Sustainability Science

How pragmatism in environmental science and policy can undermine sustainability transformations: the case of marginalized mountain areas under climate and land use change

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Abstract

Global warming, land use change, mass tourism and a deteriorating socio-economic situation pose serious threats to the sustainability of mountain areas. The future development of these areas could be an example of the Great Transition scenario. Based on iterative and collaborative discussions with 60 treeline experts, we 1) envisioned plausible futures of treeline ecosystems in Europe and 2) explored the role of pragmatism in scenario development and use. The three global change scenario classes (Conventional Worlds, Barbarization and Great Transitions) and four European scenarios (Economy First, Fortress Europe, Policy Rules, Sustainability Eventually) were downscaled using the drivers-pressures-state-impact-response (DPSIR) framework. The scenarios that emerged, i.e. Global Markets, Self-sufficient Economies, Tyranny of Climate Governance and Sustainable Use of Ecosystem Services, show that pragmatism can have either a propitious or pernicious role in scenario analysis. Instead of being truly honest brokers, scenario producers are likely to manipulate, reconstruct and change scientific knowledge to avoid socially and politically undesired trajectories. We showed by mathematical optimization that scenario users are likely to miss the Sustainable Use of Ecosystem Services scenario if they search within the pragmatic decision space which optimally justifies the two pre-existing global policies: climate policy and economic growth. We conclude that pernicious pragmatism leads to "the trap of the day" – a tendency of both users and producers of scenarios to use pre-existing policy agendas and scientific narratives as a pretext to promote their own objectives instead of being open to transformation in science and policy.

Keywords: Climate Change; DPSIR; Ecosystem Services; Exploratory qualitative scenarios; Land use; Science-policy interactions.

1. Introduction

Much of the global debate on the possible futures of social-ecological systems is concentrated around human well-being and environmental sustainability and the major driving forces and critical uncertainties associated with them (MA 2005). Reflection on the current challenges and transformative actions needed to address these questions has led to the identification of a number of possible alternative development paths (Raskin et al. 2002; MA 2005; IPCC 2014; Kishita et al. 2016). A promising approach to explore futures linked to sustainable development (O'Neill et al. 2015) is by developing scenarios. Scenarios are "renderings of plausible possibilities which are designed to stretch the imagination, stimulate debate and, by warning of pitfalls ahead, prompt corrective action" (Raskin et al. 2010: 2627). They are not a prognosis for the future, but rather plausible and relevant stories about how the future might unfold, accounting for critical uncertainties (Raskin et al. 2005). Coherent scenario storylines follow the internal scenario logics and explore consequences of uncertainties regarding the development of key driving forces (Zurek and Henrichs 2007).

In exploring alternative futures several approaches are possible depending on the scale of research and the aim of scenario building. Large-scale scenario assessments envision possible changes in the major global drivers, such as economies, human population growth, energy use, technological advancement and climate change. They have been conducted among others by the Intergovernmental Panel on Climate Change (IPCC 2014); UNEP (2007), Millennium Ecosystem Assessment (MA 2005), Tellus Institute (2016) and the Great Transition Initiative (http://www.greattransition.org/). Global

change scenarios have certainly been instrumental for illuminating the possible state of civilization and the environment in the future, but globalized discourse may neglect context-specific dynamics at the local level (Kok et al. 2016; Turnhout et al. 2016) or in vulnerable social-ecological systems. The scenario development literature has frequently faced challenges in combining global perspectives with issues unique to the regional or local scale (Zurek and Henrichs 2007). “Glocal” thinking (Roudometof 2015) seems to be best suited for the exploration of multi-dimensional and multi-level decision contexts.

With regard to the aim of scenario building, two major approaches have become established in scenario analysis. Normative “backcasting” scenarios search for feasible trajectories to achieve the desired state. Exploratory scenarios, on the other hand, describe one or more trajectories the system may follow if “left to itself” or under alternative sets of initial conditions (Gallopin 2015) while taking into account multiple alternative legitimate states of the future and paths to it (Wilkinson 2009; Vervoort et al. 2014).

One fundamental characteristic of exploratory scenarios is that they outline various plausible development paths and their consequences without being policy-prescriptive. The value choice of what to do with the renderings of plausible possibilities is a decision for actors. Governmental, non-governmental and intergovernmental organizations; international corporations; and civil society may have their own interpretation of the scenarios. These actors need the political and corporate will for

gradually bending the curve of development towards a desirable future (Raskin et al. 2002). However, the reform path may not always be recognized as pragmatic and desirable. Aspirations for a more sustainable world could be in conflict with the interests of global capital for infinite economic growth, although several simulations suggest that growth and globalization are not only undesirable from an environmental point of view but also not feasible from an economic, energy and climate dynamics point of view (Capellan-Perez et al. 2015). On the other hand, in their battle for the environment, intergovernmental organizations and civil society may excessively identify themselves with strict global climate policy, leaving all other local alternative developmental paths aside. Such pernicious pragmatism leads the scenario users to support scenarios that are based on the pragmatic experiences of current paradigms and situations rather than truly free deliberation on the future (see Dewey 1929; Hildebrand 2003; Gutek 2014), which diminishes options for adopting scenarios other than those high on the current policy agenda.

Also, scenario producers may be tempted by pragmatism, as they are expected to create and communicate a compelling narrative that engages users. In communicating scenarios to actors, honest brokering of various policy alternatives has been one of the most powerful approaches to enhance the relationship between science and policy (Pielke 2007; Striling 2010). However, facts may not always be free from values, and since scenarios can have simultaneous positive and negative implications for sustainable development, they open up space for the pragmatic behavior of scenario producers to promote the scenario that best fits into pre-existing policy agendas (see Latour 1987; Van der Sluijs 2005). Scenario producers also use other strategies in their rhetoric to

transform existing scientific knowledge into knowledge usable for policy makers and stakeholders, such as "reduction" and "rhetorical packaging" (Boezeman 2016). "Reduction" aims to narrow down the topic under examination to a level that can be handled in a credible way, while "rhetorical packaging" is used to make compelling arguments as to why a particular scientific discipline is the best source of trustworthy knowledge (Boezeman 2016). Overly pragmatic utilization of such strategies can transform honest brokering into "stealth issue advocacy", which seems a value neutral strategy at a first sight, but promotes certain (hidden) agendas (see Pielke 2007). However, the value choices may be invisible even for the scenario producers themselves. Pragmatism in scenario production maximizes self-interest, objectives and power in order to support pre-existing and positioned objectives and paradigms at the expense of openness to great transitions (see Goodin 2010; Beck 2012).

This paper explores how pragmatism in science and policy may replace honest brokering in developing, communicating and using exploratory scenarios. Using scenarios of the European treeline areas as an example, we 1) analyzed how global climate policy and economic growth imperatives on the one hand, and visioning as a method for producing the consensual and compelling scenarios (Moore et al. 1999) on the other hand, open up space for the pragmatic behavior of both scenario users and producers and 2) proposed a framework for assessing and quantifying the pragmatism of scenario users. It is argued that pre-existing policy objectives and scientific approaches narrow down the creative capacities of actors, leading to "the trap of the day".

2. Materials and methods

2.1. Scenario production

The threat of "the trap of the day" is exemplified in the scenarios of European treeline areas. Ecosystems at or near treelines are one of the early detectors of global change (e.g. Kupfer and Cairns 1996). Defined as ecosystems at the line connecting the uppermost or northernmost patches of trees in alpine and arctic forests below heathland and grassland (Holtmeier 2009), they have long been considered as evidence of a warming climate and anthropogenic pressures (Mountain Agenda 2002). Sarkki et al. (2016: 2020) extended the ecological definition of a treeline to "treeline-related administrative areas, and associated landscapes and ecosystems" to emphasize the embeddedness of a treeline in the broader context of social-political factors.

Our scenario development started with existing stylized global story lines (i.e. Conventional Worlds, Barbarization and Great Transitions, Raskin et al. 2002) and European scenarios (i.e. Economy First, Fortress Europe, Policy Rules, Sustainability Eventually) (UNEP 2007; Kok et al. 2011), which were relabeled and downscaled to account for specific issues relating to the treeline areas. The three stylized global story lines and four European scenarios reflect diverse developments, such as economic growth, national security and self-sufficiency, climate change mitigation and sustainable use of ecosystem services, which might have divergent impacts on treeline areas.

The large-scale scenarios were downscaled through iterative and collaborative discussions with around 60 experts from nine European mountain regions and the Caucasus (EEA 2010, Fig. 1) in seven two-day meetings of the SENSFOR project (Enhancing the resilience capacity of SENSitive mountain FORest ecosystems under environmental change). The downscaling took into account the previous work of the SENSFOR project in 41 case studies (Fig. 1) on the drivers-pressures-state-impact-response (DPSIR) factors (Kyriazopoulos et al. 2014), stakeholder needs regarding ecosystem services (Sarkki et al. 2016) and assessment of good governance in European treeline areas (Sarkki et al. 2015). A draft of four scenario storylines was presented to the SENSFOR members at the project meeting in February 2016, where the participants were encouraged to come up with additional elements of scenarios associated with political, economic, social and technological (PEST) dimensions of the future (Healey 1994).

Fig. 1. Europe's mountain massifs with the number of case studies used for the development of the treeline area scenarios (adapted after EEA 2010).

We followed the methodology for developing exploratory scenario storylines in six steps as follows (Henrichs et al. 2010; Kok et al. 2011; Fig. 2): 1) We discussed the current state of European treeline areas. 2) We discussed the main uncertainties about the future of European treeline areas with respect to anthropogenic global warming and land use change as the two main direct pressures (Kyriazopoulos et al. 2014). 3) We linked key uncertainties to existing global change scenarios (Table 1). 4) We discussed

the scope and limitations of the scenarios with regard to different developments in European treeline areas. The examined developments were as follows: i) the expansion of unregulated global markets; ii) increasing national and European self-sufficiency in raw materials, energy and food production; iii) the extent of climate change mitigation; and iv) sustainable use of ecosystem services. 5) We developed storylines based on key uncertainties and existing scenario logics. To focus on treeline area specifics we selected the sub-themes that link to land use and climate change pressures as the most relevant for European treeline areas (Kullman and Øberg 2009; Smith et al. 2009). The themes included transport, food production, subsidies, energy supply, governance and policy, the role of science in governance, markets, general attitude to environmental problems and the perception of treeline areas. 6) We envisioned the possible impacts of the scenarios on European treeline areas with regard to these themes (Electronic Supplementary Material S1-S4).

To understand the potential impacts of global and regional change drivers on European treeline areas, we applied the DPSIR framework (e.g. Rounsevell et al. 2010). Knowing the social-ecological conditions in European treeline areas and being aware of the internal logics of each of the presented scenarios, we summarized the positive and negative points of each of the four scenarios with respect to sustainability (Table 2).

Finally, we assessed the scenarios in a self-reflexive session. Self-reflexivity critically assesses the framings, reductions, generalizations and rhetoric of the paradigms and theories one uses to analyze the empirical materials (Davies 2008). Using the example

of pastoralism in treeline areas, we illustrated differences between the results of a straightforward DPSIR application and more contextual assessment of pastoralism and land use at the local level using a cognitive map. The cognitive map (see van Vliet et al. 2012) identifies a complex web of related issues that are easily missed when examining environmental change by downscaling and generalizing global storylines and relying only on direct causalities between the DPSIR factors (Figure 4; see Niemeijer & de Groot 2008).

Fig. 2. The workflow diagram in scenario production and evaluation

2.2 A framework for assessing the pragmatism of scenario users

Once the qualitative storylines were developed, we quantified the themes that emerged as the most relevant for European treeline areas in step 5. In the quantification we used the PoleStar System projections for Market Forces, Policy Reform, Fortress World and Great Transition scenarios for Europe until 2050 (Tellus Institute 2016) for the indicators that either corresponded or closely related to our themes (http://www.polestarproject.org/). For instance, to quantify the development of Transport in treeline areas under the scenario of global economic growth, we used the Final Transport Energy Demand indicator from Market Forces, for Food Production we used Agriculture Crop Production, for Energy Supply we used Primary Energy Supply and for Markets we used the Gross Domestic Product per capita based on purchasing power parity (GDP_{PPP}), all calculated as a mean for Eastern and Western Europe projections and as an index relative to 2005. For the themes not quantified in the

PoleStar System (i.e. Subsidies, Governance and Policy, Role of Science in Governance, Worldview on Environmental Problems, Treeline Area Perception) we used expert judgment to project their magnitude of change relative to 2005. This quantification aimed to operationalize the scenarios in a relative sense to show how distant the scenarios are from each other with regard to the indicators rather than to project how a specific indicator will change in the future.

The expected behavior of scenario users was analyzed by constructing the decision space (D) in which any decision of scenario users for the trajectory satisfies the condition that the trajectory does not deviate "too much" from the pre-existing policy agendas and scientific narratives. Identifying the best solution from all feasible solutions that does not violate certain constraints is a typical optimization problem. The identification of the most pragmatic scenario (s_{PRAGM}) could thus be represented as an optimization problem where the two politically dominating but conceptually fundamentally different scenarios by 2050 (s_i) (i.e. global economic growth and strict climate policy) are considered the two boundaries of D,

supremum ($s_1 = \sup_{[2005,2050]} D$) (Eq. 1) and

infimum ($s_2 = \inf_{[2005,2050]} D$), (Eq. 2)

and the objective function to be minimized (Z, Eq. 3) is the loss function. For the sake of simplicity the loss function was the sum of squares of deviations in the parameters of the s_{PRAGM} by 2050 from the parameters of the s_1 and s_2 scenarios over all 9 themes (t) of the scenarios (Table 1):

$Z = \min \sum_{t=1}^{9} \sum_{i=1}^{2} (s_{PRAGM} - s_i)^2$ (Eq. 3)

D containing the most pragmatic scenario in the period p from 2005 to 2050 is thus represented as the area between the supremum and infimum:

$D = \int_{2005}^{2050} [s_1(p) - s_2(p)]\, dp$ (Eq. 4)

The pragmatic decision space (D') is a subset of D in which the pragmatic scenario users are likely to start searching for plausible trajectories. We expect that under the doctrine of economism that attaches principal importance to economic growth (e.g. Escobar 2015), the search for the optimal scenario is likely to start near the scenario that attaches greatest importance to market forces and then gradually moves toward the scenario of strict climate policy, but ends in between these two at the most pragmatic scenario s_{PRAGM}.

In the calculation of s_{PRAGM} we used the non-linear solver in the What's Best® package 12 (Lindo Systems Inc. 2012), which uses linear approximations to the problem functions at a number of stages in the solution process.

3. Results

3.1 The scenarios for European treeline areas

Four scenarios emerged: Global Markets, Self-sufficient Economies, Tyranny of Climate Governance, and Sustainable Use of Ecosystem Services (Table 1). The four scenarios represent the possible futures of treeline areas shaped mainly by

anthropogenic global warming and land-use change (Fig. 3). Each of the four scenarios has different implications for the economic, ecological, social and cultural dimensions of sustainability (Table 2).

Fig. 3. Four scenarios for the future of European treeline areas ordinated in a climate change – land use matrix

Table 1. Four scenarios of the future of European treeline areas and the key variables describing the scenarios

Table 2. Negative (-) and positive (+) implications of the scenario storylines on the four dimensions of sustainability of European treeline areas

3.1.1. Global Markets

The "Global Markets" scenario is characterized by a reactive attitude to environmental problems and climate change mitigation. Food and energy production are located in the cheapest locations, possibly leading to a decrease in land-use intensity in marginal rural areas. The main global driver is neoliberalization of markets (Heyen et al. 2007) leading to a dramatically changed climate (IPCC 2014).

In this scenario the paradigm of economic growth dominates. However, if unregulated markets have negative impacts on other economically productive land uses, compensation schemes may be introduced or synergies considered. Climate change

worsens and fossil fuels are widely used. As land use intensity in European treeline areas declines, there are no significant direct pressures on treeline ecosystems apart from mass tourism in snow-safe destinations. Electronic Supplementary Material S1 outlines the key pressures and their impacts on treeline areas under this scenario.

S1. Pressures and impacts in the "Global Markets" scenario

3.1.2. Self-sufficient Economies

The "Self-sufficient Economies" scenario is based on the assumption that regionalization instead of globalization drives political decisions and that climate change mitigation measures are inferior to aspirations for local self-sufficient economies. The markets are mainly European as borders are closing due to increasing migration and terrorism threats, and the relationships between western and eastern and developing countries are poor. The need for self-sufficiency leads to extensively subsidized agriculture and pastoralism despite the potentially negative environmental impacts (Schmid et al. 2007).

Self-sufficiency in energy, food and goods production leads to an intensification of land use in treeline areas. Only profitable activities are supported, which means that stakeholders representing minor interests or economically inefficient land uses will have little impact on decision-making. Industrial activities and agriculture are only regulated if they exceed the maximum sustainable yield or threaten other economically important land uses (see Electronic Supplementary Material S2 for details).

S2. Pressures and impacts in the “Self-sufficient Economies” scenario

3.1.3 Tyranny of Climate Governance

The “Tyranny of Climate Governance” scenario is a global top-down technocratic scenario, where proactive climate change mitigation objectives drive policy and distract political attention from issues other than climate change. Strong climate governance leads to wide ranging, strong and efficient implementation of European and global mitigation policies and measures.

In this scenario climate-neutral energy production dominates (e.g. hydropower, wood-based energy, nuclear power, solar panels and wind turbines). Forests are moderately used to produce biomass as attention is paid to carbon storage. Trade in food decreases due to the negative effects of transportation on climate change, resulting in the intensification of European pastoralism and agriculture. International mass tourism is very low due to a dramatic reduction in air travel. A strong technocratic policy may lead to non-compliance of many sectoral policies, resulting in sanctions. On the other hand, subsidies and economic incentives for climate-neutral and local production of goods and services may gradually result in a more positive attitude to technocratic climate governance. The pressures and their impacts under this scenario are outlined in Electronic Supplementary Material S3.

S3. Pressures and impacts in the “Tyranny of Climate Governance” scenario

3.1.4. Sustainable Use of Ecosystem Services

This scenario combines market measures and regulatory governance to safeguard ecosystem services. It is a proactive scenario that links environmental problems to human well-being. Under this scenario land use in treeline areas is moderate, leading to a balanced use of multi-functional landscapes. The combination of regulatory policies and market-based instruments at multiple levels, including local, is used to enhance sustainability and balanced use of ecosystem services. Previously unrecognized ecosystem services are targeted and governed by developing markets for them. These include hydropower companies’ payments to down-stream water users, state payments to private forest owners for practicing retention forestry and payments by tourism entrepreneurs to pastoralists and traditional users to enhance the image of the treeline area as a tourist destination. Global mass tourism is in decline. Renewable energy solutions are developed. Land use effects are systematically monitored and problems are detected at an early stage (Electronic Supplementary Material S4).

S4. Pressures and impacts in the “Sustainable Use of Ecosystem Services” scenario

3.2. Reflections on scenario production

The experts focused on commonly recognized and direct implications of climate and land-use change. Alternative drivers, such as human population growth, migration and technological development, were left out of the picture. The scenarios addressed technological development only via greener production, but did not envision its influence on the development of rural treeline areas. Moreover, many single pressures related to land use and climate change were identified, whereas cumulative pressures from climate and land use change and contrasting impacts of various land uses in the same area on the environment and local cultures and livelihoods were not considered. The commonly identified pressure was grazing, with a negative impact on the integrity of treeline areas. This rather generalized assumption separates nature and culture, which does not reflect local realities where pastoralism is often considered as part of the treeline landscape rather than as an external threat.

Impacts were limited only to direct impacts to treeline areas with no holistic assessment of impacts on the socio-cultural realm. No possible impacts of diverse and modern free time activities for young people on land abandonment prevention and intergenerational change in pastoralism were identified (Figure 4). The scenarios addressed mainly large-scale policies and governance instruments directly linked to nature stewardship, while rural development policies targeting human population viability in remote areas were not considered. Locally initiated self-organized actions were not included.

Figure 4. “Reduction” and “rhetorical packaging” in the DPSIR framework for studying treeline area pastoralism (white background) and more contextual mapping of key factors explaining future changes in treeline area pastoralism (grey background). The arrows between boxes illustrate feedbacks that can be positive (+) or negative (-).

3.3 The pragmatism of scenario users

Pragmatism in selecting future trajectories of treeline areas favors the trajectories that meet the objectives of the “Global Markets” scenario and in the best case approaches the objectives of climate policy (Fig. 5). However, in trying to minimize a loss of legitimacy in the eyes of the economic sector while moving towards a low-carbon society, scenario users actually search in decision space D’. The risk of failure is minimized if s_{PRAGM} is the chosen scenario. The “Sustainable Use of Ecosystem Services” scenario is almost never reached, as the political and financial costs of a fundamental shift in the management paradigm are considered to be too high. Any step away from the two dominating global policy imperatives – global economic growth and strict climate policy – could result in the failure to reach either of them. Policy makers are unlikely to risk losing the legitimacy of their policies against global capital and international bodies for climate governance. The result of such pragmatism is the Business-As-Usual growth trajectory (i.e. the most pragmatic scenario) that is only marginally adapted by alternative visions of the future.

Fig. 5. Four scenarios for the development of key variables in European treeline areas with the pragmatic space in which the scenario users can choose trajectories that best fit pre-existing policy agendas and scientific narratives and maintain the legitimacy of climate-sensitive and economic growth-oriented policies.

4. Discussion

4.1 Pragmatism in scenario production

Our study showed that there are several points where knowledge producers may manipulate, reconstruct and change scientific knowledge to reach certain pre-established policy objectives (Nelson et al. 2008). We highlighted "reduction" and "rhetorical packaging" as two capacities of knowledge producers that may also be used perniciously in transforming existing scientific knowledge into that which can be used by policy makers and stakeholders (Boezeman 2016).

There were two interlinked pragmatic "reductions" in our scenario exercise. Turnhout et al. (2016) has made a strong argument about the danger of using a globalized scientific representation of human-environment relationships, especially in the field of climate change, but also increasingly in terms of biodiversity and ecosystem services. Globalized reduction by the application of the DPSIR framework that was used to narrow-down the topic under examination to a level that can be handled in a credible way (Boezeman 2016) assumes simplistic causal relationships between different components of a social-ecological system (Niemeijer & de Groot 2008). This

framework, if not adapted to the local context, can only identify factors directly linked to the environment, while indirect factors emerging at the local level remain cursory (Figure 4). In this light, it has been recognized that the utilization of "monological" methodological approaches to assess futures may lead to impartial results which are unaware of the key underlying assumptions of the applied methods (Kaivo-Oja 2016). The scenario literature has tackled the challenges related to reduction and globalizing narratives by developing multiple methods to produce multi-level scenarios, which involve a varying degree of connectedness and enrichment between the levels (Zurek & Henrichs 2007).

The second reduction of surprises and complexities occurred when the whole spectrum of relevant issues (e.g. art, religion, law, sport, health, education, and the mass media) was truncated to a limited number of dimensions, such as science, policy and economy (Roth and Kaivo-Oja 2015). No interactions between the issues, nor their cumulative impacts, were considered. For example, the Technocratic Tyranny of Climate Governance scenario represents a global view of science and policy. Similarly, the Self-sufficient Economies scenario strongly relates to the aspiration of some national policies in Europe for apartheid economies and societies. The Global Markets scenario inherently assumes that people must have access to global markets in order to succeed in economic terms. However, sustainable use of ecosystems diverges from globalized paths as it is related to locally developed practices (c.f. Adapting Mosaic" in MA 2005). Each of these scenarios has internal logics, which aim to make a given storyline compelling. However, the drive for increased ownership inevitably leads to overexploitation of existing narratives on socio-environmental change and reduces

complexity and surprising aspects in the scenarios. The reason for such bias may be due to scenario producers' willingness to maximize the impact of their scenarios by making strong connections to existing storylines or "discourse coalitions" (Hajer 1995) considered as mainstream regarding global environmental and social changes and futures.

Envisioning future alternative paths often leads to rhetorical packaging in form of "the usual suspects": the good (Balanced Use of Ecosystem services), the bad (Global Markets), the ugly (Self-sufficient Economies) and the great unknown (Tyranny of Climate Governance). Thus, even though our scenarios are exploratory and not policy prescriptive, some of them are likely to be implicitly supported over others. We presented the usual suspects, but also illustrated the plausible side effects of top-down climate governance and showed that all the scenarios have positive and negative implications for sustainability (Table 2). In this way we tried to depolarize the clash between the scenarios that focus either on neoliberal markets or environmental sustainability. This polarization often sees a reactive (free markets) vs. proactive (environmental sustainability) relationship to environmental problems as the two interchangeable alternatives (cf. Kok et al. 2011). The result may be a naïve blaming of organizations for environmental "immorality" (cf. Roth 2016). However, preaching cannot enhance environmental sustainability. Rather the opposite, it evokes defenses and a retreat to purely pragmatic decisions.

4.2 Pragmatism in making the decisions on the future

Bending the curve of development is often challenging; it is easier to continue with business-as-usual than to implement a change. In addition, an emerging threat, though of short-duration, may quickly provide social license for a fundamental deviation from the chosen path with no return to the long-term optimal trajectory. However, scenario users are unlikely to take the risk of losing their legitimacy and follow the path that seems to satisfy the most influential actors.

The detection of such pernicious pragmatism is challenging and has not received much attention. Quantitative methods have been mostly used in scenario development, e.g. for structural analysis, quantifying relations between the variables, consistency analysis, choosing smaller subsets from sets of plausible scenarios, and scenario visualization (e.g. see Carlsson et al. 2015, LIPSOR 2016, Lord et al. 2016 for recent applications). An equally important part of scenario analysis is communication with scenario users and monitoring their progress in sustainability. The proposed framework for detecting and quantifying the pragmatism of scenario users can be used to foster the transformation.

A strong advantage of our framework in comparison to more theoretical, philosophical and normative critiques of the world trajectories is that we used virtually the same language that organizations in the era of neoliberalism and global capitalism use: optimization. Our hack on pernicious pragmatism is thus not moral and not about a "more or less of the same" (Roth 2016: 11). Rather the opposite, we stimulate the actors to "re-functionalize the growth" (Roth 2016: 3) and reprogram their

"organizational programs" (Roth 2016: 6) "in line with the fact that the economy is only one among many function systems" (Roth 2016: 11). Pernicious pragmatism which searches for the scenario that is optimal for the currently ruling policies can thus gradually transform into a propitious filtering out of the trajectories that are unsustainable for society as a whole.

The hypothesized pragmatism of scenario users is, rigorously speaking, a theory which can only be supported or falsified after a certain period of time when the actual trajectory of the treeline area development could be positioned within the pragmatic space D' and analytically paralleled with the s_{PRAGM} trajectory. It is also unlikely that in practice policy-makers behave as utility maximizers who maximize the robustness of their decisions against climate-sensitive or growth-oriented policies for *all* themes of relevance. For instance, if climate change seriously threatened sufficient food production in mountainous areas, this could result in an extension of the pragmatic decision space D' in the subsidies theme (Fig. 5), and the subsidy policy would be searched for closer to the "Tyranny of Climate Governance" scenario.

5 Conclusion: "Trap of the day"

Scenarios can ideally function at the interface of science and policy and envision future developments. However, envisioning the future and transformations in science and policy may be seriously bound by the pragmatism of pre-existing science and policy. We argue that this leads to the "trap of the day", where transformations are blocked by a strong and pragmatic orientation towards the current state of ecosystems and society

instead of truly anticipatory explorations of future uncertainties and their consequences. Pernicious pragmatism also decreases actors' creativity, leading to limited anticipation of future development, which does not go beyond simple causalities between global drivers and local impacts. Nevertheless, both scientists and policy makers should try to anticipate futures and adapt, redefine and transform their agendas based on careful deliberation. A potential analgesic for the "trap of the day" – but not a panacea – is the combination of normative backcasting and exploratory scenarios to guide the interpretations of scenario users. The minimum is to be transparent on the underlying policy objectives and causal assumptions, and to accept that the most likely future might collide with the objectives and aspirations at hand, which requires thinking beyond positioned views on today's desirable state.

ACKNOWLEDGEMENTS

This article is based upon work from COST Action ES1203 SENSFOR, supported by COST (European Cooperation in Science and Technology). Support of the H2020 SIMRA project on Social Innovation in Marginalised Rural Areas, Contract number 677622, provided by the European Commission to the James Hutton Institute and the University of Oulu is acknowledged by Maria Nijnik, the Coordinator. The study is also part of the thematic research carried out at The James Hutton Institute under the Scottish Government's Strategic Research Programme, 2016-2021. We are grateful for the support provided, and to Carol Kyle for proofreading.

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Tables:

Table 1. Four scenarios for the future of European treeline areas and the key variables describing the scenarios

Key variables	"Global Markets"	"Self-sufficient Economies"	"Tyranny of Climate Governance"	"Sustainable Use of Ecosystem Services"
Transport	Global travel increases and fossil fuels are used	Fossil fuels are used, but global travel declines. Local mobility systems	Alternative fuel deployment, air travel in strong decline	Greener and climate friendly logistic systems, multimodal ticketing
Food production	Food comes from global markets, price competition dominates	National food production is heavily subsidized and supported in mountain areas	National and regional climate-neutral products are used	Sustainability of food production, imported goods not in fashion
Subsidies	No subsidy support for entering into global markets	Heavily subsidized food and energy production to ensure self-sufficiency of treeline areas	Resources allocated to climate change adaptation and mitigation	Small-scale and green energy and food production solutions subsidized
Energy production	Energy is produced in the cheapest way and location, fossil fuels heavily utilized	All forms of energy production maximized within states and EU	Only climate friendly solutions are used including nuclear power	Emphasis on green and small-scale energy production
Governance and policy	Weak national policies	National level policies prevail	Global top-down policies	Balanced multi-level governance
Role of science in governance	Innovation platforms with science and market actors	Multi-level optimization to maintain national growth	Technocracy dominated by global climate science	Adaptive co-management between policy, stakeholders and science
Markets	Global unregulated markets	Circular economy	Climate mitigation policies	Globally connected but regulated for sustainability.
Worldview on environmental problems	Reactive: action taken after problems appear	Only recognized when they link to security and national self-sufficiency	Climate change is the No 1 problem	Proactive view and use of the precautionary principle
Treeline area perception	Interesting tourism destinations	Underused resources for national economies	Icons to be safeguarded	Multi-functional landscapes

Table 2. Negative (-) and positive (+) implications of the scenario storylines on the four dimensions of sustainability for European treeline areas

Dimension of sustainability	Global markets	Self-sufficient economies	Tyranny of climate governance	Sustainable use of ecosystem services
Environmental sustainability	(-) Ecological values in treeline ecosystems are accounted for only if they possess economic value (+) Less productive treeline areas are of no interest to industrial stakeholders	(-) Environmental problems are only recognized when they link to security or self-sufficient economy (+) Decline of unsustainable global transportation of people, goods and services, less migrations	(-) Climate change is the only recognized environmental problem (+) Acknowledges links between ecological sustainability and climate change in treeline areas	(-) Stronger focus on ecological values with market value (+) Proactive regulations to prevent negative environmental impacts
Economic sustainability	(-) Markets promote industrial land-use having negative impacts on other land users (+) Connections to global markets increase economic benefits	(-) Treeline stakeholders without link to strong economic activities will perish (+) Production of goods in treeline areas is strongly subsidized	(-) Strict regulation of markets may hinder economic opportunities (+) Markets for climate mitigation and resources for adaptation	(-) Normative sustainability goals may hinder markets (+) Less market failures, new economic opportunities
Social Sustainability	(-) Democratic decision making is overrun by markets (+) By engaging in markets treeline stakeholders can detour policy hierarchies	(-) Treeline land use policy tailored to dominant industrial actors (+) Domestic and local economic interest in treeline areas are priority	(-) Technocracy dominates the governance (+) Scientists and citizen scientists are monitoring climate change impacts in treeline areas	(-) The compromises between treeline stakeholders may satisfy nobody (+) Collaborative governance engages treeline stakeholders

Cultural sustainability	(-) Respect for treeline cultural values is replaced by aims for cost-efficiency. (+) Cultural values may diffuse via global movement of treeline goods and services	(-) Maintaining cross cultural dialogue is a challenge (+) Treeline traditional livelihoods and related products are valued	(-) Places climate neutrality above culturally important livelihoods (+) Educates citizens about the impacts of climate change by using treeline areas as indicators	(-) Negative environmental impacts of traditional land uses are not tolerated (+) Local cultural values are respected as equal when compared to other interests on ecosystem services

List of Figure legends

Fig. 1. Europe's mountain massifs with the number of case studies used for the development of the treeline area scenarios (adapted after EEA, 2010).

Fig. 2. The workflow diagram in scenario production and evaluation.

Fig. 3. Four scenarios for the future of European treeline areas ordinated in a climate change – land use matrix

Fig. 4. "Reduction" and "rhetorical packaging" in the DPSIR framework for studying treeline area pastoralism (white background) and more contextual mapping of key factors explaining future changes in treeline area pastoralism (grey background). The arrows between boxes illustrate feedbacks that can be positive (+) or negative (-).

Fig. 5. Four scenarios for the development of key variables in European treeline areas with the pragmatic space in which the scenario users can choose trajectories that best fit pre-existing policy agendas and scientific narratives and maintain the legitimacy of climate-sensitive and economic growth-oriented policies.

Figure1

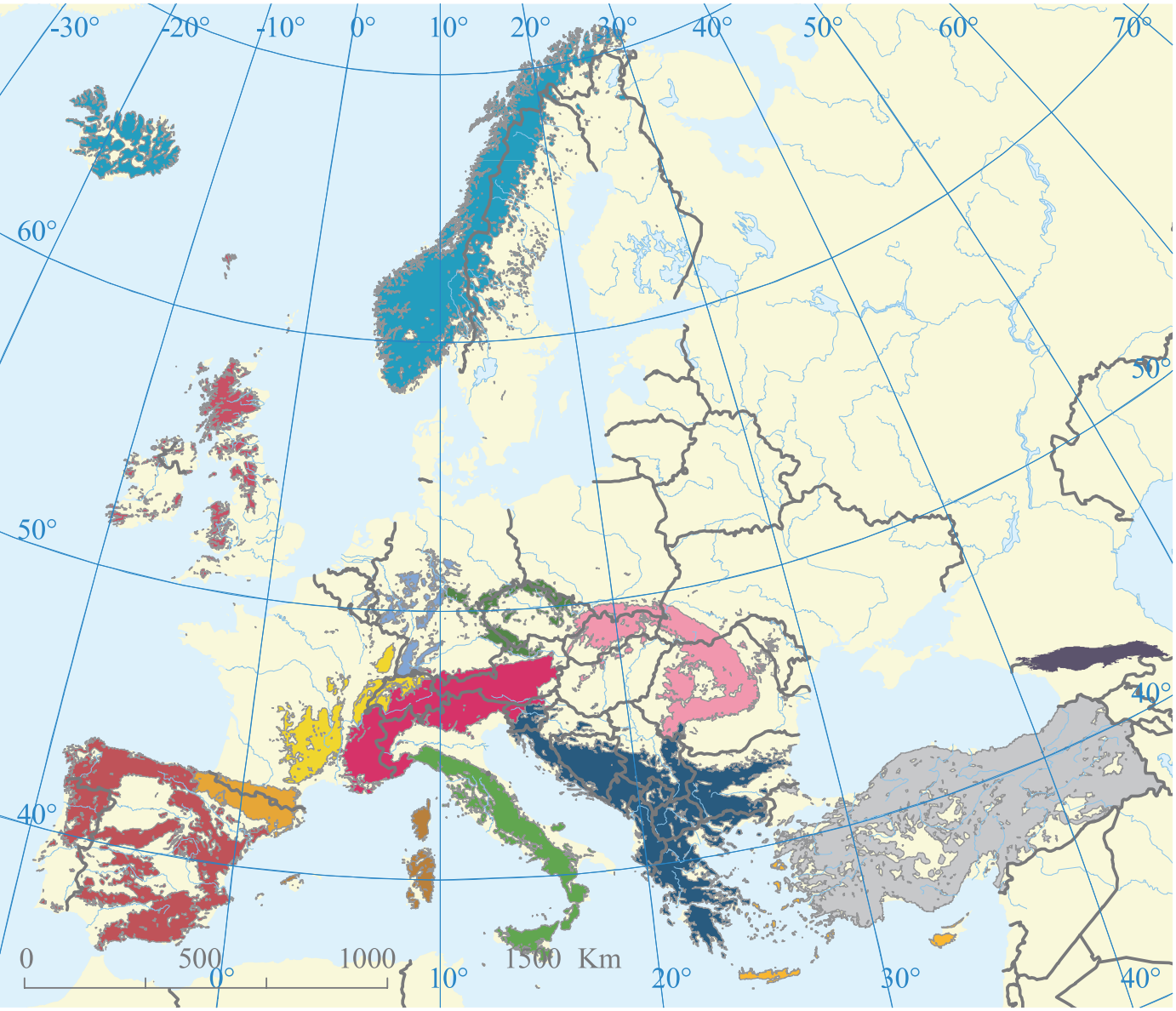
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Figure2

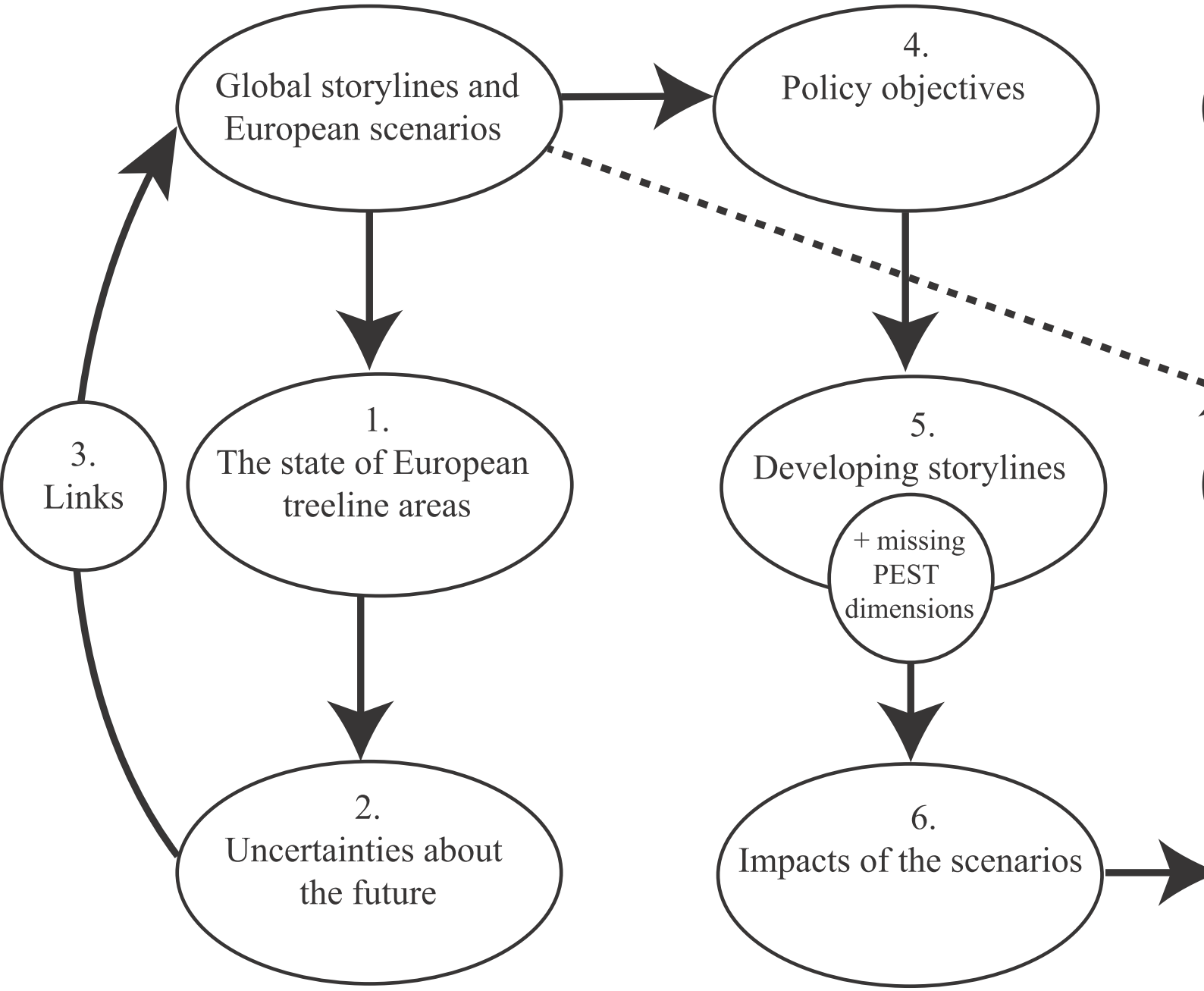
Global storylines and European scenarios
4. Policy objectives
1. The state of European treeline areas
5. Developing storylines
+ missing PEST dimensions
3. Links
2. Uncertainties about the future
6. Impacts of the scenarios

Figure3

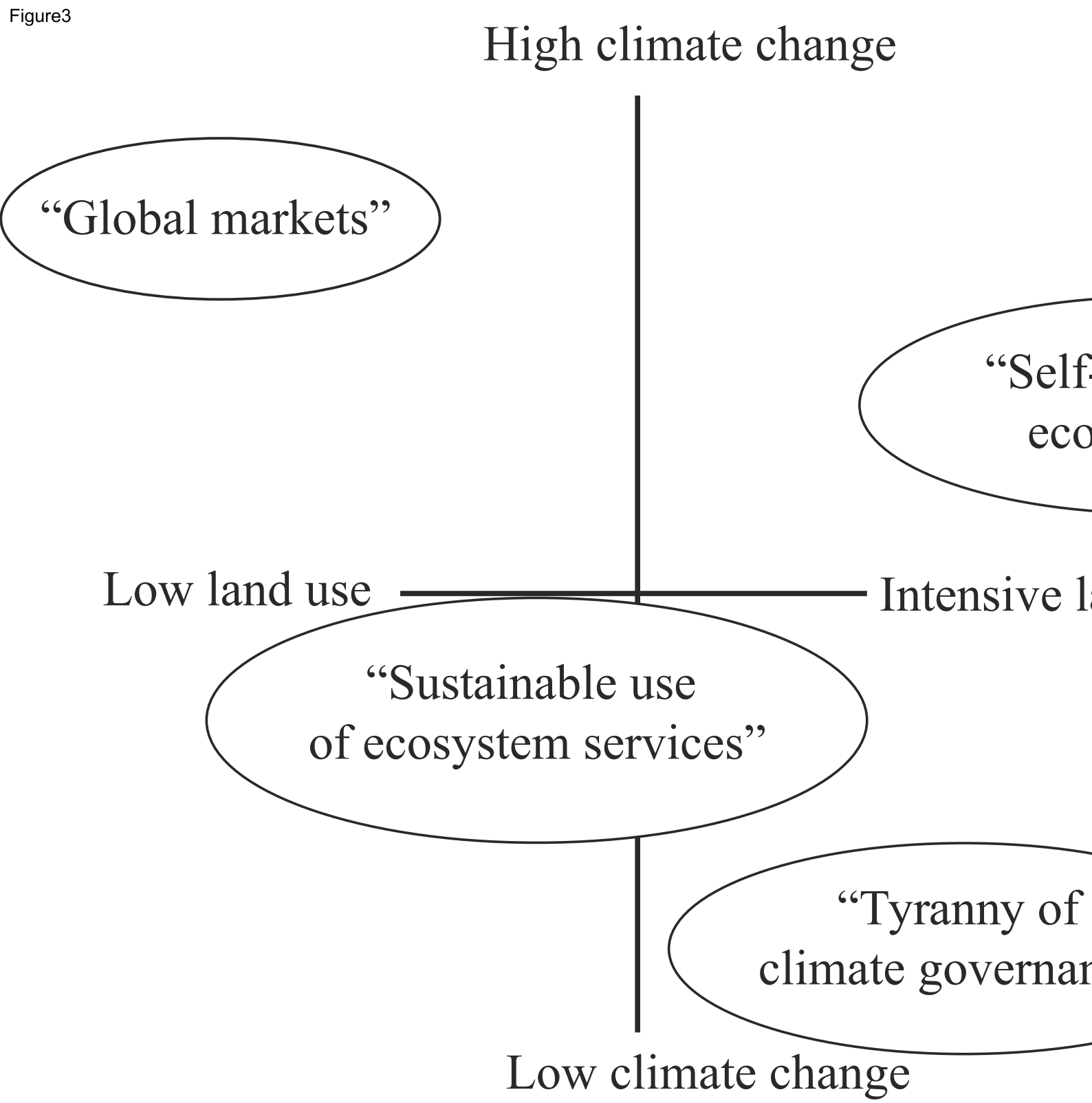
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Figure4

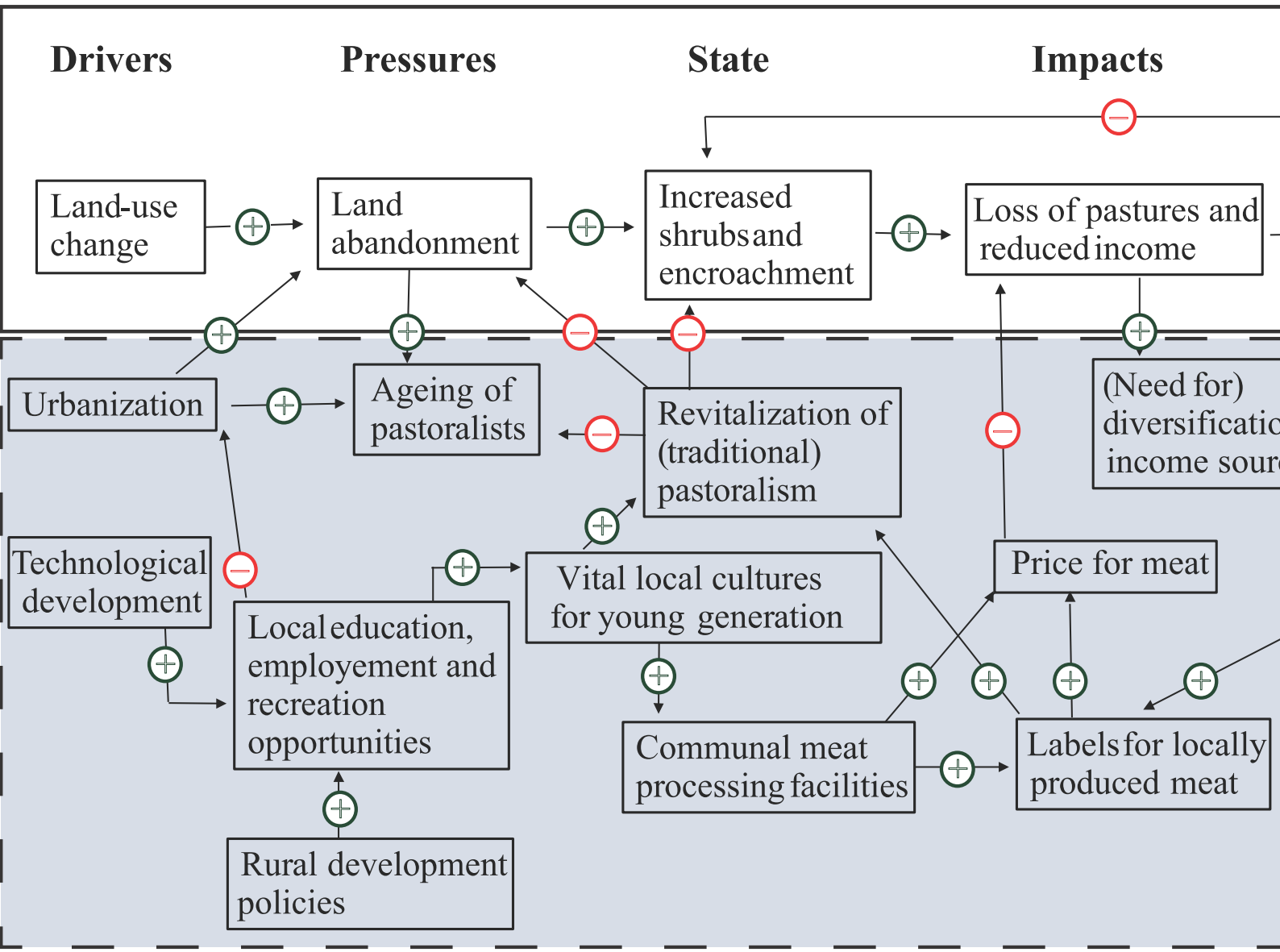
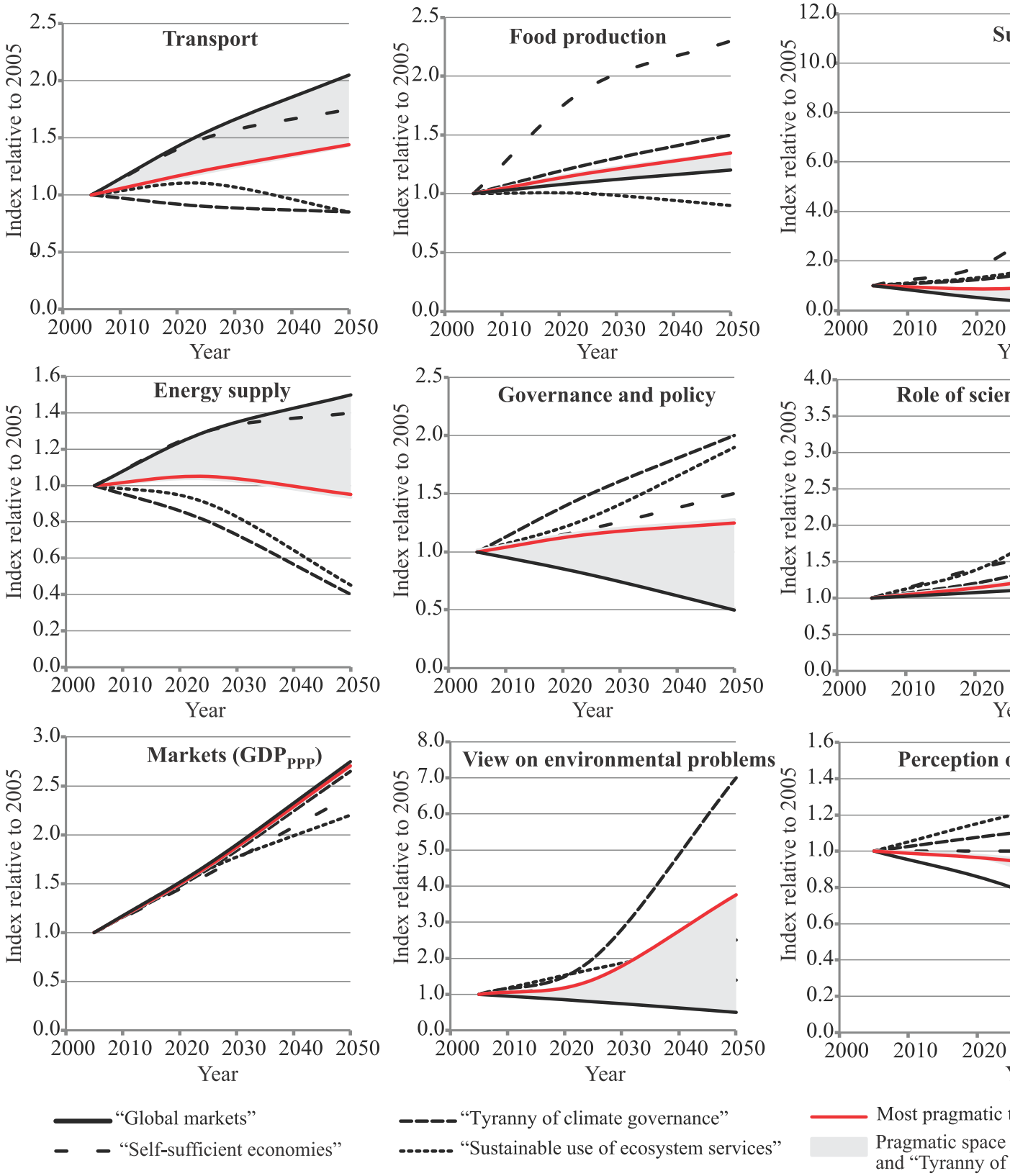

Drivers
Pressures
State
Impacts
Land-use change
Land abandonment
Increased shrubs and encroachment
Loss of pastures and reduced income
Urbanization
Ageing of pastoralists
Revitalization of (traditional) pastoralism
(Need for) diversificatic income sour
Technological development
Local education, employement and recreation opportunities
Vital local cultures for young generation
Price for meat
Communal meat processing facilities
Labels for locally produced meat
Rural development policies

Figure5


Transport
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"Self-sufficient economies"
"Tyranny of climate governance"
"Sustainable use of ecosystem services"
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