



Short Communication

Mainstreaming the nexus approach in climate services will enable coherent local and regional climate policies

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Abstract

The current challenges that society faces call for actions fostering climate change adaptation and long-term sustainability grounded in effective policies. Consequently, to raise environmental resilience and sustain human wellbeing, we need to overhaul the policy-making process towards a ‘holistic approach’. The nexus approach has proven a valuable tool for identifying gaps and incoherencies in current policies, for understanding major interlinkages across sectors and scales, and for promoting the Sustainable Development Goals (SDGs). Nevertheless, a ‘silo approach’ to decision making currently prevails, thus achieving cross-sectoral and cross-scale harmonization still remains a challenge in policy-making. In response to this challenge, the next step in the science–policy–practice interface is to integrate the nexus approach in the ‘climate services’ arena, in order to support integrated policies. Climate services embody a bridge between researchers and stakeholders, and by supporting integrated policies they will ensure synergies between sectors and scales, reduce potential trade-offs, and enable co-benefits.

Keywords: Stakeholders; Nexus; Climate services; Cross-sectoral policies; Climate resilience

1. Introduction

Nowadays, society faces multiple challenges generated by climate change and accelerated by socio-economic developments, such as population increase, urbanisation, and lifestyle changes, which together lead to multiple environmental, social, and economic issues. Knowledge and policy gaps among the water-energy-land-food nexus elements,

which may even induce conflicts amongst its actors, add to the above-mentioned issues, compromising the solutions devised by traditionally siloed policy-making processes. As a consequence, these issues often result in unintended and undesirable trade-offs among nexus elements and in unsustainable resource management. This becomes more problematic under climate change and particularly under increased water scarcity (Cremades et al., 2021). In addition to this, adaptation to future challenges, in particular to drought occurrence and intensity increased by climate change, requires new approaches to integrate climate services into decision-making processes dealing with multiple sectors and scales.

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Aiming to showcase how to avoid or handle such trade-offs, we provide insights based on examples of the particular advantages of applying the nexus approach in the context of adaptation to climate change. We also elaborate on the advantages of the nexus approach for sustainable resource management, on the limited degree of implementation of the nexus approach in practice, and on the next steps in using climate services and the nexus approach for ensuring local and regional climate resilience. We base our insights on three case studies across Europe with differences in land and water use and governance structures, namely a touristic urban coastal hub in Spain, a forested mountain river basin in Romania, and a region dominated by agricultural land use in Austria.

2. Why is the nexus approach necessary in climate policy?

If climate change adaptation measures ignore the links of the water-energy-land-food nexus, bad practices or maladaptation may arise. For instance, unbalanced water or energy consumption may increase GHG emissions due to higher fossil energy use, as was observed in different geographical locations and sectors. To ensure long-term sustainability, integrated resource management needs to take into account the links between resource uses across scales and sectors and their dynamics under different challenges. A valuable manner to achieve an integrated and sustainable management of natural resources is nexus thinking. The water-energy-land-food nexus approach is useful for understanding these links (Weitz et al., 2017; Cremades et al., 2019). Moreover, the nexus approach guides decision-makers to move from traditionally siloed resource planning and management to integrated resource management, thus enhancing systems understanding, resilience and adaptability to the hazards induced by climate and socio-economic changes.

3. The degree of implementation of the nexus approach is limited in the science–policy–practice interface

The nexus approach has been discussed since the 1980s (Sachs and Silk, 1990), still it only gained traction in the academic community after 2011 thanks to the Bonn Nexus conference (Hoff, 2011). One year after this conference, the United Nations Conference on Sustainable Development, Rio +20, took place. In the resolution adopted during this conference, a common vision to established “[...] to significantly improve the implementation of integrated water resource management at all levels”. Moreover, they called “[...] for holistic and integrated approaches to sustainable development that will guide humanity to live in harmony with nature”. Also, during this conference, the path towards the Sustainable Development Goals (SDGs) to established, which build “[...] upon the Millennium Development Goals and converge with the post 2015 development agenda”. In the declaration of the 2030 Agenda for Sustainable Development the signing countries “[...] committed to achieving sustainable development in a balanced and integrated manner” (UN, 2013). Moreover, the 2030 agenda is “[...] considered to be universal, holistic and

indivisible, with a special imperative to leave no one behind” (UN-DESA, 2018). Despite these advances, progress has been slow in the policy–practice interface, and few countries or supra-national entities have designed policies that tackle the nexus elements comprehensively (de Andrade Guerra et al., 2021). In the Advancing the 2030 Agenda: Interlinkages and Common Themes at the High-Level Political Forum organized by the Division for Sustainable Development, UN-DESA, the participants emphasized: “[...] inadequate or poorly developed governance structures, for example in connecting across global, regional, national and local levels in the case of the food-energy-water nexus, it is also important to link to national and regional sustainable development plans” (UN-DESA, 2018). Scientific literature has provided sufficient evidence that narrow, sector-specific policies may generate unintended and undesired consequences due to neglecting cross-sector and cross-scale interlinkages (Cremades et al., 2016; Hudson et al., 2019; Venghaus et al., 2019). Land use and management are linked to the availability and quality of water resources, which affects the opportunities for mitigation and adaptation to climate change, and the production of food and other environmental services (FAO, 2013). Therefore, we consider it fundamental to refer to the water–energy–land–food nexus, especially taking into account the latest trends in vertical and organic farming. In addition, inadequate land use and management will increase the vulnerability to water hazards such as floods, which in turn may trigger land degradation processes (through erosion processes) with long-term impacts. Furthermore, as a result of the intensification of extreme weather events in the context of climate change, land degradation processes may increase the risk of desertification across EU member states (Prigent et al., 2018). In Europe, there has been an increase in large-scale desertification in Southern and Central Southeastern countries (Právělie et al., 2017; Prigent et al., 2018). It should be noted that degraded land may still be economically viable (e.g., building houses and roads, installing solar panels) but with mostly irreversible consequences in terms of biocenosis (permanent loss of soil productivity, biodiversity and food production). For fostering sustainable land use and management in the context of climate change, we need to consider and enhance knowledge about the interlinkages with other sectors. This may also support the achievement of EU’s climate and biodiversity objectives (2030 EU Biodiversity Strategy), Land Degradation Neutrality by 2030 and the development of a circular bio-economy including nature based solutions. Furthermore, considering additional nexus elements will aid to understand interactions across sectors and scales, and broaden horizons in assessing trade-offs and co-benefits in order to follow a climate-resilient transformational pathway (Liu et al., 2018; Cremades and Sommer, 2019). In this context, conventional siloed approaches to decision- and policy-making, although still dominant, are not adequate to achieve long-term sustainability under climatic and socio-economic change. On the contrary, comprehensive nexus approaches, which could effectively promote sustainability, are seldom considered. We observed eight main reasons for this hindrance across three

case-studies in Europe: i) limited collaboration amongst distinct sectors and stakeholders because of a tradition in sectoral policy-making, ii) poor consideration or limited knowledge and awareness of the implications of change on nexus components and their dynamic interactions, iii) superficial analysis of research results by societal actors, iv) bias related to ‘hot cognition’ (Kret and Bocanegra, 2016) leading to a focus on current disasters such as droughts and floods in detriment of long-term planning, v) disconnection in the legislation between national and regional or local scales that impede cross-sectoral and cross-scale planning and management of resources, (Cremades et al., 2021), vi) insufficient research with co-production and co-dissemination about the advantages of ex-ante long-term planning and evaluation, vii) inappropriate discounting of potential future costs and benefits under deep uncertainties, and viii) orientation of most decision-makers to short-term emergency response strategies (Tudose et al., 2020). These factors represent considerable barriers in the implementation of the nexus approach in local and regional climate policies.

4. Next steps in the nexus approach for ensuring long-term climate resilience

The next step in nexus research is its mainstreaming in the climate services arena, by integrating climate information in nexus tools (Bahri and Cremades, 2021) and by emphasizing co-production practices with policy- and decision-makers. This step will ensure moving beyond a linear science-policy interface through empowering policy- and decision-makers in the continuous knowledge change processes and to incorporate their knowledge and experience in the research process in order to co-delivering climate-resilient societies (Gorg et al., 2016). This new approach will provide the necessary information to understand and diminish potential trade-offs and to highlight feasible synergies and co-benefits between the involved sectors and across scales, e.g. integrating *de facto* shared water scarcity between cities and agriculture, understanding the implications at the river basin scale, and researching the implications for the future management of forested land use.

Providing usable climate services implies transforming climate projections and local knowledge into tools and information tailored to the local needs of decision- and policy-makers (Jacob et al., 2015). If climate services are developed, is also proposed to significantly engage stakeholders in all major research stages—co-design, co-production and co-dissemination.

We here argue that the ‘co-’ is not enough during research, but has to be extended into the governance structures of all nexus-related elements to explore its trade-offs and the implications of the related policies across sectors and scales. In river basins experiencing an increase in the number and intensity of droughts, we observed how changes in land use and management, e.g. by converting rain-fed to irrigated land, are disconnected from urban growth implying a further expansion of water demands. Extending the ‘co-’ is necessary on the one hand to ensure powerful science—policy—practice interfaces for

nexus management and, on the other hand to increase societal resilience in the face of multiple socio-economic, climatic and environmental challenges. In this respect, governance mechanisms should be implemented in order to i) highlight the interaction of different sectors under different pressures (socio-economic, climate etc.); ii) understand the local needs and interests of relevant stakeholders and balance preexisting power structures; iii) ensure transparent information on nexus elements, their interactions, and related decision-making; and iv) when possible legally enforce—a collective agreement on sustainable management of resources (Tudose et al., 2020).

In summary, integrating the nexus approach with climate services at local and regional scales (Cremades et al., 2019) will enable the development of decision-support tools for developing coherent local and regional climate policies. When co-creating these decision-support tools with societal stakeholders it is necessary to incorporate the most recent climate projections with high spatial resolution at local to regional scales, e.g. from the Copernicus Climate Change Service (Cheval et al., 2020) and to build upon local knowledge and information to consider local specificities of the nexus in order to understand, avoid or minimize the trade-offs.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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