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Urban water security assessment: A review of indicators and frameworks

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Abstract

Urban water security is important for urban development. In urban areas water related issues are rising due to climate change, land use changes, and environmental degradation. As increase in population growth and competition increase in resources ensuring safe and affordable water access to all urban areas as become a complex challenge. This review systematically examine the state of water security, focusing on how the concept is defined and assessed, the frameworks and indicators employed. These research aims to identify the knowledge gap for urban water security. A literature review was conducted using prisma guidelines, reviewed articles, institutional reports, and worldwide case studies. The review evidence on assessment frameworks particularly indicator based tool such as WATSAT. The findings reveal that under water security multidimensional and evaluate water supply, sanitation, productivity, disaster risks, environmental quality and governance.

Keywords: Urban water security, WATSAT, governance, participatory approach

Introduction

Urban water security is understood through aspects such as quality and quantity of drinking water, sanitation, human wellbeing, water productivity, social economic values, ecosystems and environmental health, water related hazards, and water governance are presented by frameworks (ABOELNGA, 2019) ^[1] and (BABEL, 2020) ^[11]. The indicators are used to assess the urban water security. Today climate change and population increase are placing tremendous stress on water resource. This study aims to carryout urban water security analysis, using WATSAT. The capacity of population to safeguard sustainable access to adequate quantities and acceptable quality of water for sustaining livelihoods, human wellbeing and socio economic development for ensuring protection against water-borne diseases, pollution and water related disasters and for reserving eco systems is a climate of peace and political stability (UN-WATER, 2013) ^[35].

WATSAT utilize a multilayer structure of dimensions, indicators and variables to generate comprehensive water security index, offering a wholistic view of a city's water security status (Aboelnga *et al.*, 2019, Larsen *et al.*, 2016; UN-Habitat, 2020) ^[1, 25, 34]. The research questions addressed

- How urban water security is is measured?
- Which indicators are effective for urban water security assessment?
- What are the challenges influencing urban water security?

By exploring these questions, this review provide the current state of urban water security and to examine pathways that support resilience and equitable development in rapidly expanding cities.

Urban Water Security Frameworks

Urban water security is defined as ability to provide sufficient, safe and affordable water for all residents, while effectively managing risk such as scarcity, pollution, disaster and the impact of climate change (Aboelnga *et al.*, 2019; Larsen *et al.*, 2016; Liu *et al.*, 2017) ^[1, 25, 26]. It also align with SDG' i.e. SDG 6.

- The target 6.5 is to implement IWRM at all levels
- The target 6.6 is to protect and restore water related ecosystem

- The target 6 a is to expand international cooperation and capacity building support to developing countries in water and sanitation related activities and programs, including water harvesting, desalination, water efficiency, waste water treatment, recycling and reuse technologies.
- The target 6 b is to support and strength the participation of local communities in improving water and sanitation management.

Dimensions of Urban Water Security

The dimensions of urban water security are water quality, quantity, accessibility, reliability, affordability and governance.

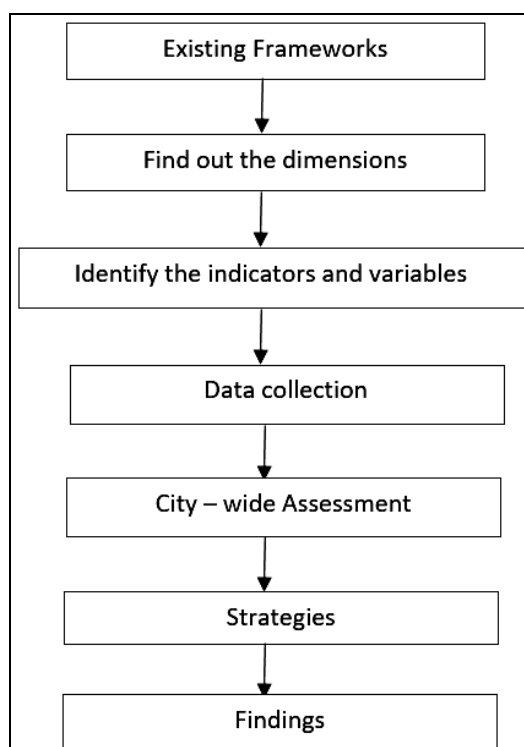
Table 1: Dimensions of urban water security

Dimensions	Description
Quantity	Availability of required water quantity
Quality	Meet the safety standards
Accessibility	Equitable access to all
Reliability	Continuous supply
Affordability	Cost relative to income
Governance	Policy, Regulation and Institution

Integrated Frameworks

Integrated urban water management is one of the approach that include water supply, sanitation, stormwater and waste water management. Integrated urban water management emphasizes cross sectoral coordination, stakeholder participation and the use of both supply side and demand side strategies to achieve sustainable, reliable and equitable urban water system (Larsen *et al.*, 2016) ^[25].

Methodology



Assessment of Frameworks

Overview of Existing Frameworks

One of the most effective tool for urban water security is Water Security Assessment Tool (WATSAT). It has three

layered structure helps to keep the framework generic and reliable. It is used to capture the site specific issues and challenges about water security.

Dimension

1. Water security and sanitation
2. Water productivity
3. Water related disasters
4. Water Governance
5. Water Environment

Each indicator in the dimensions are qualified by the variables. Then it is normalized and contributed to overall Water Security Index (WSI) ranging from 1 to 5. This tool helps the city authorities to identify vulnerability and track progress toward water security.

Strategies in Urban Water Security

1. Demand side management
2. Supply side management
3. Nature based solution
4. Community based management

Findings

This literature explains that urban water security is multi-dimensional and context specific challenge, integrated and adaptive management approaches (Aboelnga *et al.*, 2019; Larsen *et al.*, 2016; UN-Habitat, 2020) ^[1, 25, 34]. WATSAT is an indicator based framework, developed to access water security for cities. It is useful for city authorities and decision makers. The usage of standardized dimensions and indicators aligned with Sustainable Development Goals.

Future Directions

- Expand digital and web based tools for real time, dynamic assessment and monitoring of urban water security (UN-Habitat, 2020) ^[34].
- Promote trans disciplinary approach that bridges technical, social and policy domains for holistic understand and action (Larsen *et al.*, 2016) ^[25].
- Strengthen the participatory research

By focusing on these recommendation, cities can move towards more sustainable, equitable urban water futures.

Conclusions

Urban water security is essential for a healthy city. It requires ensuring that every resident has reliable, safe and affordable access to it, even cities faces pressure from rapid growth and climate change. To achieve this, cities must move beyond old methods and adopt integrated strategies that combine new technologies, nature based solutions and strong leadership. The tool is in the public domain (www.watsat.org). The findings and reflections that emerged out of the study are summarized as follows:

- The tool is holistic in nature and robust to capture the elements of water security and thus can be applied to any city across the globe;
- City stakeholders can make an objective assessment and have a holistic understanding of water security and interconnections of various factors affecting it and assist them in informed decision-making to arrive at system-based interventions to tackle water security threats in the cities; and

- The validation of the tool is carried out. Results show the overall state of water security, there is considerable for improvement in terms of water-related disasters and water environment dimensions of water security.

By prioritizing water security and fair distribution, a city doesn't just provide a basic service- it protect public health strength the local economy and builds a more resilient future for everyone. Thus, it is expected that the tool will help build the capacity of city authorities, planners and decision-makers, practitioners, and academicians, among others, in an improved understanding of the holistic nature of water security and its assessment.

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