

Notes and Comments

Urban waters

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1. Introduction

1.1. A Urban Planet

From an estimated population of 9.7 billion inhabitants by 2050, about 60% will be living in urban areas. At present, 2021, close to 4 billion humans live in cities; Earth is therefore already a Urban Planet (Science, 2016). The demands for water, energy, habitat and food in the next 30 years will rise increasing the pressure and valuation on water resources in cities (WWDR, 2021). Cities alter the environment in several ways: changing the water cycle; increasing of water and air pollution; augmenting of impervious surfaces and decreasing infiltration to ground water. Moreover, uncontrolled urbanization provokes flood disaster risks, promoting urban catastrophic floods. There is a strong relationship of the towns' economy with climate changes, water demands, water quality, water availability and citizens' actions. To build resilience, sustainability and adaptation to climate change is vital to cities in the 21st century. The urban water sustainability includes provision of safe drinking water for all the urban population, wastewater treatment, and water footprint (Souza et al. 2021) protection against flooding and adequate water planning schemes. Integrated urban watersheds management, should include all sectors of food provision, public services supply, industry, urban ecosystems functioning, economy and society (ABC, 2017). Since water related problems are defined by regional and local conditions (climate, socio-economic and cultural demands, water availability, water quality, hydrogeochemical conditions) each city or region should develop its own mechanisms and strategies to face the challenges ahead.

1.2. Urban water challenges

There are several urban water resources challenges in this 21st century. Thus, understanding and tackling these challenges is fundamental to promote integrated water management and provide new creative and innovative solutions. On the one hand, these challenges are, among others: rapid population growth with divergent water affordability and regulation, cultural and equity aspects on water valuation, unequal access to water and unsustainable water habits, fast growing urban areas

without poverty mitigation, uncertainties of climate change impacts, mismatched disaster risk reduction and resilience actions, aging infrastructure in urban water distribution pipelines, loss of treated waters for public supply, emerging contaminants and pollutions sources, progressive higher rainfalls, with more frequency and significant flooding ground imperviousness, deforestation in urban areas and deficit of green open spaces, urban ecosystem sustainability, information flows and community participation, water scarcity ambiguities in metropolitan regions, integration of nation- and state-wide programs on urban water education, and emerging jobs and employment related to water sectors. These challenges are related to Economy, Society, Environment, Science and Technology (see Figure 1) illustrates the main issues involved in urban waters management.

On the other hand the following problems related to urban waters should also be taken into account: **water**



Figure 1. Main issues involved with urban water management (Tundisi and Munha, 2019).

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Received: July 5, 2021 – Accepted: July 22, 2021



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security, waste management, extreme events, pollution control, reduce & re-use; water cycle; governance (Vammen et al.2018). This implies in the establishment and development of novel local and regional data bank that provide the scientific and technical background for decision makers (Tundisi and Munha, 2020). University collaborations with the society along with the participation of interested private sector should contribute to these data systems promoting a better and adequate science-policy interface (Acuto and Parnell, 2016).

2. Research and Innovation Areas of Action

Considering the present urban waters challenges, the urgency to solve problems, the complexity of the urban ecosystem, and the need for interdisciplinary integration, connecting different players such as water managers, scientists, decision makers, health systems, and the community participation, the following research and innovation areas are identified as priorities:

- **Urban forestry** – Promotion of urban parks and forests
 - Protection of urban biodiversity, flood control, controlling the city microclimate, new educational opportunities to citizens, protection of groundwater recharge areas;
- **Storm water management** – Development of traditional engineering and new ecohydrological projects to control urban water extremes, promoting nature based solutions and pathways towards a future urban biocycle economy;
- **Groundwater protection** – Protection of aquifers and recharge areas;
- **Emerging contaminants** – Monitoring, control, and contamination reduction of antibiotics, cosmetics, pesticides, herbicides and other dissolved substances that are harmful to human health;
- **Integrated public health and environmental protection** – Novel urban wastewater treatment, basic sanitation and hygiene for a post-pandemic;
- **Urban big data**- Developing urban intelligence, promoting a urban data bank and advanced water monitoring technologies, developing projects of integrated water management including water resources and Human Health projects;
- **Smart and Digital Water** - Real time monitoring of water quality and quantity, satellite images and GIS technologies to assist managers with adequate tools;
- **Political and social awareness** – Water environmental challenges, information flows, community participation, stakeholder awareness and governance;
- **Recovery of degraded urban ecosystems** – Urban rivers and wetlands;
- **Education, capacity building, community engagement** and citizen science;

- **Promotion of University - Industry – Municipality** initiatives and joint ventures through projects for technological advances;
- **The food-energy-water-ecosystem nexus** – Water productivity and urban ecosystem services (capturing value from waste, nutrient recovery, water reuse);
- **Funding sustainable development initiatives** – Municipality incentives for the implementation of Integrated Urban Waters Management Program;
- **Master Plans for Valuing Urban Waters** - related to ecosystems, risks, infrastructure, socio-economic activity, and sociocultural values;
- **Job creation and opportunities** for emerging areas in water sectors.

Acknowledgements

Contribution from Unesco Urban Water Catedra São Carlos USP-IIE Brazil.

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