

# Conceptualizing urban water security in an urbanizing world

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In this paper we review literature and suggest a framework to examine and measure urban water security as it interacts with urbanization and urban-regional systems. We develop a comprehensive framework to start bridging that gap. In this framework, urban water security is shaped by five interacting social and environmental domains. These are Socio-demographic, Economic, Technological, Ecological, and Governance (SETEG). We suggest a few indicators and aggregation methods that can shed light on the multidimensional and interconnected nature of urban water security, and illuminate different levels of influence among the five SETEG domains. By improving the selection of indicators for the multiple SETEG domains and interactions creating urban water security (or insecurity), combined approaches such as the one outlined above might help move a scattered array of water security goals towards the creation of informed, cohesive and relevant policy interventions.

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## Introduction

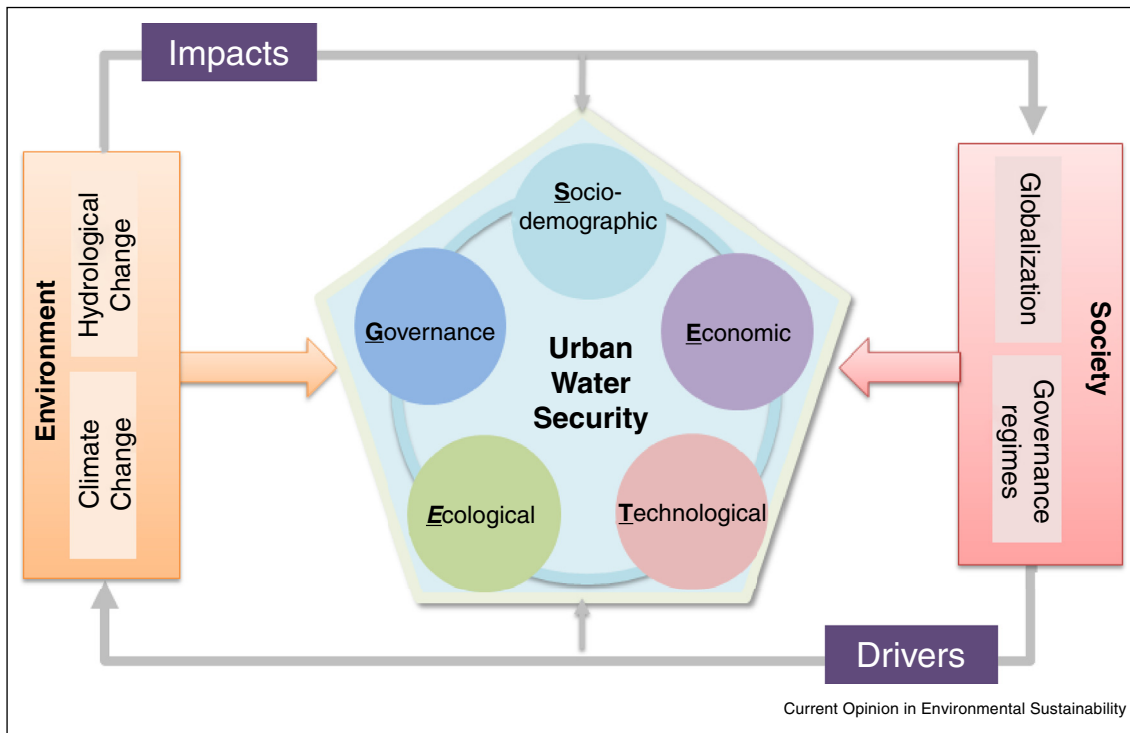
While the concept of water security has received increased interest recently [1<sup>\*</sup>], relatively few scholars and practitioners have engaged with urban water security. This is not surprising given that agriculture has historically been the main water user; however, this trend is starting to change. Urban areas are increasingly shaping water security as they grapple with the sustainable availability of water and navigate the barriers and options involved in protecting people and ecosystems against water-borne stresses and water-related hazards [2].

Urbanization, itself, can, and often does, create many of these obstacles and options. For instance, it can exacerbate competition for water and deplete aquifers and water bodies [3], but it also has the potential to create the conditions for a sustainable enhancement of water security. Though much of this potential remains untapped and unexplored.

Climate and environmental change are also projected to affect water availability and heighten stress on water supplies by increasing the evaporation of surface water and altering the timing and dynamics of snowmelt, monsoons, rainfall and other hydrological processes [4]. Such changes have a high probability of affecting the replenishment of reservoirs and creating negative impacts to urban areas, such as floods and droughts [5,6]. An interaction between urbanization and environmental change is affecting water security in unprecedented ways that will challenge urban actors to find opportunities for innovative and transformative actions and responses. To be successful, urban and regional water managers and actors will need tools that can help them assess the challenges posed to water security by their unique urbanization pathways. They will also need metrics to determine the effectiveness and sustainability of any actions they design to enhance water security.

In this paper, we will examine the dynamic links between urbanization, urban areas and water security and suggest some ways to respond cohesively to these challenges. Building on the findings of existing literature, we will suggest a framework to approach and assess urban water security. We hypothesize that urban water security is embedded in (and shaped by) interactions between urbanization, urban-regional systems, regimes and users, and a complex resource. These interactions take place within a broader context of drivers such as globalization, climate change, global urbanization, environmental degradation and shifts in international governance regimes (see [Figure 1](#)). We discuss existing frameworks, metrics and aggregation methods, built upon national level models and metrics, which, we suggest, can be used to measure urban water security. This approach attempts to bridge the gap between scholarship and methods that focus on urban area dynamics with those that study regional, national and global views but ignore the local urban area, where any change must be actualized. Such approaches can help move scattershot urban-regional water security goals towards more cohesive and policy relevant narratives and interventions.

Figure 1



Urban water security. This conceptual diagram shows urban water security as a product of five interacting development domains, which also interact with environmental dynamics: Socio-demographic, Economic, Technological, Ecological, and Governance. These domains operate within a wider context of interactions between environment and society.

### Conceptualizing urbanization, urban areas and water security

Before exploring the influence of urbanization and urban areas, with their unique place-based socioecological features, in shaping water security, we will briefly consider the definitions of ‘urbanization’, ‘urban’, and ‘water security.’ Pathways of urbanization and the urban areas they produce belong to a set of worldwide, mega-phenomena that are profoundly altering the relationship between human beings and the environment, while affecting water security in complex ways and at alarming rates. Yet, paradoxically, little agreement exists among scholars and communities of practice about the definition of urban and what makes a population or place urban [7–9]. We define *urban areas* as socioecological systems comprised of five interacting (SETEG) development domains (see Figure 1) [10], which also interact with environmental dynamics. These domains are: first, Socio-demographic, that is, living in hazard-prone areas based on lifestyles (aesthetic desirability of location) or lack of options; second, Economic, affecting differences in wealth creation and access to water, and to assets and options to respond to climate risks; third, Technological, defining the possibilities to introduce high efficiency water infrastructure or flood protection measures more sustainably; fourth, Ecological, affecting an area’s water and land

endowments and susceptibility to hazards, and fifth, Governance, shaping patterns of urban growth, land use regulations, water management and use, and proactive or reactive water risk mitigation and adaptation responses.

We define urbanization as an array of interconnected changes (transitions) that determine how humans interact with each other, and with the environment, to produce an urban area [9,11]. These transitions, which are key to water security issues, include: an increased number of people living in relatively compact areas; changes in lifestyle, social practices, and culture; economic shifts from primary activities, such as agriculture or mineral extraction to manufacturing and services; land use changes associated with the growth of urban built-environments and infrastructures; and the transformation of ecosystems and hydrological systems associated with these changes.

Urbanization and urban areas directly and indirectly shape water security. Because of the large changes in economic growth, population structure, social practices [12] and lifestyles, land use and the built environment that they imply, urban processes are an increasingly important source of competing demands on water resources, changes in the hydrological cycle and land

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