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POLICY PERSPECTIVE

Nature-Based Solutions for Europe's Sustainable Development

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Abstract

Pursuing economic targets of job creation, growth, and innovation while tackling global environmental challenges, has long been seen as impossible. However, any long-term economic competitiveness and security depends on the extent to which natural resources are used sustainably. Therefore, the European Union is investing in nature-based solutions to achieve this double goal. The difference between the prevailing economic model and a sustainable resource use has long seemed insurmountable. While many debates are paralyzed or radicalized, nature-based solutions could offer a transition path with realistic, incremental steps toward a sustainable economy as envisaged by the EU Horizon 2020 vision. This paper outlines the basics of a nature-based scenario for Europe, and proposes criteria to focus, guide, and evaluate the implementation of nature-based solutions, geared at production of wide socioeconomic benefits, provision of jobs, and low-carbon technology innovations.

Introduction

Pursuing job creation, growth, and competitiveness while tackling the global environmental crisis, is a long-standing economic and societal challenge and a top priority for the European Commission, the executive arm of the European Union (EU; European Commission 2010). Any region's economic competitiveness and security—in the long run—depends directly on sustainable use of natural resources. Increasing the production of manufactured capital with non-renewable resources could boost economic growth and create jobs, but trades off with global challenges such as climate change and biodiversity loss. The increasing use of non-renewables causes transgression of systemic boundaries on planetary and local scales (Rockström *et al.* 2009; Steffen *et al.* 2015) threatening the economy as a whole. To achieve this double goal of economic growth and sustainability, the EU will invest in so-called *nature-based solutions* under Horizon 2020, the EU's research and innovation program. These are defined by the European Commission as *living solutions inspired by, continuously supported by and using nature, which are designed to address various societal challenges in a resource-efficient and adaptable manner and to provide simultaneously economic, social, and environmental benefits* (see also European Commission 2015a). Within this very broad concept, we put forward the basics of a nature-based scenario for Europe, and we propose quantitative criteria to focus, guide, and evaluate their implementation, geared at the production of wide socioeconomic benefits, provision of jobs, and low-carbon technology innovations. As such, nature-based solutions might offer a credible transition path of realistic incremental steps toward a sustainable economy.

EU citizens expect a sustainable economic growth model which avoids irreversible and unpredictable changes to the global ecosystem. Addressing the current economic model's perilous assumptions of infinite natural resources and pollution buffer capacity is now a concrete and urgent issue for European leaders. This

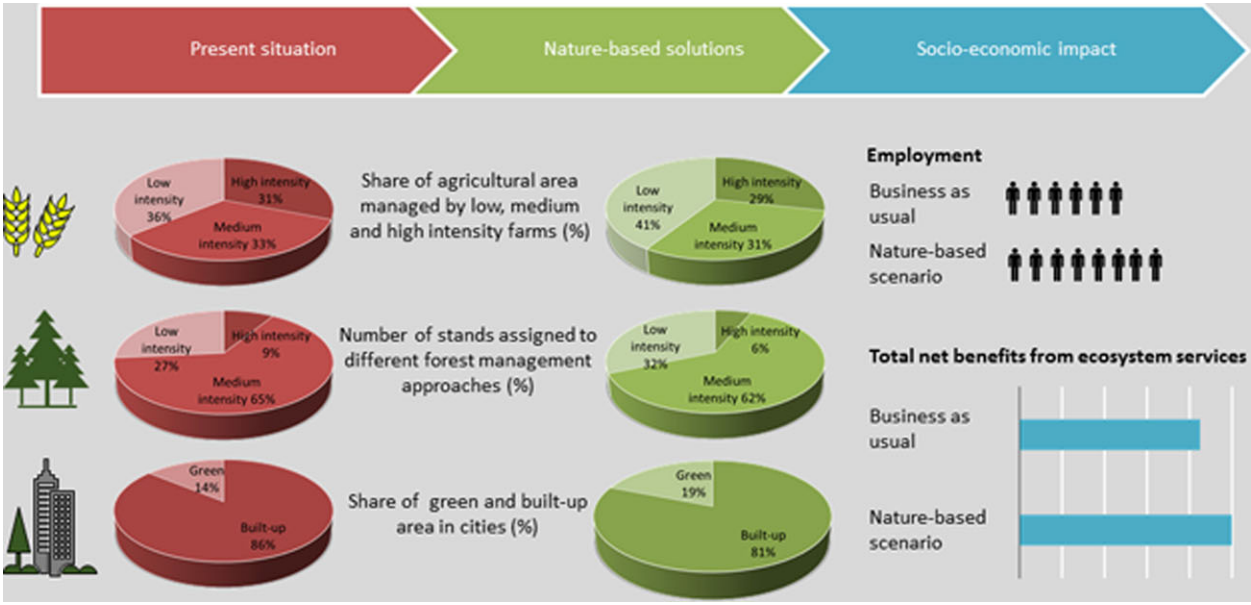

Figure 1 Potential of a nature-based economic scenario: increasing the nature-based use of farmland, forests, and urban areas creates additional jobs and increases total socioeconomic benefits of ecosystem services. The rationale and data sources used to make this figure are presented in the Supporting Information.

is clearly reflected in Horizon 2020 which promotes research as a driver to smart, sustainable and inclusive growth, and jobs (European Commission 2015b)

During the last five years, Europe has seen a surge of research and policy initiatives on *ecosystem services*, heavily supported by the European Commission through the "EU Biodiversity Strategy to 2020" (European Commission 2011). Ecosystem service research connects ecology with human well-being and economy, by classifying and studying the benefits people receive from ecosystems. Realizing these benefits always requires human investment: from a minor intellectual effort to enjoy a scenic view, to large labor and energy investments to produce food. All ecosystem service flows occur along this gradient from nature-based use (e.g., picking mushrooms) to technical use (e.g., greenhouse crop cultivation). Entire technical substitution of ecosystem services is rare, as is an entirely natural flow. The gradient in ecosystem service use from nature-based to more technical forms is determined by the energy mix applied (van den Bergh & Jeroen 2001; Day *et al.* 2009): the ratio of renewable capital (ecosystems, renewable energy, labor) versus non-renewable natural capital (fuel, minerals, rare earth materials) invested to generate benefits.

The nature-based versus technical use, in turn, determines effects on other services' future supplies. For instance, a modern agroindustrial farm effectively produces large amounts of food, but influences the linked supply of cultural and regulating services by altering ecosystems. Also, conventional modern farming increases nutrient and chemical inputs into the environment and depletes soil organic carbon, jeopardizing the future supply of food. This type of trade-off between technically optimized, single-service use, and rising externality costs appears in all described ecosystem services. Avoiding these trade-offs and increasing synergies—in other words, changing the energy mix—can substantially increase ecosystem service flows without generating more negative effects.

This vital role of nature in realizing the economic policy objectives of the EU is recognized in the EU's Green Infrastructure Strategy (European Commission 2013). Nature is no longer solely seen as a source of commodities to (temporarily) relieve an economic crisis, but inspires more systemic economic solutions. From a systemic viewpoint, a natural system consists of highly productive and interconnected subsystems thriving exclusively on renewable energy while producing and recycling goods in a highly effective way. These "ecosystems" evolve to diverse but locally optimal equilibriums between productivity, adaptability, and resilience.

Nature-based solutions

The EU intends to invest substantially in nature-based solutions to tackle the socioeconomic challenges we

face in the 21st century. The Horizon 2020 program foresees large-scale pilots and demonstration projects of tangible nature-based solutions, which should maintain or increase production of well-being and welfare at lower costs, and offer potential for job-rich innovation (e.g., BenDor *et al.* 2015). Concrete application of nature-based solutions in a research and innovation agenda requires a sharper definition of nature-based solutions, capitalizing on the accumulated knowledge on ecosystem services. In that sense, we define nature-based solutions as any transition to a use of ecosystem services with decreased input of non-renewable natural capital and increased investment in renewable natural processes.

Opportunities to promote nature-based solutions already exist for numerous ecosystem service applications (Figure 1). For the example of food production, nature-based use can be realized by (partial) replacement of fossil fuel and fertilizer input by natural processes and jobs. Innovations in agroecology and ecological intensification could increase productivity while delivering opportunities for skilled labor (Bommarco *et al.* 2013; Edwards *et al.* 2013). Short-term costs for fuel, chemical pest control, and external damage mitigation will drop, while benefits arise from the improved bundled delivery of ecosystem services such as natural pest control, pollination, water quality regulation, enhanced soil fertility, and erosion control. On the medium term, benefits increase even more: as ecosystems are renewable and therefore combine lower maintenance cost with longer lifetimes, initial investments are depreciated over longer periods compared to technical systems, although fast depreciation is encouraged by many taxation and accounting systems. Ultimately, the long-term benefit is safeguarding food security. Similar benefits on short, medium, and long terms can be quantified for other ecosystem services, in particular in cities. Relatively small increments of nature-based use of urban systems, for example, by implementing green roofs, pockets of nature, or sustainable urban drainage systems, have the potential to generate large socioeconomic benefits.

Stepping stones to a new green economy

Current conditions for the development, implementation, and evaluation of nature-based solutions seem favorable: the number of EU Member States which initiated a national ecosystem service assessment under Action 5 of the EU's Biodiversity Strategy to 2020 is growing, scientific knowledge is accumulating and societal awareness on ecosystem services and sustainability issues is rising. However, the seemingly insurmountable difference between the prevailing economic model and a strongly sustainable economy paralyzes and radicalizes debates. Here, nature-based solutions could realize a resource use transition in realistic incremental steps, if guided by a clear vision and permanent evaluation. Development and evaluation of nature-based solutions therefore spans three requirements: (1) decrease of fossil fuel input per produced unit, (2) lowering of systemic trade-offs and increasing synergies, and (3) increasing labor input and jobs.

Conditions for effective implementation of nature-based solutions

The total net benefit of nature-based solutions depends on how much non-renewable energy can be replaced without decreasing total production of ecosystem services. Realizing nature-based solutions requires political, economic, and scientific challenges to be tackled. First and foremost, adaptation of economic subsidy schemes is required. Shifting the current financial promotion of fossil-fuel consumption toward renewable energy and job promotion is a prerequisite to allow development of nature-based solutions, although there is little political will to do so. Second, for investors and practitioners to choose for nature-based over conventional techniques, choices and decisions have to consider larger temporal and spatial scales and integrate diverse values (Dendoncker *et al.* 2014; Menz *et al.* 2013; Adams 2014). Whenever long-term net benefits for society do not concur with short-term interests of businesses, opportunity costs, and economic risks could be shared by society using subsidy systems or other legal instruments. Third, ecological innovations are key to design nature-based solutions which effectively contribute to sustainable economic growth. Rapidly growing fields such as ecological engineering, agroecology, ecological intensification, and sustainability economics should therefore focus strongly on real-life practical applications with upscaling potential and socioeconomic relevance.

Nature-based solutions can help us to remain within the safe operating space for humanity, improve local ecological and social sustainability, and guarantee long-term productivity. Europe has the opportunity and responsibility to apply nature-based solutions—now a broad concept embracing diverse societal actors—as a guiding economic strategy geared toward shifting our natural resource use.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Table S1. Shares of agricultural area managed by low, medium and high intensity farms.

Table S2. Number of stands assigned to different forest management approach for Europe.

Table S3. Share of built-up and green/blue areas in cities in Europe (based on a sample of 30 cities).

References

Adams, W.M. (2014) The value of valuing nature. *Science*, **346**, 549-551.

BenDor, T.K., Livengood, A., Lester, T.W., Davis, A. & Yonavjak, L. (2015) Defining and evaluating the ecological restoration economy. *Restor. Ecol.*, 209-219.

Bommarco, R., Kleijn, D. & Potts, S.G. (2013) Ecological intensification: harnessing ecosystem services for food security. *Trends Ecol. Evol.*, **28**, 230-238.

Day, Jr, J.W., Hall, C.A., Yáñez-Arancibia, A., Pimentel, D., Martí, C.I. & Mitsch, W.J. (2009) Ecology in times of scarcity. *BioScience*, **59**, 321-331.

Dendoncker, N., Keune, H., Jacobs, S. & Gomez-Baggethun, E. (2014) Inclusive ecosystem service valuation, in: Jacobs, S., Dendoncker, N., Keune, H. (Eds.)Ecosystem Services: Global issues, local practices, Elsevier, New York, pp. 3-12.

Edwards, P.E.T., Sutton-Grier, A.E. & Coyle, G.E. (2013) Investing in nature: restoring coastal habitat blue infrastructure and green job creation. *Mar. Policy*, **38**, 65-71.

European Commission. (2010) Europe 2020 A strategy for smart, sustainable and inclusive growth.

European Commission. (2011) Our life insurance, our natural capital: an EU biodiversity strategy to 2020

European Commission. (2013) Green infrastructure (GI)—enhancing Europe's natural capital.

European Commission. (2015a) Towards an EU research and innovation policy agenda for nature-based solutions and re-naturing cities. Final Report of the Horizon 2020 expert group on nature-based solutions and re-naturing cities (full version). Brussels.

European Commission. (2015b) What is Horizon 2020? http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020 (visited May 08, 2015).

Menz, M.H.M., Dixon, K.W. & Hobbs, R.J. (2013) Hurdles and opportunities for landscape-scale restoration. *Science*, **339**, 526-527.

Rockström, J., Steffen, W., Noone, K. *et al*. (2009) A safe operating space for humanity. *Nature*, **461**, 472-475.

Steffen, W., Richardson, K., Rockström, J. *et al*. (2015) Planetary boundaries: guiding human development on a changing planet. *Science*, **347**, 1259855-1-1259855-10.

van den Bergh, S. & Jeroen C.J.M. (2001) Ecological economics: themes, approaches, and differences with environmental economics. *Regional Environmental Change*, **2**, 13-23.

