Draft 1 – 31 October 2016

The Urban Nexus:

Conceptual Framework and Linkages to Global Agendas[1]

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1. Introduction

As major centres of human populations, cities are also economic powerhouses responsible for around 80 per cent of global GDP. Although increasing urbanisation and economic growth provide significant benefits, they

[1] This discussion paper is developed for the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) by Adnan A Hezri. For feedback please E-mail: hezri.adnan@anu.edu.au

also play a major role in the global rate of resource consumption and are significant sources of anthropogenic environmental impacts. Cities consume around 70 to 75 per cent of global energy and materials, a megatrend which is set to continue into the future (Hodson, Marvin, Robinson, & Swilling, 2012; IEA, 2008; Shell, 2012; UNEP, 2013a).

In recent decades, countries in Asia and the Pacific region have seen the intensification of economic, social, political, and cultural changes involving rapid transformation of natural and agricultural land into urbanised areas that is historically unprecedented. They also act in concert to form interlocking effects presenting systemic challenges of natural resources insecurities. If not tackled well, such insecurities may become impediments to social stability and economic growth.

The solution to the interlinked challenges outlined by many is 'nexus thinking' or a 'nexus perspective'. Specifically, the existence of a water-energy-food nexus (WEF) has been gaining significant attention in international natural resource management and policy debates in recent years. The WEF nexus is also a cross-scale phenomena with global, regional, national and local consequences. Arguably, what is urban about the nexus is also a critical issue in terms of natural resources management but also governance or institutional enabling factor.

1.1. Urban Challenges

The UN's *World Urbanisation Prospects* (WUP) report estimates that around 54 percent of the people on the planet now live in urban settlements (UN, 2014). It also projects that continuing population growth and urbanisation will result in 2.5 billion people being added to the global urban population by the middle of the century. By 2050, the global level of urbanisation is expected to rise from 54 per cent (in 2014) to 66 per cent. In this 'second urbanisation wave', overall, nearly 90 per cent of the global urban population increase is set to occur in Africa and Asia, currently the two most rural continents in the world (UNEP 2013). By 2050, Asia's cities in China and India alone will have grown by an additional 696 million.

Urbanisation in the Asia and Pacific region has important global implications. In 2014, 60 per cent (4.3 billion) of the worldwide urban population was living in Asia and the Pacific. It is the most populous region in the world. It is also home to 17 megacities, out of 28 globally. By 2030, the region may have 22 megacities. The ESCAP's *State of Asian and Pacific Cities Report 2015* estimates that half of the region's population will be urban by 2018 (Figure 1). The growth so far has followed the sprawl model; as cities expand, there is also growing concern that productive land and natural areas are converted to urban uses, especially through informal conversion. Manila, Jakarta and Bangkok have expanded intro sprawling mega-urban regions stretching "50 kilometres to 100 kilometres from the city centre, engulfing small towns, cities, and rural areas on the urban periphery on a scale never seen before" (UNDP 2016: 156). In a study on dematerialisation by the United Nations

Environment Programme (UNEP) and The Commonweatlh Scientific Research Organisation (CSIRO), data shows that by the start of the twenty-first century, the Asian and Pacific region had become the world's largest resource user, consuming 35 billion tonnes of metal ores, industrial minerals, fossil fuels, construction minerals and biomass per annum by 2005. This is 58 per cent of the global resource use of about 60 billion tonnes.

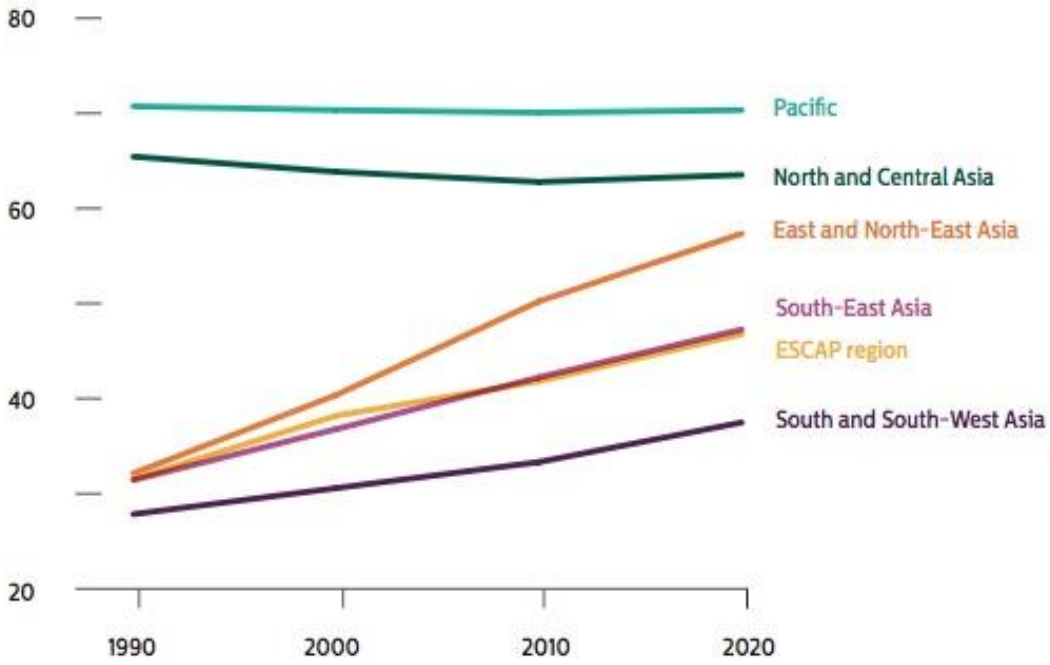

Figure 1: Urbanisation in Asia and the Pacific across subregions, 1990–2020
Source: aESCAP 2013 [http://www.unescapsdd.org/files/documents/SPPS-Factsheet-urbanization-v5.pdf]

Moving forward, how countries in Asia and the Pacific manage urbanisation over the next 15 years will be critical to ensuring continuous resource availability for development. Ultimately, it will help define governments' ability to achieve the Sustainable Development Goals (SDGs) and the New Urban Agenda.

1.2. The Nexus Imperative

Cities are a complex system with many cross-cutting challenges. The lack of adequate infrastructure and social organisation to deal with growth in cities, means that environmental unsustainabilty and resource insecurity can only intensify. A security threat gaining increased attention has to do with pressures and tensions around global provision of water, food and energy. In 2050, with a forecast 9.2 billion people sharing the planet, it is expected that there will be a 70 per cent increase in demand for food and a 40 per cent rise in demand for energy (Hoff, 2011). By 2030, however, the world will have to confront a water supply shortage of about 40 per cent. Against this

background, the recent years saw a conceptual surge with the resource nexus idea. The key motives for the growth of the 'nexus industry' are at least four-pronged:

- *Stressed resource system* – world's WEF resources are already experiencing significant shortfalls and their exploitation has led to ecological degradation;
- *Demand rapidly increasing* – growing population, insatiable demands from expanding middle-class lifestyles and diets;
- *Well-being and access* – need to improve the well-being of the poorest and most vulnerable populations by securing access to WEF; and
- *Securitisation* – without considering interconnections, resource allocation may easily become a zero-sum game where intense competition for resource access can easily become conflict.

In addition to the global attention and political reference to the nexus strategic importance of the nexus, there is also increasing recognition of the dynamic interplay of resources in an urban context (ESCAP 2015: 15):

> "Water, energy and food security are closely interconnected, providing an opportunity for a 'policy nexus' that integrates urban planning and resource management within and across urban boundaries or jurisdictions. Resource-efficient approaches and practices can ensure that natural commodities are conserved and consumed prudently. Integration of resource planning and management - a 'policy nexus' - requires the active involvement of all actors and stakeholders at local and regional levels, but there is often a lack of institutional capacity and coordination for planning and management in local and regional governments."

The nexus perspective is solutions-orientated and aims to avoid the pitfalls of governing resources in silo. Attempting to solve a problem in one domain can cause a problem in another. It contends that lack of proper analysis may lead to negative trade-offs impacting policy and technological choices, if not misguided policies. Therefore, the nexus approach seeks to understand risks, engage decision-makers, and enable action. It asks what are the different pathways that lead to resource security,sustainable development and green growth. Another dominant interpretation of the nexus stresses knowledge integration, efficiency, synergy and 'win-win' solutions.

For these ambitions, the nexus thinking can be seen as the latest in a series of policy narratives based on integrative ideals following on from notions such as Integrated Water Resource Management (IWRM), Integrated Natural Resource Management (INRM), Integrated Environmental Management (IEM), Integrated Solid Waste Management and other integrative policies around water that emerged in the 1980s. However, past approaches have encountered significant barriers to progress, including challenges to cross-sector collaboration, complexity, political economy and incompatibility of current institutional structures. The contemporary nexus approach provides a framework – and a context for – that reignites integrated resource management. With securitisation, it launches a new agenda setting stage or a policy window that points to the urgency of integrated thinking and action.

1.3. Defining the Urban Nexus

The meaning of nexus remains ambiguous despite its popularity. Save for a few examples (Beck and Walker 2013, ICLEI 2014, Chen and Lu 2015; Mohtar and Lawford 2016; Treemore-Spears et al 2016), the literature on nexus application in an urban context is thin. As a result, the definitions available do not diverge far from the lexical meaning of nexus as: i) a central or a focal point; and ii) a connection or series of connections linking two or more things. For instance, "a nexus", according to Mohtar and Lawford (2016), "is a connection or link—often causal—between a group or series of objects, ideas, or, in our case, the water, energy, and food sectors that comprise the WEF nexus". Similarly, Leck and colleagues (2015) define a nexus as "one or more connections linking two or more things".

These definitions see nexus mainly as simply relationships. Nexus is also defined as a multi-pronged solution, a way of (or lens for) seeing, or a security threat. Informed by resilience thinking, Beck and Walker (2013: 640) broadens the definition to nexus security, which they define as:

> "Nexus security is a compound mix of ideas: reconciling human needs and wants with access to multiple resources; diversity of access to those resources and services; resilience in the face of weather- and climate-related variability; resilience likewise in the face of infrastructure failure; and the personal, individual sense of belonging"

Building on from studies of urban metabolism, Chen and Lu (2015: 5) proposes the Urban Nexus frame to study "how the social relations interact and work within the city and between its surrounding/supporting areas." Specifically, it focuses on the interlinkages among various elements and their twisted conversion pathways – extraction, supply, distribution, end use, disposal – in the consumption and production chains of socio-economic sectors. This definition points to one obvious fact – cities serve as nexus or focal point that connect and are shaped by economic, technological and social forces (Jacobs 2016).

In a workshop to discuss nexus solutions for post-industrial urban areas in the United States, participants identified four emergent themes crucial in defining urban nexus (Treemore-Spears et al 2016). These are: partnerships and governance structures; environmental justice and social equity; integrative metrics; and land transformation. The International Council for Local Environment (ICLEI) so far provides a practical definition that is close to the need of urban planners:

> "The Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains so as to increase institutional performance, optimize resource management, and services quality. It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and

facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and quality of life within our planetary boundaries."

To encourage wider purchase of the nexus thinking in urban analysis and practice, greater clarity on its meaning is necessary. Although definitions above are important for illumination, they neglect the plural understandings of nexus at other scales, which tend to dominate the current literature. As a heuristic, it is useful to distinguish between 'intra-urban nexus' and 'nested urban nexus'. The former fits the existing definitions of urban nexus, focusing solely on what is urban in the nexus framing. As a site for nexus interaction, city managers will have to optimise solutions related to urban metabolism, infrastructure and human security. However, the nexus dynamics are an outcome of cross-scale interactions with global, national, sub-national and regional levels. The only way that the urban dynamics can be meaningfully understood is to simultaneously capture the driving and constraining forces at both lower and higher scales. This is the essence of the nested urban nexus framing. Thence, nexus analysis at a city level will have to pay attention to themes commonly associated with other scales such as geopolitics (global), whole-of-government policy integration (national), and ecosystem approach (sub-national and regional) (Figure 2).

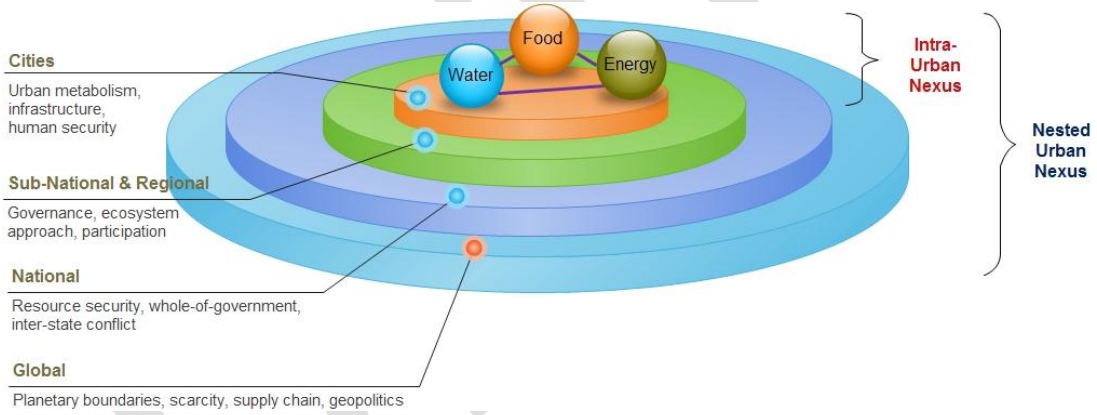

Figure 2: Intra and Nested Urban Nexus Perspectives

1.4. About the Paper

While the particular terminology of the WEF nexus is a fairly recent addition to the policy and scientific discourse, the concept of integration (of disciplines, sectors, governance mechanisms and so on) as an ideal has a much longer pedigree. By synthesising this rich body of work, this paper develops a conceptual framework specially tailored to the water-energy-food nexus at the urban scale. The rationale for the need for nexus and urban nexus is an obvious one – whilst urban areas are key contributors to unsustainable

resource consumption, they are also sites with great potential for resource productivity, efficiency and decoupling. The aim of the paper is to sharpen the conceptual basis for Urban Nexus and how it can be aligned with urban-related global agendas. It is guided by the following questions:

- What is the meaning of urban nexus? What are the key emergent themes in the nexus literature?
- What are the foundational building blocks for urban nexus concept and for applying them in public policy making?
- What are the relevant links and tensions concerning their interconnections?
- What is the transition model or what are the best ways for nexus-related methodologies to engage with wider policy debates in real-world political arenas?
- How to situate the urban nexus concept in relation to global agendas such as the Sustainable Development Goals and the New Urban Agenda

Section 2 unpacks the meaning of urban nexus by tracing six streams of ideas. Next, Section 3 discusses some examples of urban nexus in practice. Section 4 outlines the urban nexus framework, followed by a discussion on its linkages with the unfolding global urban-related agendas. Finally, Section concludes the paper with an outline of policy and research priorities for the future.

2. Concept of Urban Nexus

The popularity of the nexus terminology can best be understood as symptomatic of an increasing emphasis on integration as an ideal, an emphasis on science-policy solutions to environmental problems, and a preference for efficiency gains in confronting resource scarcity. But many aims of the nexus approach pre-date the recent nexus agenda. Are there new perspectives and demands on public policy from the recent attention on water-energy-food nexus? Specifically, what is ‘urban’ about urban nexus? This section surveys six streams of ideas or concepts informing the application the nexus approach in an urban context (Figure 3).

Figure 3: Five streams of ideas informing the nexus approach in an urban context

2.1. Business pragmatism

In 2011, the World Economic Forum (WEF 2011) launched a landmark report Water Security: The Water–Food–Energy-Climate Nexus. The report recognises WEF Nexus with climate change as its threat multiplier as one of the three greatest threats to the global economy. It also alerts the world's political and business leaders to the need to examine the interrelations between these global challenges: 'Water security is the gossamer that links together the web of food, energy, climate, economic growth and human security challenges that the world economy faces over the next two decades' (WEF 2011: p1). Raising further interest, businesses, at the WEF 2014,