention, the Habitats Directive or the Water Framework Directive (EEA 2005). A cross-section of EU policy areas ranging from agriculture to transport and environmental protection to regional development will be affected by the need to preserve the European landscape. The sustainability of agriculture and regional development, for example, has become a key objective of recent reforms of the European Common Agricultural Policy or the new guidelines for the European rural development policies (see Swinbank, Daugbjerg, 2006).

However, these reforms - and related impact assessments - still tend to operate within the confines of a five-to-seven-year cycle at best. This is at odds with the long-term consequences that many of the decisions will have. Europe will spend the large majority of the approximately 868 billion Euros budget over the next financial perspective (2007-2013) on agriculture, regional and cohesion policies. Furthermore, Europe is at the crossroads of major policy reforms that will have a decisive influence on the socio-economic and environmental development in Europe's regions over coming

decades. This concerns, for example, the implementation of the new European Agriculture Fund for Rural Development (EAFRD), that entered into force 2007 or the announced “health-check” of the Common Agriculture Policy for 2008, which might lead to major reform discussions in 2009, centred around the mid-term review.

Against this background, long-term alternative scenarios can provide a framework in which potential effects and effectiveness of different policy options can be discussed and assessed (see Busch 2006). Scenarios are neither a forecast nor a prediction but can be understood as a “coherent, internally consistent and plausible description of a possible future state of the world” (Nakícenovíc et al., 1994). Scenarios come, however, in many variants (Godet et al., 2004, van Notten et al., 2003, EEA, 2000). For example, the IPCC scenarios stem from a highly formalised process that involves only expert scientists from specific disciplines. Here, a clear distinction between scientists and political stakeholders is drawn (EEA, 2001a). On the other hand, exercises like the Millennium Ecosystem Assessment of the United Nations involve political and other societal stakeholders into the process of scenario development (MEA, 2005).

Over the last years, a number of arguments in favour of participatory scenario development have been developed in the literature, according to which participation helps to (Welp et al., 2006; Kok et al., 2006; Pahl-Wostl, 2002a; van Asselt, Rijkens-Klomp, 2002; van Kerckhoff 2001):

- give access to practical knowledge and experience, learn about new problem perceptions and identify new challenging questions,
- bridge gaps between the scientific communities and governments, businesses, interest groups or citizen, thus providing a reality check for research assumptions and methodology,
- improve communication between scientists and stakeholders and facilitate collaboration and consensus-building on problem-solving and
- increase the salience and legitimacy of the scenarios<sup>1</sup>.

An approach that has been designed to combine the strengths of participatory qualitative scenario development with quantitative model analysis is the ‘story-and-simulation’ (SAS) approach (see EEA, 2001)<sup>2</sup>. Its main parts are (Figure 1):

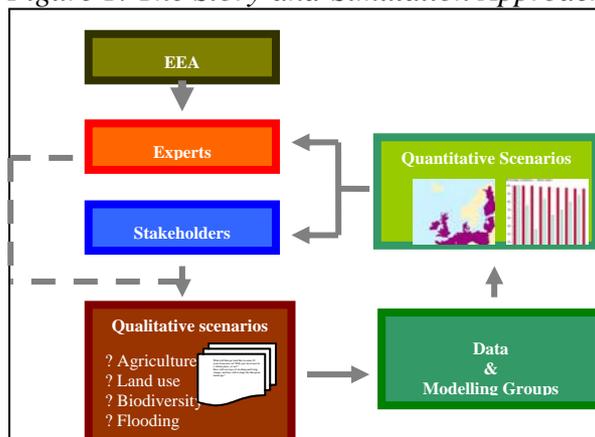
- A group of stakeholders develop qualitative storylines, based on in-depth discussions about key uncertainties and underlying driving forces of social, technological, economic, environmental and political development.
- Experts translate this information into quantitative model input and underpin the qualitative storyline with quantitative results.
- Stakeholders and experts engage in an iterative process of refining storylines and quantification until a set of compelling, plausible and relevant stories and simulations about the future is reached.

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<sup>1</sup> Whereby the term “salience” refers to the ability of the scenario exercise to address the special concerns of users, i.e. convince that the results are relevant to support decision-making processes, whereas the term “legitimacy” refers to the perceived fairness of the exercise, i.e. the users are convinced that their interests have been taken into account in a fair way and that the assessment is not one-sided. “Credibility” is the third attribute of a successful assessment (EEA, 2001a).

<sup>2</sup> See for a comprehensive discussion of the approach Volkery et al., 2007.

Figure 1: The Story-and-Simulation Approach



Source: EEA 2007

### 3 Scenario development in PRELUDE

Land use change cuts across a wide range of policies and affects many social interests. Accordingly, it was decided to go for a wide participatory approach in PRELUDE. Following the SAS-approach, a stakeholder panel was set up in the beginning of the project. The panel consisted of up to 30 stakeholders and experts from across Europe with a broad diversity of backgrounds. This included policy-makers, academic researchers, representatives of interest groups and independent thinkers. In order to create an atmosphere of trust and to create ownership for the process, it was a deliberate decision to give stakeholders full responsibility for defining driving forces and create storylines. EEA as the sponsoring organisation and the involved modellers took a step back and supported the stakeholders in their work (Volkery et al., 2007).

The EEA organised three workshops to develop the PRELUDE scenarios. Each workshop lasted for three days. Experienced facilitators conducted the working sessions in order to arrive at the final storylines. The first workshop focused on identifying key uncertainties, driving forces and the scenario logics, as well as considering potential land-use related environmental impacts. After the workshop the draft scenarios were reviewed by the EEA project team and a scenario analysis support group that comprised land-use experts and modellers also present at the workshops. The draft scenarios were then quantified using spatial explicit data from land-use simulation models.

The objective of the second workshop was essentially to revise the first round of model results, check for inconsistencies, and refine the scenario storylines in view of the modelling data. Interaction between modellers and stakeholders resulted in the translation of the narratives qualitative statements into numerical valuations (see section 2.3). These numbers were further calibrated based on modelling data from existing relevant exercises. Subsequently, the model results were revised to accommodate the changes agreed during the workshop. In addition, efforts were made for improving the communication of the scenarios, including multimedia illustration and editing of the narratives. The third workshop had three objectives: a) a final review of the five scenarios, b) a review of the environmental impacts of the scenarios and c) a process to build consensus among participants concerning the final PRELUDE results, main products and future dissemination initiatives.

The PRELUDE scenarios combine the assessment of changes in the bio-physical environment with simultaneous changes in the socio-economic environment. Whereas environmental change scenarios have been widely developed, socio-economic change scenarios are less well developed. They mainly focus on qualitative descriptions. This is especially true for the construction of integrated long-term scenarios for land use change, which face the problem of integrating a set of different driving forces within a consistent framework of analysis (Rounsevell, Ewert, Reginster, et al., 2005).

Stakeholders categorised a broad variety of driving forces that influence different land use types and land use change in Europe. Consequently a common basis for comparison was needed. This was done in the following step wise approach:

- “Influence chains” were generated by the group. Influence chains and general driving force categories were used to derive a consistent set of 20 driving forces.
- The magnitude of change of the driving forces was qualitatively valued for each scenario on a scale from 0 (minimum value) to 10 (maximum value).
- Qualitative values were transformed into quantitative values as model input, based on past data and existing authoritative scenarios for other issues (i.e. IPCC SRES scenarios).

*Figure 2 Driving forces in the PRELUDE project (base year 2005, 0=minimum, 10=maximum)*

<b>Driving Force</b>	<b>Qualitative Value</b>	<b>Driving Force</b>	<b>Qualitative Value</b>
Subsidiarity	4	environmental awareness	5
policy intervention	5	economic growth	5
settlement density	7	international trade	7
population growth	2	daily mobility	6
ageing society	8	self-sufficiency	8
immigration	3	technological growth	5
internal migration	3	agricultural intensity	5
health concern	5	climate change	8
social equity	5	renewable energy	6
quality of life	5	human behaviour	5

#### *EEA 2007*

Stakeholders developed a set of five very different, yet consistent storylines of how Europe could evolve until 2035. The five PRELUDE scenarios are:

1. Great Escape - Europe of contrast
2. Evolved Society - Europe of harmony
3. Clustered Networks - Europe of structure
4. Lettuce Surprise U - Europe of innovation
5. Big Crisis - Europe of cohesion

Following, we give a very brief overview of the key characteristics of the scenarios. A full description can be found in EEA, 2007.

*Great Escape:* This scenario is driven by globalisation, decreasing solidarity and passive government. Societal tension builds up as relatively poor immigrants move to urban city centres. Climate change affects the growing conditions for agriculture. The agricultural market is liberalised and only large-scale farms with intensive management survive the pressure from the world market.

*Evolved Society:* Main ingredients in this scenario are an energy crisis, growing environmental awareness and active rural development. Serious flooding occurs and people leave the most vulnerable areas. They rediscover the countryside where small-scale organic farming, supported by strong policy measures, increases.

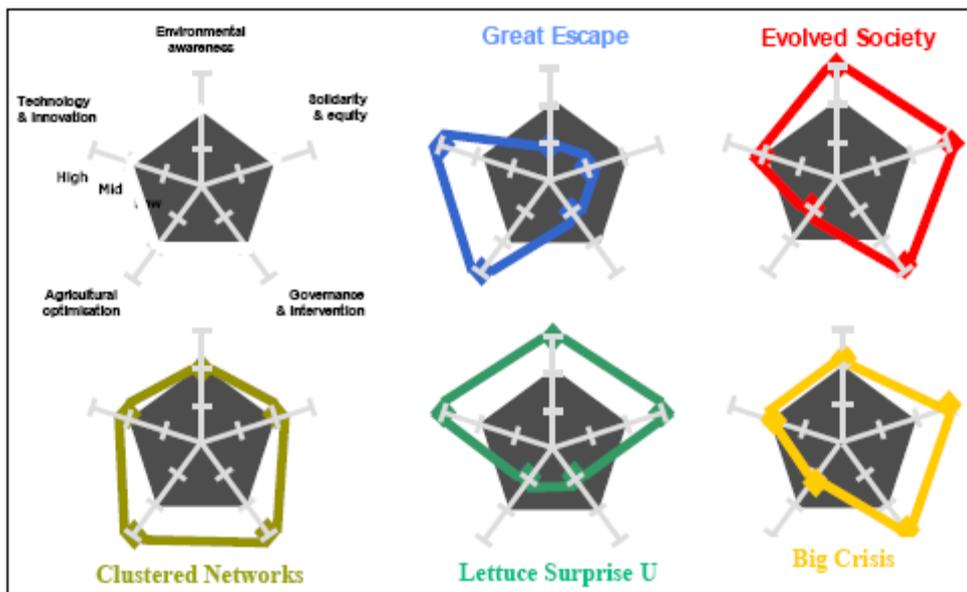
*Clustered Networks:* This scenario is all about optimization of land use and strong spatial planning in response to an ageing of society and a declining agricultural sector. Climate change is a less prominent driver in this scenario.

*Lettuce Surprise U:* The essential drivers here are growing environmental awareness, technological innovation and decentralisation. Agriculture revolutionises, facilitated by open source mentality and propagation of knowledge. Production becomes small scale and less intensive.

*Big Crisis:* In this scenario climate change related disasters and increasing solidarity are all-important. Floods and droughts affect many people and trigger strong European policy interventions, aimed at a balanced regional development.

The scenarios cover a wide spectrum of possible developments of drivers of change in society, economy, governance, environment and technological invention. Figure 3 shows simplified spider diagrams (developed on the basis of the 20 driving forces that were initially developed) that illustrate the key characteristics of each scenario.

Figure 3: Simplified spider diagrams of the PRELUDE scenarios



#### 4 Managing participatory scenario development effectively – lessons learnt and challenges

The PRELUDE project was based on the assumption that the participatory development of long-term, contrasting scenarios adds useful value to already established decision support tools in earth system governance. This is supported by most of the related literature. Participation in scenario development is, however, a complex matter. Problems can arise easily (see the discussion in van de Kerkhoff, 2001). Of particular concern are two aspects: the *advocacy-discourse dilemma* and the *science-policy dilemma*. While the PRELUDE project could successfully avoid the first dilemma, problems arose with regard to the second dilemma.

The *advocacy-discourse dilemma*: Diverging interests, conflicting views and possible hidden agendas of participants can lead a scenario process easily into a stalemate, where an open-minded discourse would be needed instead. Stakeholders often have clearly defined interests in the outcome of a scenario exercise, especially if the scenario exercise deals with a contested issue where policy decisions are to be shaped. They might not subscribe to an open-minded discussion about future developments. The process then can be easily perceived as too “politicised” which might undermine the credibility and legitimacy of the assessment. At this stage new thinking beyond prevailing mind-sets is utterly hampered. Rather than building consensus, participants tend to defend their positions and dismiss others. The consequence is a locked-in thinking that fails to challenge strategic paradigms.

It is therefore important to select stakeholders who are able to abstract from their background to a certain extent and are open for discussing new perspectives, but still obtain a relevant decision-making position. There are, however, no success criteria for this exercise. It may take quite some time. It is also necessary to engage a competent, professional facilitator who can win the trust of participants and can reveal and sort out interest conflicts in the beginning (Toth, 2001). Otherwise, trust relationships among participants are difficult to build, which is a key success factor: if single stakeholders manage to manipulate or even capture the process, it will lose its credibility for other participants and they might even disengage from the process. If there is a lack of consensual support, ownership and rules of engagement, scenarios lose their trustworthiness and authority (Selin, 2005). To build trust, several iterations of the process are needed, which can be a time-consuming endeavour too<sup>3</sup>.

However, overcoming the advocacy-discourse dilemma does not only require the right selection of participants and competent facilitation. It also requires active engagement of stakeholders. Giving stakeholders full responsibility for storyline development is one way to overcome the advocacy-discourse dilemma, as it increases ownership for the whole process. The development of alternative scenarios also ensures that all interests at stake can be displayed in one or the other manner.

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<sup>3</sup> Several techniques have been developed over the years to create the conditions for effective brainstorming on innovative scenario input. Their applicability depends on the aims and objectives of the scenario exercise. They should be, however, not the subject of discussion here (see Slocum, 2003; Toth 2001 for extended discussion).

The *science-policy dilemma*: It is a well-described fact that the role of scientific support for decision-making changes, if problem complexity and uncertainties are high and the prospects of reducing uncertainties with additional scientific research are rather low: Instead of producing “objective” assessments, scientists then have to join other actors to “co-produce” relevant knowledge (see Pahl-Wostl, 2002b). This means that scientists have to accept that other actors can have an equal, sometimes maybe even more important, role to play in the conduct of assessments.

Managing these interactions between stakeholders and scientific experts can be difficult, as they attribute different weight to the credibility, salience and legitimacy of a scenario exercise (Eckley, 2001). Stakeholders usually tend to be more concerned with the political salience of the exercise, i.e. they focus on wider assessments, incorporate a broader range of factors and usually pay less attention to quantitative modelling requirements. This can encounter resistance by scientific experts who tend to be more concerned with the credibility of the exercise. They tend to focus the assessment more narrowly and avoid considering input factors that are difficult to measure, and might therefore reject creative scenario input by stakeholders as unreasonable and not complying with scientific standards. Scenarios might lose, however, their legitimacy for stakeholders and end-users, if they feel that their input has not been taken properly into account (Eckley, 2001).

The benefits of running a broad participatory approach to scenario development are visible in the content of the PRELUDE scenarios. Bringing together a broad group of stakeholders ensured that a set of interesting, contrasting and innovative scenarios could be developed. The prerequisite for creative and open-minded discussion was to give stakeholders responsibility for making final decisions about the content of the qualitative analysis and related storylines. PRELUDE turned from being a project of the EEA to a project of up to thirty people working very hard on it.

But the stakeholders did not only manage to create interesting stories. Moreover they developed a strong trust in the validity and suitability of their problem analysis. Nearly all felt a strong feeling of ownership for the scenarios in the end and did not leave the process. Furthermore they publicly endorsed even the scenarios that implied negative implications for their own organisation, because they accepted them as a plausible analysis. The project was thus successful in bridging gaps and improving communication and collaboration between quite different actors.

A competent facilitation of the working process together with own responsibility helped to avoid a stalemate due to diverging interests of stakeholders: because stakeholders held responsibility for creating the scenario storylines, they abstained from persisting with inflexible, predetermined opinions or views. Instead, they aimed at a common solution when problems arose during the storyline development. PRELUDE confirms the assumption that creating ownership early on in the process helps to reduce opposing views and facilitate better cooperation.

Problems emerged, however, with the formalisation and quantification of the scenarios. It takes sufficient time to align the output of the stakeholder meetings with the requirements of the modelling, and vice versa. Time was limited in the PRELUDE project and the round of iterations could be run only once. This complicated the translation of the qualitative assumptions on driving forces into quantitative model input,

since stakeholders and modellers were not always able to find to a common understanding. It created problems of ensuring overall consistency between the qualitative assumptions and quantitative input. The stakeholders also worked with assumptions that could not always be brought into a meaningful quantitative format or appeared not to be consistent across the scenarios. At this point, concerns of the scientific experts focused more on the scientific credibility of the exercise.

If scenarios want to stimulate policy-makers and stakeholders to re-think existing policy strategies and instruments, they need to express contrasting qualitative information in a convincing and appealing way. The benefits of triggering strategic conversations among key stakeholders can outweigh the problems of quantification. However, aligning the outputs of qualitative storyline development with the requirements of formalisation and quantification in a consistent and effective way remains a major challenge for further research development. In the end, it is the combination of formal and non-formal approaches that makes scenarios a useful and powerful tool.

## **5 Using the PRELUDE scenarios with key clients: lessons learnt and challenges**

The PRELUDE scenarios were developed with the aim of creating plausible descriptions of alternative long-term futures of land use change and environmental implications. They were not developed with the clear objective of evaluating the robustness of certain policies or strategies. However, while the overall outreach process mainly focussed on communicating the key outcomes of the exercise to selected target audiences and on stimulating strategic discussions about the probability, relevance and desirability of the different scenarios, we also always tried to take the discussions one step further and analyse strategic implications for key policies with regard to agriculture, rural development and environment. Especially the first outreach workshop devoted a whole day to this exercise. The aim of this exercise was to have participants reflecting the key strength and weaknesses of existing and planned policy approaches and discussing adaptation needs in the different scenarios.

The PRELUDE workshops gathered participants from European institutions, Member States, interest groups and academics from all across Europe. Bringing together actors from various backgrounds for this kind of open and strategic discussion worked out surprisingly well. Linking scenario and strategic analysis effectively turned out to be more complicated, for a number of reasons:

- Using scenarios for strategy analysis needs a sufficient understanding of the approach and the scenarios themselves. It is de-facto a process of its own. Most of the participants from European institutions, Member States or interest organisations were not familiar with the scenario approach adopted in PRELUDE or with scenarios in general. Since time is a limiting factor, the main attention was on exploring and understanding the scenarios as such
- Using scenarios for strategy analysis requires that a clear-cut decision focus is established in the beginning. The PRELUDE scenarios are, however, more general explorations of plausible futures. Outreach discussions are likely to turn into overly broad generalisations about future developments in society, economy or environment that do not find their way back to the task of improving actual political decision-making.

The PRELUDE scenarios indeed helped to create a language and a common platform for the different policy communities to jointly discuss and explore new ways of thinking about policies and instruments related to land use change and its environmental implications. Furthermore, and despite time constraints, the scenarios provoked strategic discussion about distinctive European governance models needed.

Initiating these kinds of discussions needed, however, *sufficient time*; at least a day. Many participants, and especially participants that have not been working with scenarios before, express some scepticism about the overall approach and the content of the scenarios. However, this initial *scepticism seems to decrease with the number of scenarios 'visited'* as well as with the time spent in exploring them. Seeing all scenarios usually allows for a better understanding of the purpose and the framework of PRELUDE, as well as for a broader and strategic discussion of the issues in focus. The downside of this requirement is that less time is available for discussing strategic policy implications.

Furthermore, time got constrained by discussing the concepts of *plausibility* and *probability*. Having a clear understanding is a prerequisite for successful scenario discussions with key stakeholders. Plausibility is a crucial objective of any scenario exercise. Any good scenario should be internally consistent, logical and should not easily be refused by policy-makers and experts. Plausibility, however, needs to be distinguished from probability: low probability does not equal implausibility – some extreme weather events, for example, have low probability, yet, they can happen and we have seen them happening, i.e. they are probable. Participants, however, did not always distinguish between plausibility and probability and criticised scenarios as implausible when they presented developments that were of rather low probability, which led to confusion among participants. In fact, another added value of scenarios is the search for *developments or events with low probability, but far-reaching consequences*. Naturally, it is these kinds of developments that take us by surprise.

In the end, the five PRELUDE scenarios were generally considered as plausible. However, the inconsistency of some assumptions and presentation of drivers across the scenarios caused rightful criticism. Due to the time constraints, a final cross-check of the overall consistency of assumptions across the PRELUDE scenarios could not be done which explains the inconsistencies that were criticised. Model restrictions and time constraints also prevented the sufficient analysis of Europe's inter-linkages with the rest of the world, especially regarding market developments in agriculture and development of global food demand. This received criticism from participants during the outreach workshops: Europe's impacts on other regions of the globe and vice versa, so the argument, cannot be ignored in a highly inter-connected globalised world. If scenarios aim to provide a meaningful framework for strategic discussion, they need to represent global-regional inter-linkages in a convincing manner.

Criticism was an indicator that the scenarios did work out: Participants got involved and tried to analyse the scenarios more and more in terms of their political and societal implications. Dealing with the role and situation of distinct policy approaches in the scenarios led, however, to questions that were not covered in the scenarios, i.e. political design, financial implementation, distributive effects, allocation of competencies etc. While participants, of course, started to fill out the blank spots in the scenarios, they could not do it in a consistent way across scenarios. Our approach showed

its shortcomings at this point. If the scenarios are supposed to function as a framework for strategy analysis and testing of the robustness of policies, a clear cut decision-focus is needed from the beginning of the scenario development to be able to include relevant information.

With regard to the claimed problems of using the scenarios effectively for strategic discussion, it was very interesting to see that most participants would have liked to have more time for this kind of discussion, but already valued the opportunity to think about more long-term issues from alternative perspectives and get new ideas highly. Discussions did not focus too much on specific results, data problems and modelling approaches as assumed originally by the scientists. One of our key lessons learnt is that scenarios have an assessment and information function, indeed. But moreover, they help connecting policy networks that are rather loosely connected and help different communities to reflect about joint problems, strategies and underlying values and assumptions.

## **6 Designing long-term robust strategies for land use change – policy issues and challenges for future research**

Scenarios have, as described, two main functions: informing decision-making (*content*) and initializing common learning and networking among policy-makers and key stakeholders (*process*). While PRELUDE scored well with regard to both functions, it is the first function that gives reason to further discuss further research needs, both in terms of methodological development and conceptual policy work.

PRELUDE delivered a wealth of policy relevant information with regard to future land use developments and their environmental consequences. They illustrate that preserving Europe's common natural heritage is a major challenge. Abandonment of agriculture land, for example, occurs in all scenarios, even in the scenarios that work with strong assumptions on effective policies; albeit it remains limited here. Land abandonment directly threatens traditional, rich rural landscapes. While they disappear in all scenarios, the scope and speed differs significantly. Southern and eastern Europe could be particularly affected by the combined effects of intensification of agriculture and rural land abandonment. The impacts of climate change affect socio-economic and environmental framework conditions in all scenarios. Eastern and southern landscapes seem to be more susceptible to the assumed social and environmental changes and show the greatest variations across scenarios. Northern and western European areas appear to be more robust.

The conservation of all areas of interest seems unlikely against this background. They underline a need to set stricter spatial priorities for rural development, and find new approaches for monitoring the effectiveness of related programs and measures. Targeted, coordinated policies are an important differentiating factor in the scenarios. They can help minimising the loss of areas of interest, i.e. in "Evolved Society" and "Big Crisis". Strong spatial planning also leads to concentrated urban development and helps creating green belts around cities in "Clustered Networks". Autonomous developments like in "Great Escape" are not beneficial in this respect.

Setting stricter intervention priorities requires better information on the one hand. This concerns a better understanding of the distribution of areas of high nature value

and biodiversity in order to be able to draw a priority list. Current data provide an insufficient overview. But it also concerns a better understanding of the impacts and effectiveness of related spending, such as agri-environment programs or less-favoured areas support. This understanding cannot be restricted to selected areas only, but necessarily needs to be achieved from an overall European level to channel resources most effectively. Our current understanding of effectiveness conditions for spending from an overall level is rather limited.

Furthermore, setting stricter intervention priorities needs a common agreement about the long-term objectives for agriculture and rural development. What kind of agriculture do we want to have in the future – concentrated and intensive or preferably area-wide and extensive? What should be the prospects for rural development – a balanced development or a differentiation according to regional distinctions and contrasts?

The current format of the Common Agriculture Policy, for example, does not stand the test of time in many PRELUDE scenarios, due to different influencing factors. Moreover, land use change is informed by many policy drivers, such as transport, housing, infrastructure or tourism. Demographic and socio-economic changes like globalisation and migration must be considered too. Ensuring a sustainable terrestrial development in the scenarios requires active coordination and integration across a wide range of policies as well as sufficient capacities for spatial planning, especially at the European level. However, major questions remain with regard to the vast differences of regional economic and environmental development in Europe and the respective ability of coordinating transitions towards desired directions.

The PRELUDE scenarios furthermore illustrate that land abandonment offers unique opportunities for large scale nature development. If land use issues are solved in an integrated manner, there appear to be considerable opportunities for regional increases in biodiversity. Biodiversity in general might benefit from the local retreat of agriculture that occurs in most scenarios, hand in hand with the quality of air, water and soils. Land abandonment offers also opportunities for the production of biomass and thus combating climate change. Autonomous developments of different policies that compete for spare land can lead to environmental detrimental developments. Better policy coordination is necessary to avoid negative impacts and inefficiencies of related projects.

Current governance approaches don't seem to be well suited for responding effectively to the needs of designing long-term robust policies. But our impression is also that social and political science research need to get more actively in the game and contribute to the discussion of methodological approaches to decision-making under uncertainty and complexity over a long time frame. This concerns especially helping to get a better understanding of what actually constitutes robust policies and how they can be determined. Is robustness also policy-area-dependent, or are there common criteria? But it also concerns better linking knowledge about the functioning of political systems, actor preferences and institutions to other assessment frameworks in the field of environmental scenario studies that operate with rather simple assumptions up to now. Future work of the EEA will focus on these aspects, among others.

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