



COMMENTARY TO SEI REPORT 'WHERE IS THE ADDED VALUE? A REVIEW OF THE WATER-ENERGY-FOOD NEXUS LITERATURE'

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We appreciate the efforts Stockholm Environment Institute (SEI) has made to review the concept of the water-energy-food Nexus (Galaiti et al., 2018) 10 years after the concept has surged to the attention of scientists and policy-makers (World Economic Forum water initiative, 2011). Such a critical reflection is timely and relevant, and it is admirable that it comes from one of the institutes that have contributed to launch the Nexus concept (Hoff, 2011). Some findings of the publication (e.g. regarding the links between key constraints of the Nexus, the main intervention points and potential outcomes) are relevant to guide SIM4NEXUS and other research initiatives on the Nexus. We however disagree with the conclusions. In the following we elaborate on our reasons, in the hope to stimulate a scholarly conversation leading to further developments of the Nexus research.

Our first comment relates to the definition of the Nexus. The report is concerned with the diversity and flexibility of use of the Nexus concept in empirical research. It is argued that, as the Nexus concept is used in different contexts, the definition remains open or flexible at least, thus being difficult to pin down. While recognizing the importance of conceptual clarity, we find added value in flexibility and adaptability of the concept. Adopting a nexus lens in research about, for example, food-water-energy in urban areas is, by nature, very different than using the Nexus approach to support the achievement of global Sustainable Development Goals. This is because of the diversity of governance processes involved across scales and jurisdictions. Therefore, from the perspective of the governance of the Nexus, flexibility and adaptability to different policy environments are desirable features. From a governance perspective, adopting a nexus lens means being able to identify critical objectives to pursue to maximize synergies and effectively manage trade-offs across sectors. Resource efficiency and circular economy, for example, are major domains of EU policy that if addressed from a Nexus perspective could lead to much more results than if tackled with a sectoral approach. Similarly, mainstreaming nature-based solutions in European policy using a Nexus lens could help identify and therefore exploit synergies across sectors. In general, we argue the Nexus concept is relevant to support policy making (Brouwer et al., 2018). In particular, we consider the following to be key features of the nexus concept.

1. **Focus on bio-physical, socio-economic and policy interactions.** Interlinkages between natural resources (i.e. water, energy, food, land, biodiversity under climate change conditions) are investigated, trade-offs among them are made explicit and potential synergies are exploited, using also advanced Complexity Science methodologies that take into account loops and feedbacks from bio-physical, socio-economic and policy interactions.

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2. **Search for a balance between different needs with the end goal of sustainable and integrated management of natural resources.** This search for balancing different needs across sectors could lead to choose for the ‘least worst’ solution rather than the ‘best’ solution. The least worst solution is the result of a negotiated compromise across sectors, while the best solution is often the result of an optimization exercise done from a sectoral perspective. For example, while optimizing food production may cause trade-offs with other natural resources (e.g. water and land), a search for a balanced solution between agriculture, water and land needs may limit the impacts of such trade-offs and even exploit synergies across domains.
3. **A systematic effort to achieve policy coherence across sectors.** Policy coherence is an attribute of policy by which conflicts are reduced and synergies exploited within and across policy areas at different spatial scales (Munaretto and Witmer, 2017). Understanding interlinkages between resources is insufficient if such interlinkages are not accounted for in policies across sectors. In this regard, by accounting for interlinkages, policy coherence ensures the risk of trade-offs from inadequate decision-making is minimized. Policies not directly linked to natural resources (such as health) could also benefit from a Nexus approach, as indirect interactions may exist that are not accounted for. Finally, it is important to recognize that achieving policy coherence is a continuous, systematic effort that permeates all phases of the policy making process from policy design to implementation and evaluation.

Our second comment relates to the research investigation. The report has reviewed the literature on the water-energy-food Nexus, using the Web of Science search engine. About 200 references published between 2011 and 2016 were examined, complemented with some additional Nexus research findings. However, since 2016 numerous scientific publications have significantly advanced knowledge on the subject and more recently a book has brought together the research in the field (Bleischwitz et al., 2018). Besides that, a growing body of research on the Nexus is undergoing since at least 3 years. Projects and calls for upcoming research for a total budget of at least €100 million have started since 2016. Specifically:

- a. Three major Nexus projects started in 2016 funded by the EU H2020 programme - SIM4NEXUS, MAGIC and DAFNE. The three projects with a total budget of €20 million cover different objectives: a resource-efficient Europe (SIM4NEXUS – <https://www.sim4nexus.eu/>), implementation of adaptive governance (MAGIC - <https://magic-nexus.eu/>) and transboundary water resource management in fast developing countries (DAFNE - <http://dafne-project.eu/>). Major scientific developments are envisaged, and important results have already been achieved, all embedded in transdisciplinary research methods. The more recently launched EU PRIMA research programme also addresses Nexus issues in the Mediterranean region.
- b. More recently, the Sustainable Urbanisation Global Initiative (SUGI), a cooperative effort between JPI Urban Europe and the Belmont Forum supported by the European Commission, has concluded a call for proposals on the food-water-energy Nexus. Fifteen projects were granted funds (total budget of €28.5 million provided by national funding agencies) for research on the nexus to be conducted between 2018 and 2021.
- c. Outside Europe the attention to the Nexus research is also growing. In the U.S., for example, the U.S. National Science Foundation (NSF) has partnered with the U.S. Department of Agriculture’s National Institute for Food and Agriculture (NIFA) to award \$46.6 million for research on Innovations at the Nexus of Food, Energy and Water Systems (INFEWS; see: <https://bit.ly/2LTomMG>). Furthermore, an on-going call for proposals will grant \$34 million more research funds in the NSF/USDA call Innovations at the Nexus of Food, Energy and Water Systems (INFEWS).
- d. At national scale, several research projects directly related to the food-water-energy Nexus are ongoing or about to start. For instance, in the UK, over £30 million have been assigned to over 100 grants investigating the water-energy-food Nexus in the last 10 years (<https://gtr.ukri.org/search/project?term=water+energy+food>).

All these initiatives show a consistent and continuous interest in the Nexus concept and its implementation at various scales and in different contexts. The upcoming body of research will bring new conceptual, methodological and empirical insights on the Nexus to inform policy making over the next years.

The third comment relates to the Nexus concept improving resource management and governance outcomes. The report makes a strong statement, indicating ‘We found no clear methodology uniting Nexus studies, and a lack of improvement of resource management and governance outcomes’. We argue there can be no single methodological approach or framework to implement the Nexus concept due to the diversity of cases and issues being investigated. Instead, it is important to promote the search for the most suitable and feasible approach, tool or model to represent interlinkages across sectors in every specific situation rather than struggling to find the one method that fits all situations. A similar approach is desirable in policy making. In general, we find complexity science principles and methodologies (e.g. System Dynamics Modelling) suitable to address nexus interactions as they are sufficiently flexible to suit different contexts, while firmly rooted in principles that characterize nexus interactions. For instance, complexity science approaches allow the simulation of feedback loops over long periods of time. Being feedback loops a typical feature of complex Nexus interactions, the use of complexity science methodologies allows to investigate impacts that may be not so evident with other methods. SIM4NEXUS is innovative because the concept of complexity science modelling has not been applied in the context of the Nexus of water, energy, food, land and climate. The reader can find specific methodologies and frameworks in the literature published in prominent environment science journals such as *Science of the Total Environment*, but also in some classic textbooks (such as Ford, 1999). More recent work in the context of the SIM4NEXUS project, confirms the suitability of System Dynamic Modelling in the simulation of water-energy-food nexus interlinkages (Susnik et al., 2018).

There is one more argument speaking for caution when making strong statements as the ‘We found no clear methodology uniting Nexus studies, and a lack of improvement of resource management and governance outcomes’. Such a statement could lead to freezing research and implementation funds; therefore one should make sure to have sound evidence supporting the claim. We think such evidence is not there yet, as it is difficult to believe a scientific concept could improve resource management and governance outcomes in less than a decade. The theoretical development, implementation and evaluation of the impacts of whatever scientific approach takes certainly more than a decade to show results that can lead to significant conclusions about its effectiveness. We are at the stage of the Nexus research where methods and frameworks for understanding trade-offs and synergies across Nexus sectors are being developed and implemented. This is insufficient to achieve outcomes that improve the sustainable management of the Nexus resources as such trade-offs and synergies need to be accounted for in sector policies. For full operationalization of the Nexus concept transdisciplinary research approaches are needed. This includes using state-of-the-art science in collaboration with stakeholders from policy, business and civil-society organisations. We trust on-going research on the Nexus will move towards full operationalization of the concept.

Overall, we believe the Nexus concept is a sound tool to support sustainable management of resources across sectors, suitable for addressing the challenge of the next few years, namely achieving the Sustainable Development Goals. From a governance perspective, the main pillar of the Nexus concept is policy coherence. The relevance of policy coherence is found, among others, in work of the European Commission and of OECD. Also, the Nexus concept is taken up by the World Economic Forum, WWF, Institute of Mechanical Engineers (UK), World Bank to some degrees, SAB Miller, Coca-Cola and other organizations. This wide interest around the Nexus across public and private agents (and not only academics) shows there is momentum for this approach to develop and mature to a level that can show meaningful impacts in the years to come.

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