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The water–food–energy Nexus – Realising a new paradigm

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SUMMARY

The water–food–energy Nexus has emerged as a new perspective in debates concerned with balancing potentially conflicting sectoral imperatives of large scale development investments concerned with energy, water or food security. Current frameworks are partial as they largely represent a water-centric perspective. Our hypothesis is that a dynamic Nexus framework that attempts to equally weight sectoral objectives provides a new paradigm for diagnosis and investigation. Dynamic refers here to explicitly understanding (or a diagnosis of) the dynamic relationships and ripple effects whereas static-comparative refers to a comparison of states before and after change. This paper proposes a balanced Nexus framework and presents results from an application to the Mekong basin. The analysis identified the advantages of a sectorally balanced, dynamic Nexus approach, in particular the ability to reveal either the emergence of cross-sectoral connections, or changes in those connections, as a consequence of single sector interventions.

1. Introduction

The water–food–energy Nexus has emerged as a new perspective to structure large-scale investments, its conceptual relevance and pragmatic potential emphasised by many policy makers during various supra-national fora. The key rationale for the Nexus discussion is that historical sectoral investments have generally been geared to prescribed, sector specific objectives and optima without cross-sectoral coordination, exposing the Nexus to a high risk of unintended side-effects and negative sectoral trade-offs. The systems approach to Nexus interactions applied here is consistent with *inter alia*, Hussey and Pittock (2012) and Newell et al. (2011) (as cited in Hussey and Pittock) summarised as: "*a system's performance cannot be optimized by optimizing the performance of its subsystems taken in isolation from one another …efforts to avoid unwanted policy outcomes and to identify leverage points for effective change must take into account the effect of interactions between sectors.*"

Developing investment strategies based on the Nexus architecture demands a clearer focus of integrated research, continuing the process introduced at the United Nations Conference on the Human Environment (UN 1972, cited in Muller Muller (2015)) and reinforced by two decades of conventions developing the notion of sustainability paradigms articulated and prescribed in the 1990s (Muller, 2015). Since gaining political momentum in 2008, conceptual variants and revisions of the Nexus conceptualisation have been developed in the science domain (Benson et al., 2015) and one actual Nexus study has been implemented in the Mekong basin (Smajgl and Ward, 2013a,b). Consistent with, for example, Bach et al. (2012), we argue that existing Nexus frameworks remain largely water-centric and therefore partial, by privileging one sector over others. By establishing evidence that current Nexus analyses are insufficiently cross-sectoral and presenting evidence of a balanced Nexus approach that assigns equal sectoral weighting, we propose this paper is more effectively positioned to provide novel insights for understanding cross-sectoral dynamics. We describe a balanced Nexus framework and the results of an application in the Mekong region to diagnose and analyse Nexus interactions. We address the question of how the Nexus paradigm can be applied to become an innovative and effective approach to assist integrated, multi-sectoral policy deliberations. In conclusion, we examine the additional benefits a Nexus perspective yields by testing implementation options and results to move the debate from a largely conceptual, abstract domain to actual implementation. Application and analysis of the Nexus framework in the Greater Mekong sub-region identified the improved capability to identify and diagnose cross-sectoral interactions as a key advantage of a dynamic Nexus approach compared to static assessments.

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The dynamic approach revealed how the occurrence, valency and magnitude of sectoral connections emerge and are altered as a consequence of single sector interventions in a water–food–energy Nexus.

2. From a water-centric to an integrated conceptualisation of the Nexus

The World Economic Forum (WEF) has been among the first organisations to identify the water–food–energy Nexus as a key development challenge, calling for a better understanding of the inter-linkages between water, energy and food at the 2008 Annual Meeting in Davos (WEF, 2011a,b). The World Economic Forum (WEF) Water Initiative explored water security in relation to energy and food systems, climate, economic growth and human security challenges, and the Water Resources Group launched a Nexus initiative with water security as a practical entry point (WEF, 2011a,b). Consistent with the WEF, the Bonn 2011 Nexus conference also emphasised the centrality of water resources (Hoff, 2011; Benson et al., 2015). However, focusing on water undermines the original intention of developing an explicit cross-sectoral perspective and response options that supersede traditional sectoral approaches. Isolated sectoral investment risks prioritising the goals of one specific sector – in this case, water – over others.

A recurring criticism of the Nexus approach is that it represents a variant of existing "integrated approaches" to design and assess investments across multiple sectors and yields relatively minor additional dividends. For instance, Odendaal (2002) contends that Integrated Water Resource Management (IWRM) pursues the integrated and coordinated management of water and land as a means of balancing resource protection while meeting social and ecological needs and promoting economic development. IWRM focuses on balancing the objectives, motivation and values of diverse and often competing water interests. However, in reviewing the IWRM concept and attendant empirical evidence, Bohensky et al. (2009) and Medema et al. (2008) argue there has been a reluctance to formulate an agreed definition and to specify operational and implementation mechanisms. Reluctance may reflect a preference for IWRM to be context specific, but it has led to an excess of definitions, semantic skirmishes and diverse and competing understanding. "*Furthermore, it contradicts itself in purporting to be holistic, by having water – rather than all natural resources and their interlinkages – as its central focus*" (Bohensky et al., 2009, p. 14). Shah (2009, p. 199) for example, argues that efforts in Asia and Africa to introduce IWRM have attempted to impose prescribed water use entitlements, sovereign rights and water trading as "endpoint" outcomes, rather than promoting "entry point" deliberative processes to discover IWRM adaptations aligned to the local water shed context. Muller (2015) contends that despite deliberative engagement, IWRM advocates concede that effective IWRM initiatives have been limited, particularly evident in low and medium Human Development Index countries where, according to UNEP (2012), progress has slowed or even regressed.

Similarly the Nexus is not immune from ongoing debate and critiques. Benson et al. (2015) for example highlight the lack of agreed definitions and praxis, stating that Nexus conceptualisations are far from unified, varying according to the focus of sectoral integration, the geopolitical context and empirical foci of research. In addition to the lack of precise terms and the tendency to revert to single sector perspectives, another critique of the Nexus approach (as implemented to date) concerns barriers to equitable distribution. Leese and Meisch (2015) argue that the reframing of Nexus security as a sustainability mechanism compromised the Bonn 2011 claim that the needs of the poorest were a Nexus priority.

Foran (2015) argues that the dominant conceptualisations articulated in the Nexus literature are fundamentally depoliticised, failing to account for historical social and political trajectories that give rise to contemporary water, food and energy planning and regulatory regimes. It is these sector specific regimes that have, and continue to impose net costs on the poor and corresponding distributional disparities. Foran (2015) argues that incorporating social and political context, essential for effective cross sectoral negotiations, can be achieved by reconceptualising the Nexus as the cumulative effects of development projects coupled with an appraisal of prevailing water, food and energy "provisioning" regulatory and planning regimes.

The Nexus debate was stimulated by the Bonn Conference and coincided with the development of a few Nexus conceptualisations (Benson et al., 2015). Several concepts, frameworks and methodologies have looked at the inter-linkages between water, energy and food (Mohtar and Daher, 2012; ADB, 2013; Bizikova et al., 2013; UN-ESCAP, 2013), but also land and soil (European Report on Development, 2012; Hoff et al., 2013), minerals (Andrews-Speed et al., 2012), and ecosystems (ICIMOD, 2012; UNECE Task Force on Water–Energy–Food–Ecosystems, 2013). Yet the approaches differ greatly in their scope, objectives and understanding of either interdependent or causal factors as the following three examples illustrate.

The Qatar Environment and Energy Research Institute (QEERI) developed a conceptual framework and tool that addresses the Qatari context of water scarcity, arid lands and a high dependency on food imports (Mohtar and Daher, 2012). Qatar's food security is the central focus of the Nexus investigation (QEERI, 2012) where Nexus inter-linkages are described in terms of the sources and scarcity of resources required to produce and import food. The QEERI Nexus framework does not explore other cross-sectoral interactions and the dynamics and state of the natural environment.

The European Report on Development (ERD) (2012) focuses on the management of water, energy and land resources across sectors subject to increasing relative scarcity and prices, based on changes in climate, global population and economic growth. The entry point for analysis is the integrated management of water, land and energy resources. The report examines cross-sectoral inter-linkages – for example, of land management policies and the implications for different natural resources. The report does not articulate Nexus-wide, ripple effects of policies on baseline conditions and factors, which represent the initial foundation of policy design.

UNECE has developed a methodology to assess the water–energy–food–ecosystems Nexus in transboundary rivers and aquifers (UNECE Task Force on Water-Energy-Food-Ecosystems, 2013). The method proposes a consultative, open-ended process to identify the "complex chains of cause-effects that link human interventions to environmental degradation and availability of resources" (UNECE Task Force on Water-Energy-Food-Ecosystems, 2013, p. 1). There are four dimensions of analysis – natural environment; economic uses and needs; future trends, drivers, and strategies; and transboundary agreements, governing bodies and policies – to understand how natural resources and ecosystems are impacted. Conceptually, these impacts are presented as "chains" of causal, linear linkages, rather than "systems" of multiple and dynamic inter-linkages as we argue in the remainder of the paper.

We therefore depart from both water-centric conceptualisations and static Nexus approaches. The dynamic Nexus approach described in this paper emphasises the continuous interaction between (1) the three sectors and between (2) the Nexus core and the three Nexus sectors. The Nexus core consists of drivers critical for water, food and energy sector dynamics and cross-sector feedbacks (Fig. 1). For the purpose of this paper we limit