I U W M

Integrated Urban Water Management

RAPID ASSESSMENT

L E H • INDIA

LEDeG

BORDA

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www.ledeg.org

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www.borda-sa.org

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to Partners & the Study

THE **PARTNERS**

LEDeG and BORDA have been working in partnership since 1987. Initially cooperation was focused on renewable energy projects which provided electricity to 67 villages through micro-hydro technology. The cooperation was later expanded to include a range of income generation activities such as food processing, handicrafts and food production. In recent years the cooperation has evolved to focus on issues related to urban water and sanitation.

As a result, they have been working closely with Urban Local Bodies (ULBs) such as Ladakh Autonomous Hill Development Council Council (LAHDC), Municipal Committee, Leh (MCL) and Public Health Engineering Department (PHED) to help, design and implement integrated water and solid/liquid waste management plans.

Most notably, in 2017, MCL and BORDA implemented a first-in-India public-private partnership for turnkey design, construction, set-up and operations of city-wide Faecal Sludge Management (FSM) services. Building on from this, the three-year EU and BMZ supported 'Liveable Leh' project was launched in 2018. Designed in line with Sustainable Development Goals (SDG) 6 (water) and 11 (sustainable cities), the project aims to strengthen the capacities of LAHDC to help them develop Leh as a more liveable, inclusive and resilient Himalayan city.

LAHDC LEH

LIVEABLE LEH

LEDeG

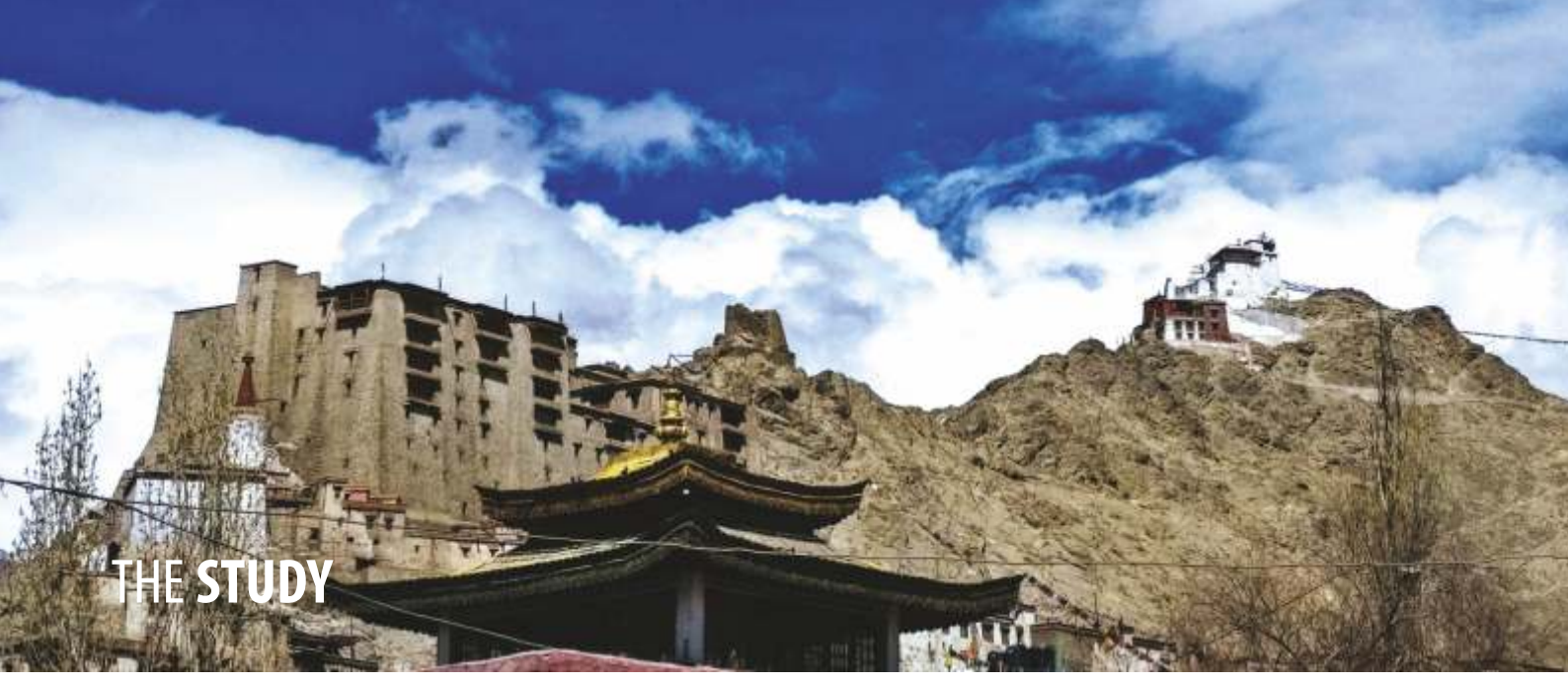
BORDA

BMZ Federal Ministry for Economic Cooperation and Development

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION

11 SUSTAINABLE CITIES AND COMMUNITIES



THE **STUDY**

At an altitude of 3,500 m Leh is the highest town of significance in India. It is defined by its desert climate, characterized by extreme cold and heat, with very little rainfall annually (>100 mm). The town is experiencing the impact of rapid urbanization and climate change, with sustainable water management becoming an increasingly pressing concern.

Consequently, the ULBs (LAHDC, PHED, MCL) actively welcomed a rapid assessment of Integrated Urban Water Management (IUWM) in Leh and supported a stakeholder workshop in March 2020. This workshop provided an opportunity for Leh water sector stakeholders to share information on the current state of Leh's water and sanitation situation, and to review and confirm specific IUWM assessment data.

The purpose of this publication is to:

- Inform stakeholders so that they start thinking about IUWM issues and possible solutions in a wider and more informed context
- Provide practical guidance on how the ULBs can actively move forward in developing a productive and sustainable city-wide IUWM approach

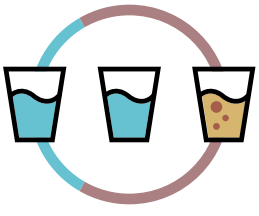
This publication provides the results of the City Blueprint Approach (CBA) and an Integration Assessment. The CBA consists of a 'Trends and Pressure Framework' (TPF) assessment and a 'City Blueprint Framework' (CBF) assessment. The results of the three assessments are discussed and provide insight into the current IUWM situation in Leh. Key highlights include:

- Leh's water-related strengths and weaknesses are identified.
- TPF: The trends and pressures Leh faces are of 'medium concern'.
- CBF: Leh was classified as a 'wasteful city'.
- Recommendations are provided for key management steps and technical focus areas within an IUWM framework.

It is hoped that the ULBs will consider employing an IUWM approach, to help build a more sustainable climate resilient future, with the ultimate goal being to conserve the environment and improve liveability for all citizens in Leh.

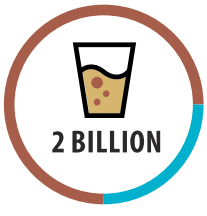
Background: **Global Context**

GLOBAL **WATER ISSUES**

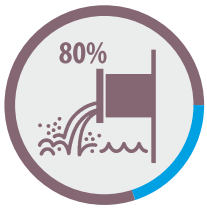


1 in 3 people worldwide, or **2.2 billion** people, currently lack access to **safe drinking water**.[1]

Over half of the global population, **4.2 billion** people, lack access to **safe sanitation**.[1]



Globally, at least **2 billion** people use a drinking **water source contaminated** with faeces.[2]

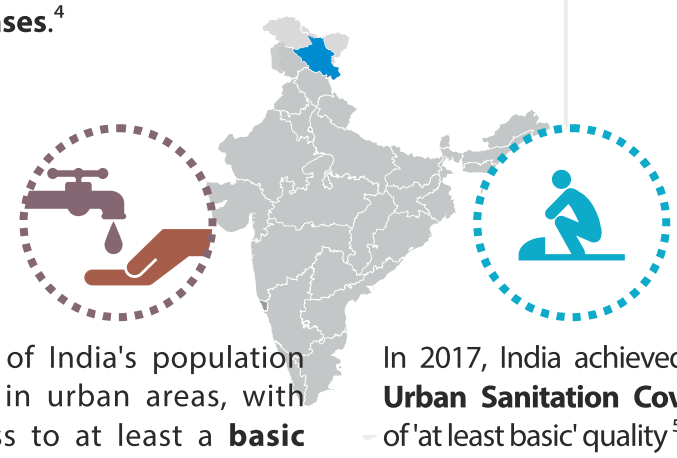


Over **80%** of global wastewater is released to the environment **without adequate treatment.**[3]

1 million people die each year from **water, sanitation and hygiene-related diseases**.[4]

By **2025**, half of the world's population will be **living in water-stressed areas**.[2]

Floods and other **water-related disasters** account for **70% of all deaths** related to natural disasters.[4]



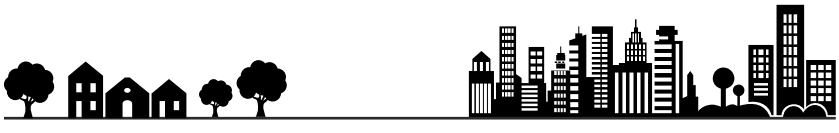
96% of India's population lives in urban areas, with access to at least a **basic water source**

In 2017, India achieved **72% Urban Sanitation Coverage** of 'at least basic' quality [5]

[1] United Nations Children's Fund (UNICEF) &World Health Organization 2019, 'Progress on household drinking water, sanitation and hygiene I 2000-2017 Special focus on inequalities', New York
[2] World Health Organization 2019, 'Drinking Water', Online
[3] WWAP (United Nations World Water Assessment Programme) 2017, 'The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource', Paris, UNESCO
[4] United Nations Children's Fund (UNICEF) and World Health Organization 2017, 'Progress on household drinking water, sanitation and hygiene: 2017 Update and SDG Baselines', Geneva
[5] UNICEF & WHO, 2019, Progress on household drinking water, sanitation and hygiene 2000-2017

GLOBAL **URBANIZATION**

The current world population is 7.8 billion and it is expected to increase to 9.7 billion by 2050.[6]



55% of the world's population currently lives in urban areas, but this is expected to increase to 70% by 2050. This means an additional 2.5 billion people are expected to migrate to urban areas around the world, an amount which is equivalent to doubling the populations of both India and China.

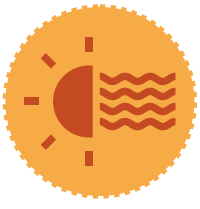
Almost all current population growth is taking place, and will take place, on 2% to 4% of Earth's land area – in Cities.

84% (2.1 billion) of the increases in urban population is expected to be in Asia and Africa, and concentrated in small and medium sized cities in low- and middle-income countries.[7]

34.9% of India's population lives in urban areas, with a current upwards trend of an additional 2.37% of the population moving into urban areas each year.[8]

[6] United Nations, Department of Economic and Social Affairs, Population Division 2014, 'World Urbanization Prospects: The 2014 Revision', New York
[7] United Nations, Department of Economic and Social Affairs, Population Division 2019, 'World Urbanization Prospects: The 2018 Revision', New York
[8] Central Intelligence Agency 2020, 'The World Factbook: South Asia:: India', Accessed at: www.cia.gov/library/publications/the-world-factbook/geos/in.html#field-anchor-people-and-society-urbanization

CLIMATE CHANGE & CITIES



HEAT WAVES

DROUGHT

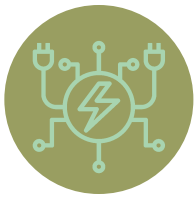
EXTREME PRECIPITATION

FLOODING

The Earth is warming; Climate change is here. The scientific evidence for the warming of the climate system is clear, and human activity, primarily from greenhouse gas emissions, is responsible.[9] However, those emissions continue to rise, and mean temperatures continue to rise. 17 of the 18 hottest years globally on record have occurred since the year 2000.[10] [11]

In all or most regions of the world, climate change means higher risks of heat waves, higher risks of drought, and higher risks of extreme precipitation events and associated flooding events. The impact will be felt through increases in the frequency, magnitude or both, of these climate related events, with many events already starting to take place with increasing frequency.[12]

How will this impact cities and towns? Climate change is expected to have significant impacts on four key sectors in most cities and towns: local energy systems, transportation, public health, and water supply, water demand, and wastewater treatment.[13]



ENERGY SYSTEMS

PUBLIC HEALTH

TRANSPORTATION

WATER

KEY **URBAN SECTORS** IMPACTED BY **CLIMATE CHANGE**

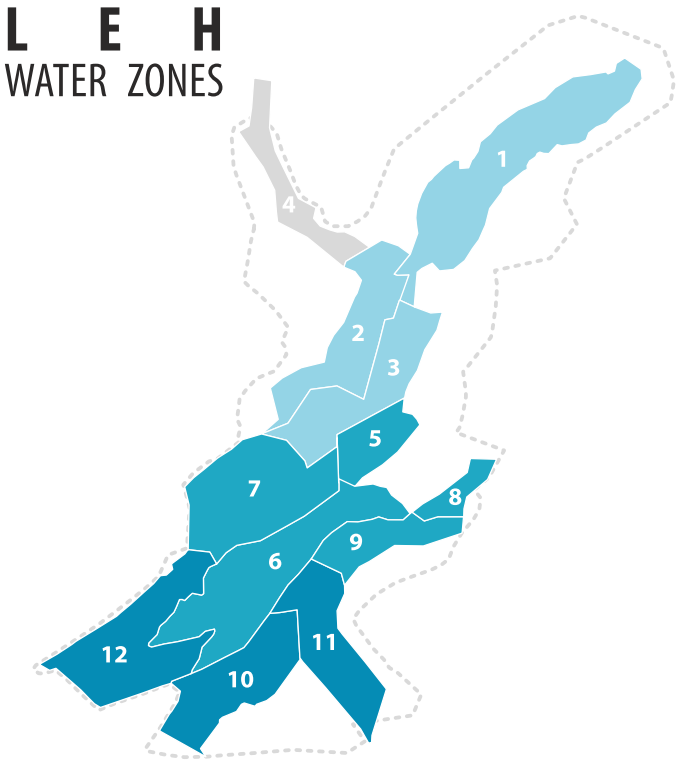
[9] Intergovernmental Panel Climate Change 2013, 'Summary for Policymakers', Cambridge
[10] NOAA National Centers for Environmental Information 2014, 'State of the Climate: Global Climate Report for Annual 2013,
[11] World Meteorological Organisation 2018, 'WMO Statement on the State of the Global Climate in 2019', Geneva
[12] Intergovernmental Panel Climate Change 2013, 'Climate Change 2013: The Physical Science Basis', Cambridge
[13] Urban Climate Change Research Network 2010, 'Cities lead the way in climate-change action', Nature, 467, 909

Background: **Leh Overview** and **Context**

Background: Leh Overview and Context

Leh is a town which sits high in the Himalayan mountains within the recently established Union Territory (UT) of Ladakh, India. At an altitude of 3,500 m, Leh is the highest town of significance in India and defined by its desert climate, characterized by extreme cold and heat, with very little rainfall annually (>100mm).

Leh Town



Leh is home to approximately 35,000 residents within an area of 17.2 km^2 and divided into 13 wards and 12 water zones. Leh's tourism sector has grown significantly in recent years, and the tourism industry now contributes to approximately 50% of Leh's GDP.[14]

A construction boom driven by the hospitality industry sees many migrant workers working and living in Leh over summer months. As a result, Leh's population greatly increases during tourism's peak-season over summer due to the influx of tourists and migrant workers. 3,27,366 international and domestic tourists visited Leh in 2018, adding significant strain on urban planning and water security in the water-scarce region.[15]

In acknowledgement of the increasing pressure on water resources in the town, the LAHDC, PHED, MCL, and other ULBs, have already demonstrated progressive foresight to address their urban water management challenges.

In 2017 for example, a modern Faecal Sludge Treatment Plant (FSTP) was commissioned by MCL to combat faecal sludge and septage contamination of water sources.

Furthermore, significant progress has been made by PHED in upgrading the water supply network, expanding water supply sources, laying a sewer network, and planning a sewage treatment plant (STP). More recently, a comprehensive report on water supply and usage in Leh was released with support from LEDeG and BORDA. [16]

Learn More:
https://leh.nic.in/
https://ladakh.nic.in/

[14] Sherratt, K 2013, 'Social and economic characteristics of Ladakh, India', Geology for Global Development

[15] Press Trust of India 2019, 'Leh emerging favourite destination for foreign tourists, nearly 50k visited in 2018', Accessed at: https://www.business-standard.com/article/pti-stories/leh-emerging-favourite-destination-for-foreign-tourists-nearly-50k-visited-in-2018-119011900373_1.html

[16] Water in Liveable Leh! (2019)

Introduction to **IUWM: What & Why?**

"IUWM is a comprehensive approach to urban water services, viewing water supply, drainage, and sanitation as components of an integrated physical system, and recognizes that the physical system sits within an organizational framework and a broader natural landscape." [17]

- Mitchell, 2006

IUWM varies in definitions and interpretations, but essentially encompasses planning and management strategies that recognize the relationships between water supply, stormwater and wastewater management within urban systems. Sanitation and solid waste management are often also considered within this definition due to their strong links to urban water cycles.

When first attempting to understand what IUWM is, it is useful to consider the scope and limitations of existing conventional urban water systems.

Inefficiencies in conventional **Urban Water Systems**

Conventional urban water systems are characterised by a multitude of inefficiencies which promotes wastefulness and inflexibility. This leads to poor sustainability and low resilience in the face of social or environmental changes.[18] The three primary inefficiencies relate to infrastructure design, system planning and system management:

INFRASTRUCTURE DESIGN INEFFICIENCIES

- Large, rigid centralized infrastructure for urban water management that is not optimized for local conditions and is difficult to expand gradually over time.
- Extended water collection and distribution networks and treatment components are designed to perform limited and specialized functions.
- Systems are expensive to build and maintain.
- Systems are wasteful in terms of energy, water and nutrients.
- Waste leads to environmental consequences, such as water source depletion and biological pollution. [19]

SYSTEM PLANNING INEFFICIENCIES

- Disconnect between wider urban planning processes, master plans and consideration of the overall catchment area.
- Top-down planning approach neglects consultation with important stakeholder groups, such as end-users particularly those living in informal settlements.[19]
- Investment planning, setting tariffs and financial sustainability are generally not planned with a long-term view.

SYSTEM MANAGEMENT INEFFICIENCIES

- Services such as solid waste management, water supply, faecal sludge management, sewerage and storm water are planned and delivered in silos/isolation, so synergies that can save costs and promote the circular economy are not exploited.
- Institutional fragmentation across different authorities.[20]

An IUWM approach to urban water management and planning aims to reduce the above-mentioned inefficiencies, while increasing sustainability and resilience against social and environmental changes.

[17] Mitchell, VG 2006, 'Applying Integrated Urban Water Management Concepts: A Review of Australian Experience', Environ Manage., 37(5), 589-605
[18] Leigh, N, Lee, H, 2019, 'Sustainable and Resilient Urban Water Systems: The Role of Decentralization and Planning', Sustainability, 11(3), 918
[19] Wong, THF, Brown, RR 2009, 'The water sensitive city: principles for practice', WST, 60(3), 673-682
[20] Adopt IUWM 2016, 'AdoptIUWM: Adopting Integrated Urban Water Management in Indian Cities', ICLEI South Asia

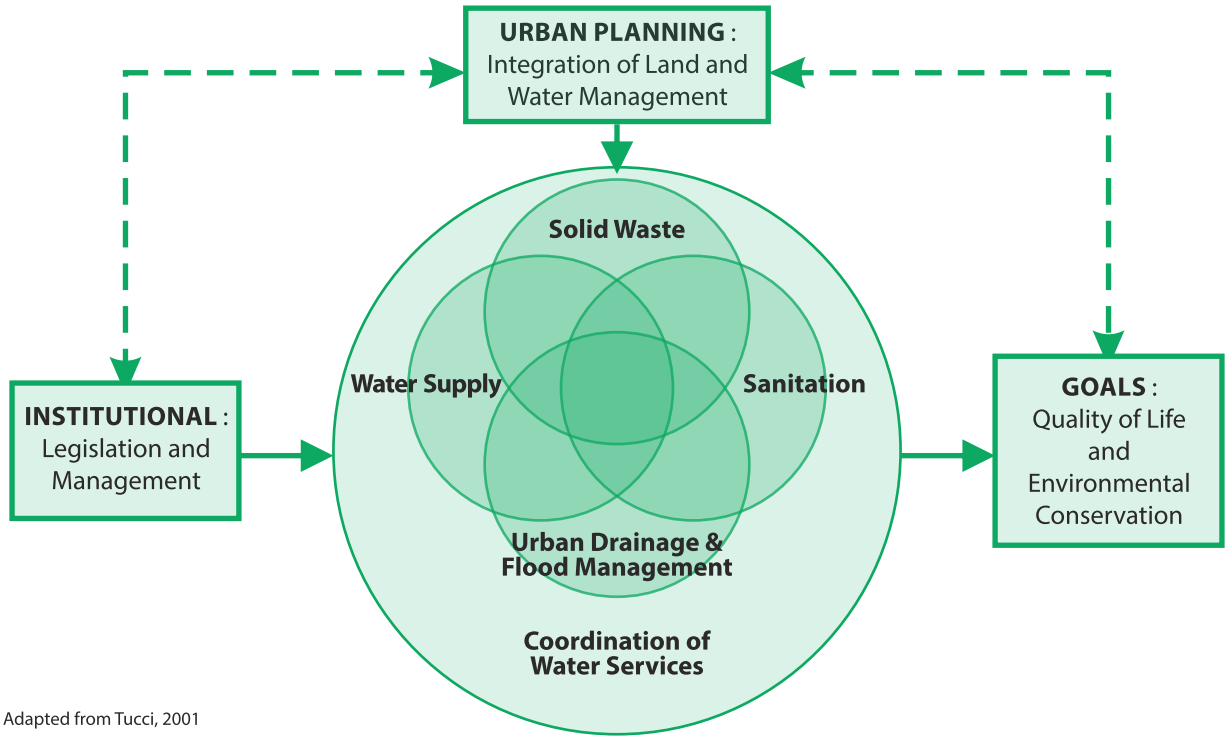
IUWM **Principles**

In order to describe the broad IUWM philosophy in a more defined and approachable manner, it is useful to consider IUWM in terms of key principles. These principles help with integrating the local context and defining IUWM from the local level.

KEY IUWM **PRINCIPLES**[17]	**EXPLANATION**[20]
All parts of the water cycle to be considered as an integrated system	All elements of water supply, sanitation and stormwater management are interlinked and should be planned and managed together
All dimensions of sustainability to be balanced	Balance supply and demand with environmental, social and economic needs in the short, medium and long term; • Conserve water sources; • Cultivate multiple water sources; • Prioritize efficiency (energy, water) and equity of access; • Recycle, reuse & recharge; • Address impacts of climate change in planning
All stakeholders including all water users to be involved	All related organisations and stakeholders should be involved in planning and decision-making processes, link to broader urban planning processes and services.
All water uses to be taken into account	Understand all users and use cases, human and ecological, urban and rural, including domestic use, recreation, commerce, tourism, industry, agriculture etc; Water use is matched with water quality.
All specifics of the local context to be addressed	Recognise the importance of local environmental, social and cultural perspectives; Local stakeholders to decide what works best in the local context; Priority to strengthening existing systems.

[17] Mitchell, VG 2006, 'Applying Integrated Urban Water Management Concepts: A Review of Australian Experience', Environ Manage., 37(5), 589-605
[20] Adopt IUWM 2016, 'AdoptIUWM: Adopting Integrated Urban Water Management in Indian Cities', ICLEI South Asia

Example **Coordinating Structure** for IUWM

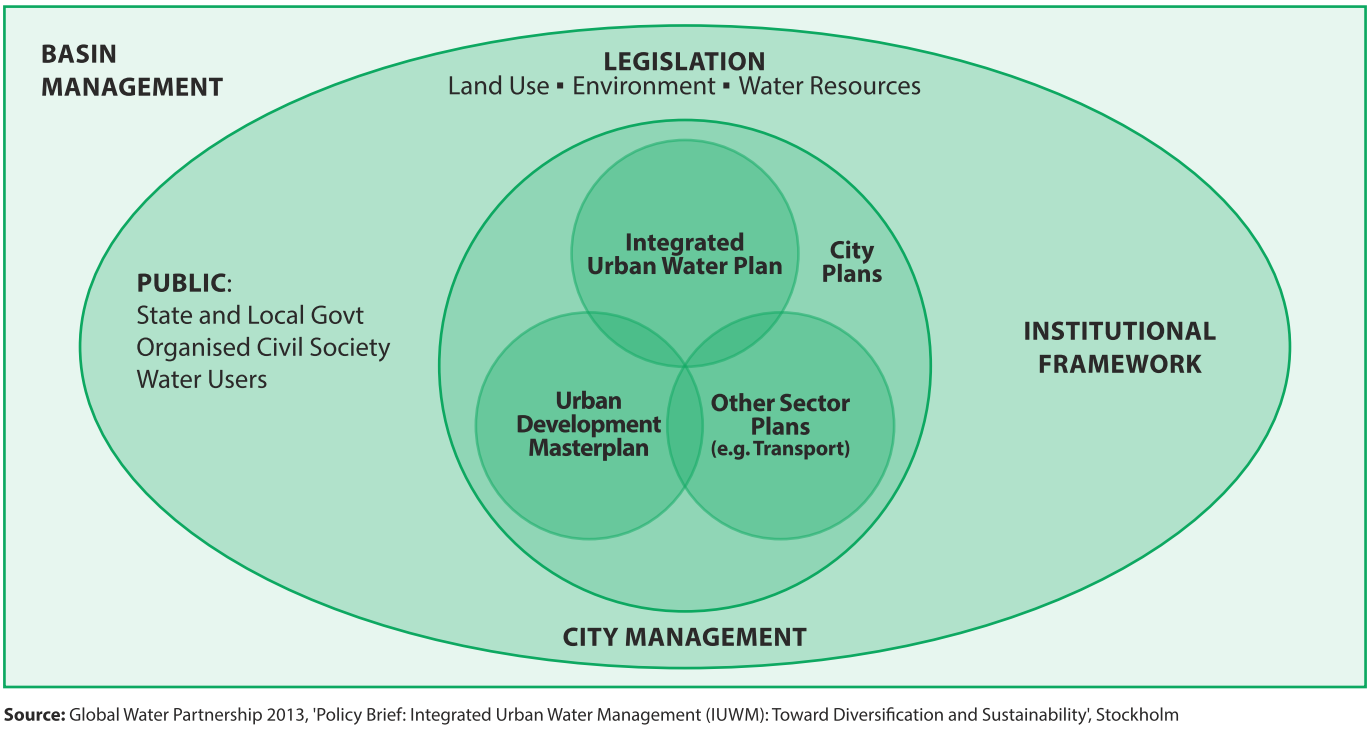


Source : Adapted from Tucci, 2001

Water supply, wastewater, stormwater and solid waste management should be considered from the perspective of being an integrated cycle. Neglecting one element of the cycle means that other elements will never perform optimally. Therefore, linking IUWM to urban planning processes and master planning is essential to improving sustainability and resilience of the wider urban water system.

Additionally, the local context is significant for defining an appropriate IUWM strategy on the local level, as different contexts can mean a different IUWM interpretation or focus areas. Truly understanding the local context is only possible with a genuine multi-stakeholder approach. All stakeholders need to be involved in IUWM planning & implementation, if the urban water management strategy of a city or municipality is to be successful.

Example **Integrated Planning Framework** for IUWM **(land and water management)**



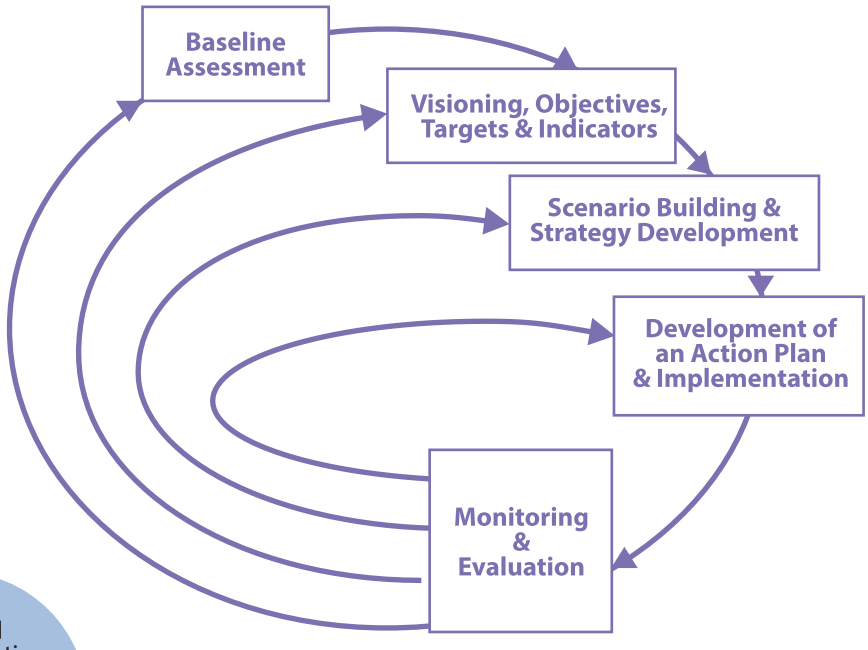
Source: Global Water Partnership 2013, 'Policy Brief: Integrated Urban Water Management (IUWM): Toward Diversification and Sustainability', Stockholm

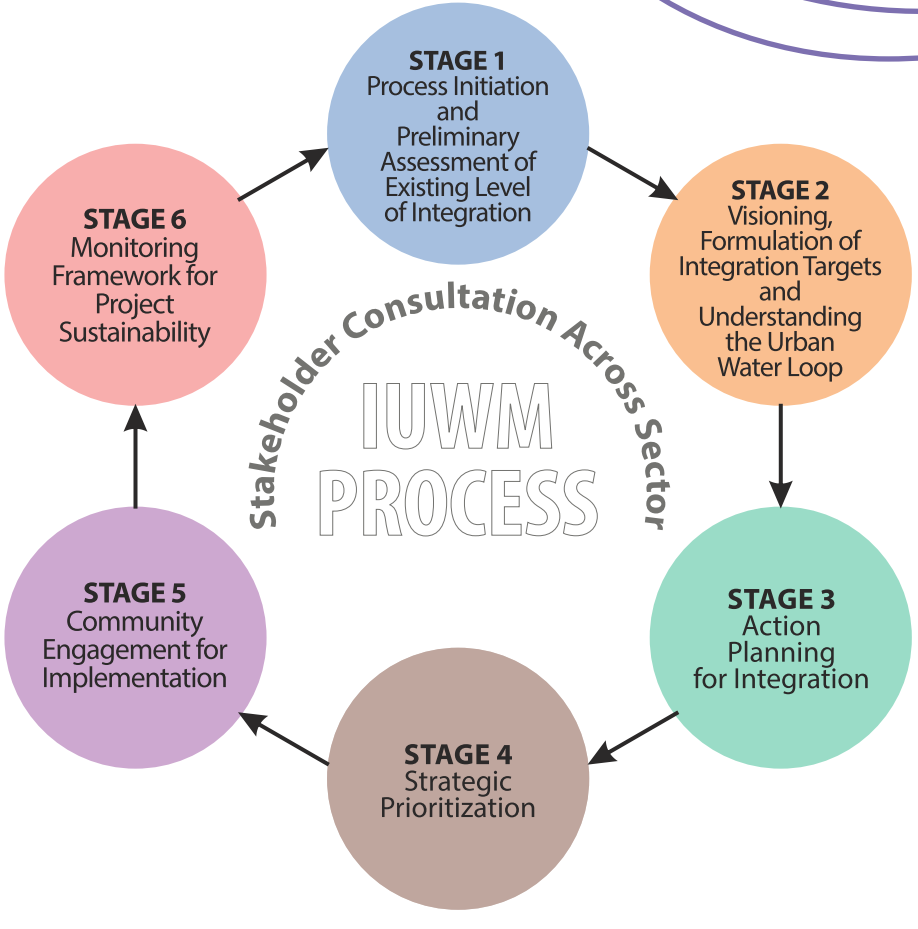
IUWM: **IMPLEMENTATION TOOLS**

There are many different tools, toolkits and manuals available to help guide cities and towns on the IUWM pathway.

Most of them follow a similar project cycle structure, especially providing guidance to **Understand, Plan, Implement** and **Evaluate.**

IUWM Project Cycle (source SWITCH)

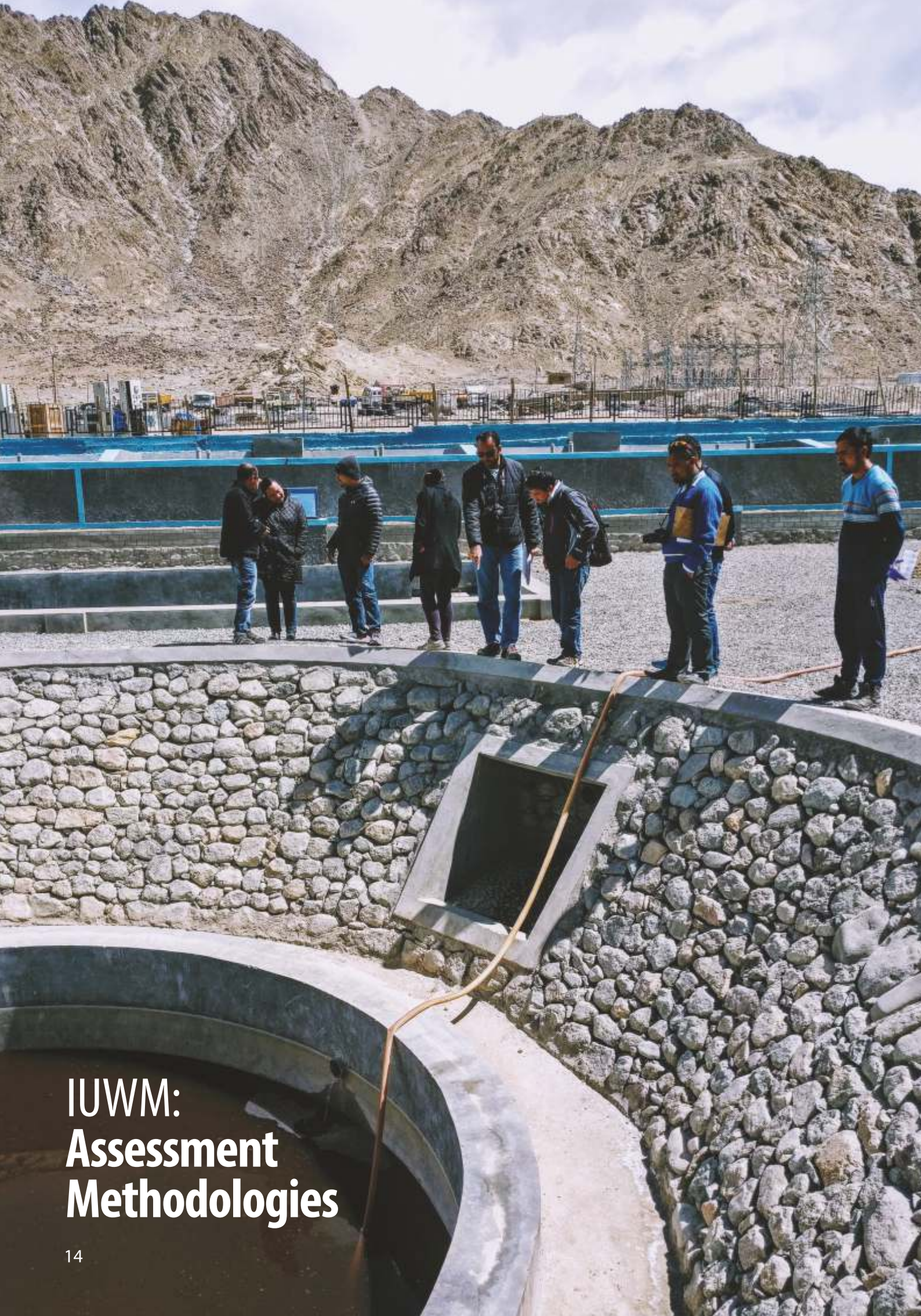




For example, the AdoptIUWM (ICLEI South Asia) process includes six stages and is designed as a cyclical process.

Remember, IUWM is a journey not a destination. The evolution and development of any urban water system is always going to be gradual and challenging, but this should not deter cities and towns from making a start with small and incremental investments in building knowledge, relationships and capacity related to IUWM.

Learn More:
https://www.gwp.org/globalassets/global/toolbox/publications/policy-briefs/13-integrated-urban-water-management-iuwm.-toward-diversification-and-sustainability.pdf
https://iuwm.urbanwatermanagementindia.org/home/
https://www.siwi.org/what-we-do/city-water-resilience-approach/
https://www.gwp.org/en/learn/iwrm-toolbox/About_IWRM_ToolBox/



IUWM: **Assessment Methodologies**

IUWM: **Assessment Methodologies**

But how to get started on the IUWM journey? We have identified two complementary tools:

A. The **City Blueprint Approach (CBA)** which serves as a method for a baseline assessment of IUWM in cities and towns.

B. An **Integration Assessment** which provides information to determine the strengths and weaknesses of the current urban water management situation.

A. The City Blueprint Approach

With limited time and resources any city or town can implement the City Blueprint Approach (CBA). The CBA serves as a method for a baseline assessment of IUWM in cities and towns, and it can act as a first step in a strategic planning process.

It should also be noted that the CBA offers an overview 'snapshot' of the current local situation, and is therefore limited to the information available when the study is conducted. Planned developments in infrastructure, institutional capacity, and policy that would positively impact a CBA score are not considered during the assessment, as they are not yet implemented.

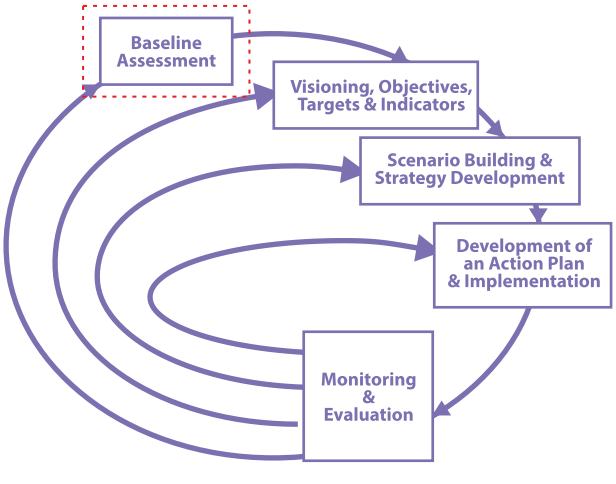
Since 2012, the CBA has been developed by KWR Water Research Institute in the Netherlands, as part of the European Innovation Partnership on Water and Watershare. The approach has been regularly reviewed and updated based on implementation experiences in 75 municipalities across 40 countries on every continent.

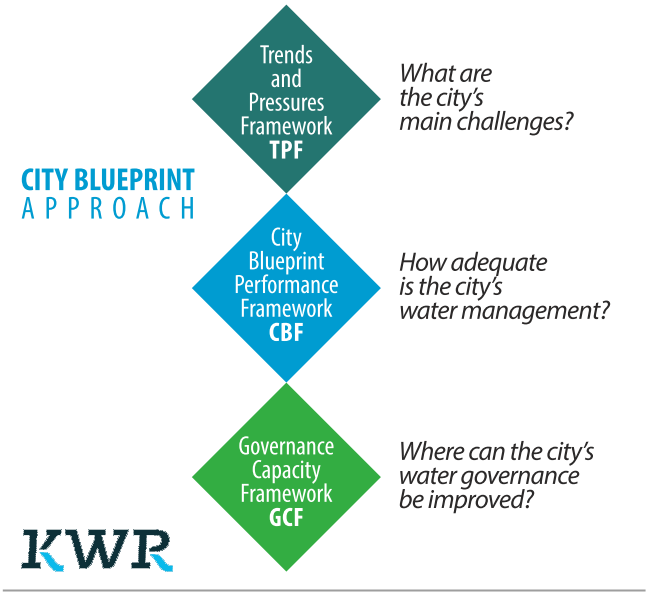
The CBA is a baseline assessment and a first step in the strategic planning process in cities, depicted in the red box below.

The CBA consists of three complementary frameworks:

- The **Trends and Pressures Framework (TPF)** to assess the main challenges of cities,
- The **City Blueprint Framework (CBF)** to provide an overview of IUWM, and
- The **Governance Capacity Framework (GCF)** to assess water governance capacity.

IUWM Project Cycle (source SWITCH)





The GCF was outside the scope of the study in Leh, thus the Leh assessment is limited to the TPF and CBF frameworks.

The data required to calculate the TPF and CBF indicators are collected from publicly available sources such as international databases, national and local reports, governmental websites and scientific articles. The data is co-collected together with local stakeholders (municipal leaders, department representatives, NGOs & water and sanitation user groups), who provide feedback and additional inputs regarding the preliminary results. KWR provides City Blueprint surveys and verifies data and scoring calculations within the CBA framework, before and after a stakeholder workshop.

TRENDS AND PRESSURES FRAMEWORK (TPF)

Each city has its own context-specific challenges, and the TPF has been developed to be sensitive towards local contexts. The TPF framework consists of **24 indicators** divided into **4 broad categories.** They are external social, environmental, financial and governance challenges and pressures that are unlikely to be able to be influenced by local authorities, but nevertheless drive a city's requirements for change and adaption.

Category	Indicators		Indicator Number
I **SOCIAL**	Urbanization Rate		1
	Burden of Disease		2
	Education Rate		3
II **ENVIRONMENTAL**	Flood risk	Urban drainage flood	4
		Sea level rise	5
		River peak discharges	6
		Land subsidence	7
	Water scarcity	Freshwater scarcity	8
		Groundwater scarcity	9
		Sea water intrusion	10
	Water quality	Surface water quality	11
		Biodiversity	12
	Heat risk	Heat island	13
	Air Quality		14
III **FINANCIAL**	Economic pressure		15
	Unemployment rate		16
	Poverty rate		17
	Inflation		18
IV **GOVERNANCE**	Voice and accountability		19
	Political Stability		20
	Government effectiveness		21
	Regulatory quality		22
	Rule of law		23
	Control of corruption		24

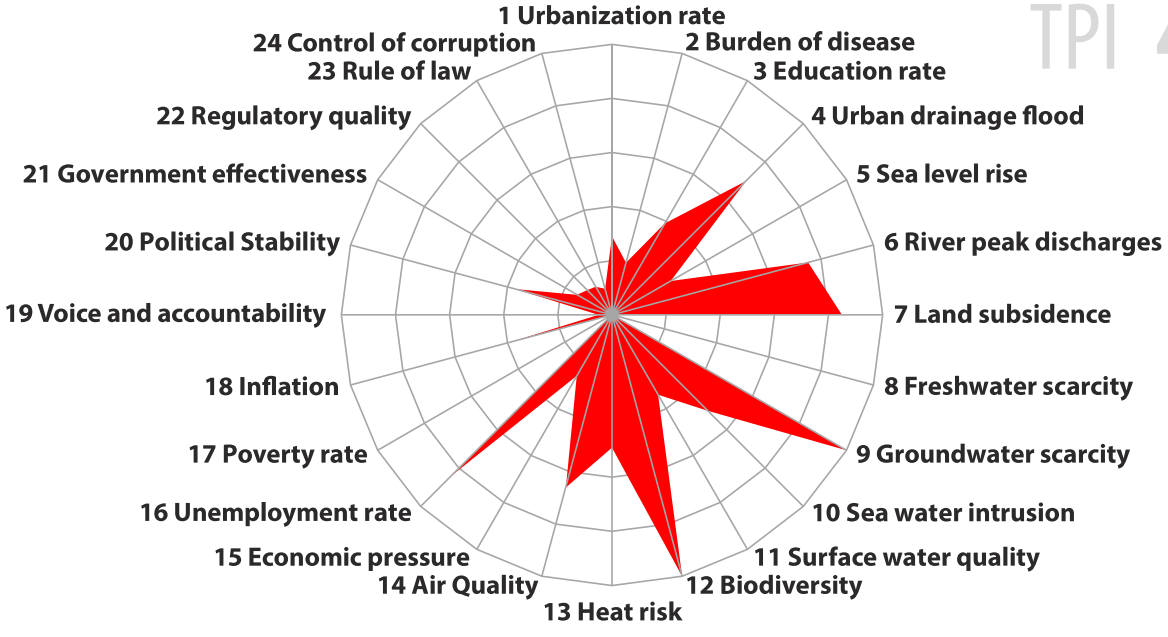
The 24 indicators are standardized to a scale of 0-10 and divided in ordinal classes expressed as a 'degree of concern' as shown below. A higher score means higher urban pressure or concern.

TPF indicator score	Degree of concern
0 – 2	no concern
2 – 4	little concern
4 – 6	medium concern
6 – 8	concern
8 – 10	great concern

There are two key outputs of the TPF, the **Trends and Pressures Index (TPI)**, which is the geometric mean of the 24 indicators, and a **radar chart** to better present the indicator scores in a more accessible visual format.

Antwerp, Belgium **TPF**

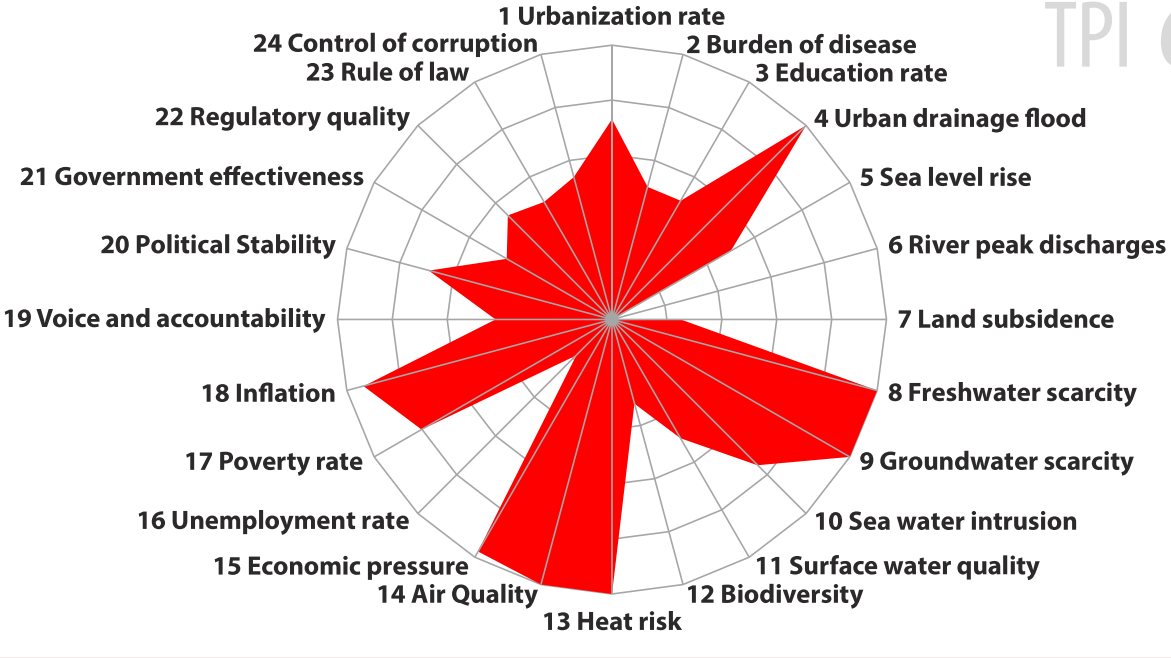
ANTWERP
TPI 4.09



Example : **Antwerp**, Belgium
TPI Score : **4.09**
This graph shows that Antwerp is a developed city with a stable political and environmental environment but is notably susceptible to the forecast impacts of climate change, and therefore requires increased climate resilience.

Ahmedabad, India **TPF**

AHMEDABAD
TPI 6.27



Example : **Ahmedabad**, India
TPI Score : **6.27**
This graph shows a comparatively higher level of pressures and challenges that Ahmedabad faces overall when compared to Antwerp. Ahmedabad is experiencing rapid urban expansion, with severe economic-related pressures, risks to water security, air quality and heat, as well as moderate governance challenges.

CITY BLUEPRINT FRAMEWORK (CBF)

The CBF consists of **24 performance-oriented indicators** divided over **7 broad categories** that together strive to provide a comprehensive overview of a city's current state of IUWM competency.

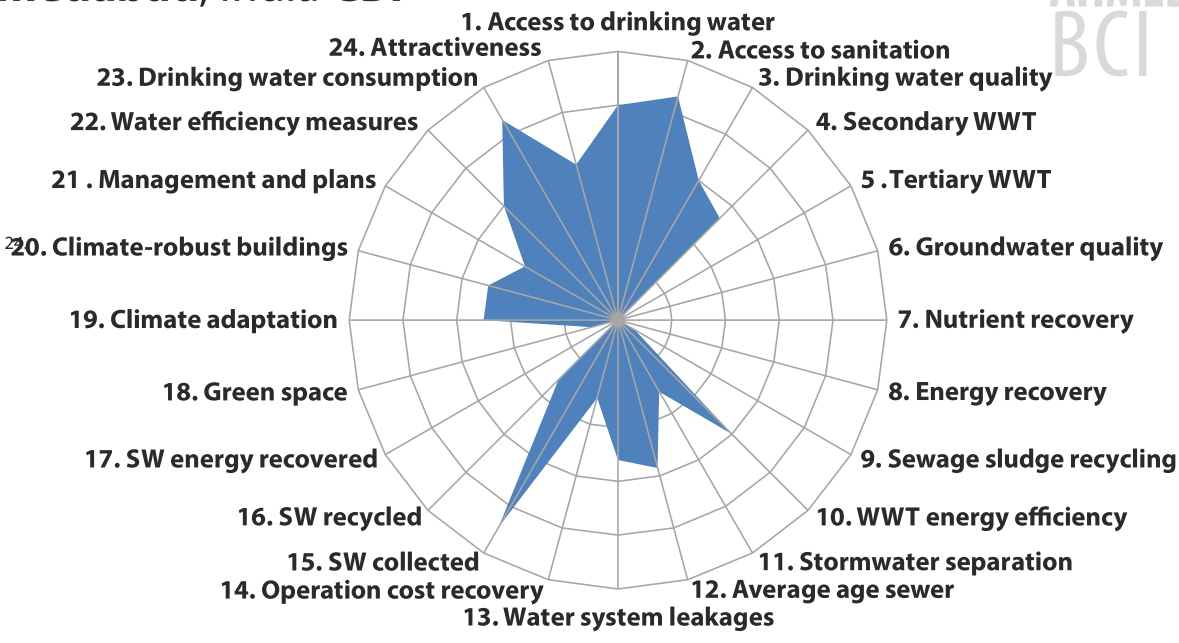
Category	Indicators
I Basic Water Services	01 Access to drinking water
	02 Access to sanitation
	03 Drinking water quality
II Water Quality	04 Secondary WWT
	05 Tertiary WWT
	06 Groundwater Quality
III Wastewater Treatment	07 Nutrient Recovery
	08 Energy Recovery
	09 Sewage Sludge Recycling
	10 WWT Energy Efficiency
IV Water Infrastructure	11 Stormwater separation
	12 Average age sewer
	13 Water system leakages
	14 Operation cost recovery
V Solid Waste	15 Solid waste collected
	16 Solid waste recycled
	17 Solid waste energy recovered
VI Climate adaptation	18 Green space
	19 Climate adaptation
	20 Climate-robust buildings
VII Plans and actions	21 Management and action plans
	22 Water efficiency measures
	23 Drinking water consumption
	24 Attractiveness

The CBF indicators are scored on a range of 0 to 10 points according to a standardised and reproducible method. A lower score indicates low performance, and a higher score indicates higher performance.

CBF indicator score	Meaning
0	Low Performance
10	High Performance

There are two key outputs of the CBF, the **Blue City Index (BCI)**, which is the geometric mean of the 24 indicators, and a **radar chart** to better present the indicator scores in a more accessible visual format.

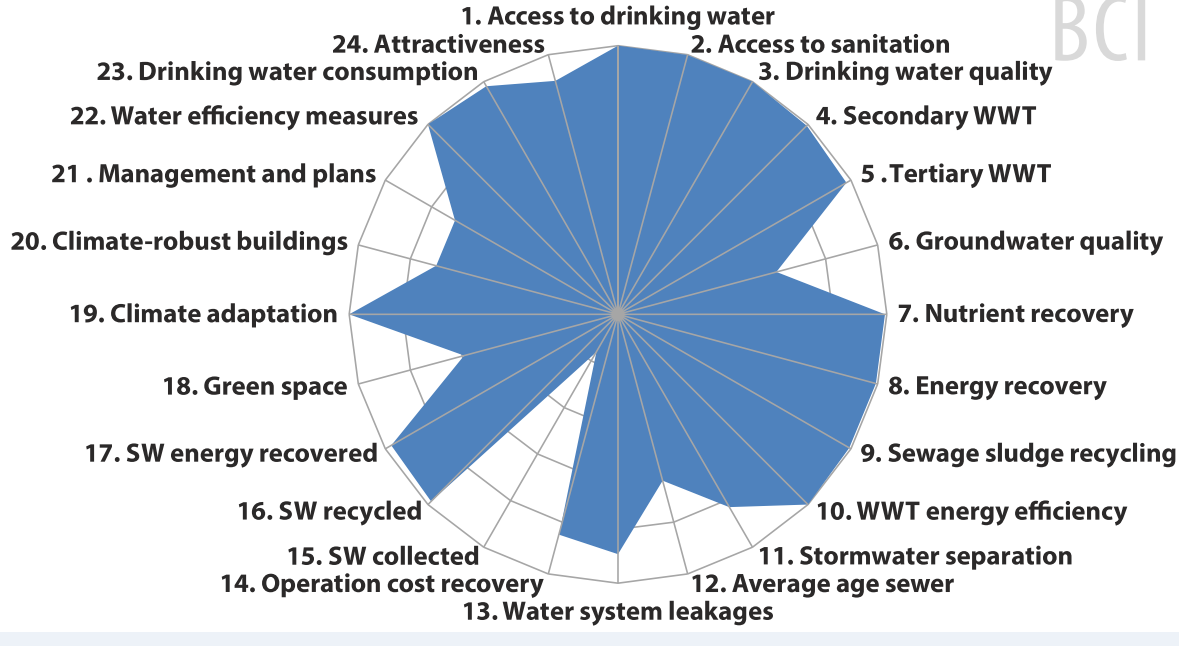
Ahmedabad, India **CBF**



Ahmedabad, India:
BCI Score: **3.2**

Ahmedabad's low BCI score indicates that IUWM concepts are either not established within the city's operations, or limited resources are available for water-related initiatives. While the city scores highly for access to drinking water and sanitation, there are performance gaps in infrastructure and climate resilience categories.

Amsterdam, Netherlands **CBF**



Amsterdam
BCI Score: **8.3**

Amsterdam's high BCI score indicates that IUWM concepts are well established, although there are still performance gaps in areas such as solid waste management, groundwater quality and aging infrastucture.

Learn More:
https://www.youtube.com/watch?v=AdQf6CT_w9U&t=332s
https://www.eip-water.eu/City_Blueprints

B. **Integration Assessment**

This methodology, published in ICLEI South Asia's 'Adopt IUWM Toolkit for Indian Cities', provides a rapid preliminary assessment of the existing level of integration of urban water sectors. Additionally, it helps to identify strengths, weaknesses, areas for quick improvement, and which sector should be prioritized (water supply, wastewater or stormwater).

IUWM Toolkit for Indian Cities
Adopting Integrated Urban Water Management in Indian Cities
(AdoptIUWM)

Example : **Integration Assessment Results**

Final Score	***150***
Existing status of integration in the city (Excellent, Good, Average, Poor, Critical)	*Poor*
Focus Sector (based on First Integration Assessment Matrix)	*Water supply*
Weaknesses	*'Institutional mechanism' and 'capacity'*
Strengths	-
Quick Improvement Areas	*'Climate change and water resources', 'infrastructure for urban poor' 'industrial wastewater'*
City-specific indicator(s)	-

In this example, the city's score is **150**, the corresponding status is **'poor'**.
This means that the city demonstrates a very low level of integration across urban water sectors and needs to take immediate measures towards integration across sectors.

Learn More:
https://iuwm.urbanwatermanagementindia.org/fileadmin/user_upload/IUWM_Toolkit_21_March_2017_Small_file.pdf

Results & Discussion: **IUWM Analysis**

Results & Discussion: **IUWM Analysis**

The purpose of the TPF and CBF is to quickly highlight key areas of concern regarding the current challenges and issues in urban water and sanitation within the assessed area. The information generated by these frameworks allows local authorities and communities to better prioritize, plan, and manage their work in the sector in a more integrated, effective and efficient manner.

It should also be noted that the City Blueprint Approach offers an overview 'snapshot' of the current situation in Leh, and does not account for improvements and plans that are under development or currently being implemented. Thus, although the Urban Local Bodies (ULBs) have many plans in development and projects underway to improve water and sanitation, they are not yet reflected in the results of the CBA assessment.

In Leh, existing plans and projects which will impact a CBA assessment once they are completed, include the planned STP, establishment of a solid waste segregation and recycling depot, phasing out all public standpipes in favour of direct household connections, installation of more pumps along the Indus banks to increase water supply to Leh, and implementation of 24 hours per day, 7 days per week water supply, in selected zones.

"Geographically and topographically Leh is different from other parts of India and therefore operation is very challenging in Leh."

Tsering Angchuk,
Assistant Executive Engineer,
PHED

Trends and Pressures Framework (TPF)

Through the City Blueprint process an overall **Trends and Pressures Index (TPI) score of 4.2** was calculated. On the TPI indicator scale, this score indicates that the external social, environmental and financial challenges and pressures Leh faces should be considered a '**medium concern**'.

The results below describe the detailed results of the City Blueprint process; the current categories of trends and pressures Leh faces, and their extent.

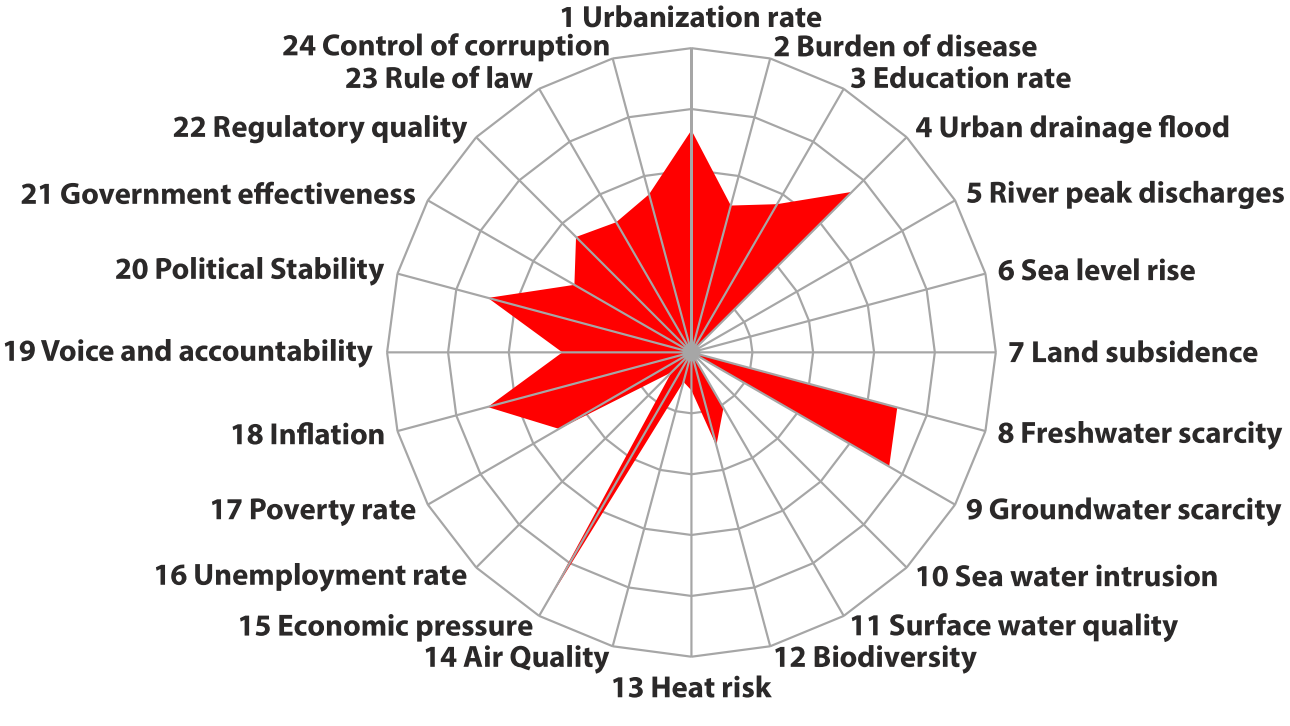
LEH, INDIA TPF

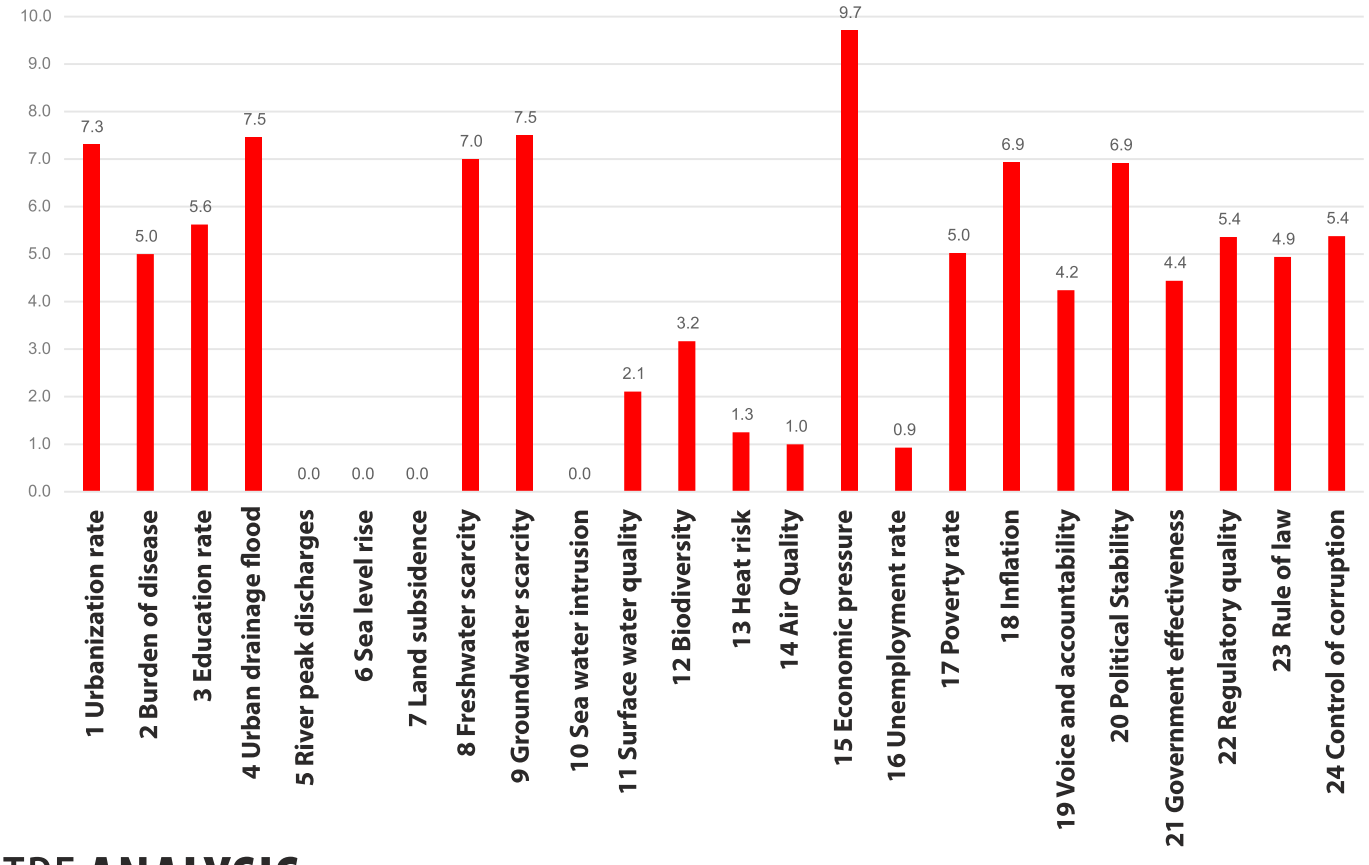
TPI: 4.2
Medium Concern

TPF indicator score	Degree of concern
0 – 2	no concern
2 – 4	little concern
4 – 6	medium concern
6 – 8	concern
8 – 10	great concern

A higher score = higher urban pressure/concern

LEH TPF





TPF **ANALYSIS**

India's overall low GDP per capita translates into high economic pressure, which limits investments that Leh can make in all sectors, including urban water and sanitation.

Groundwater scarcity is a measure of groundwater abstraction as a percentage of the annual groundwater recharge. There is no clear data available from Leh, but it is well known that abstraction rates are very high and uncontrolled. On a national level, **India has one of the highest groundwater abstraction rates in the world**, with 50 - 100% abstracted of annual recharge. It is of concern that **Leh also appears to be using its groundwater in such an unsustainable manner**. However, hard data is needed to properly quantify the issue and ramp up management measures. Further, all sources need to be assessed, including those used by the army in Leh.

Additionally, **freshwater scarcity** as measured by the abstracted fresh water as a percentage of total renewable resources is a concern for India at 34%. This includes surface water, glacier and groundwater sources. Again, there is no clear data available from Leh, however, in the workshop participants highlighted seasonal **groundwater variations, depleted surface waters, and contamination of water sources as areas of concern** for them. Given Leh's low rainfall rate and dependence on glacier melt for water supply and groundwater recharge, **more information on snowfall and ice measurements should be collected** to clarify uncertainties. However, even moderate estimates of the impact of climate change on the Hindu Kush Himalaya region suggest that **half of glacier ice could be lost by 2100**. What this means specifically for Leh and its sustainability in terms of water supply, including future levels of the Indus river, is that **further research is required**.[21]

The **risk of flooding** due to intensive rainfall (**urban drainage flood**) is also a concern for Leh. While soil permeability area is relatively high, at an estimated 40%, **flash flooding is a significant risk** with intense storms, as was experienced in the 2010 'Cloud Burst' flooding disaster. **The risk from the Leh river and other tributaries, and the potential influence of climate change, is currently unassessed**.

Another important concern identified by the TPF is the **high urbanization rate** of 2.4%. This coupled with its rapidly growing tourism industry and the **challenges** Leh faces regarding its water systems and resources, **will definitely increase over time without effective integrated planning and management.**

[21] International Centre for Integrated Mountain Development (ICIMOD) 2019, 'The Hindu Kush Himalaya Assessment'

City Blueprint Framework (CBF)

Through the City Blueprint process an overall **Blue City Index (BCI) score of 2.6** was calculated. This indicates that Leh's water management performance is somewhat low and it is classified as a '**wasteful city**' on the BCI indicator scale.

While the label of wasteful may seem rather negative, it is an accurate description when considering the waste of water, nutrients and energy in relation to urban water and sanitation management.

The results below describe the current state of IUWM within Leh, according to the CBF analysis.

LEH, INDIA CBF

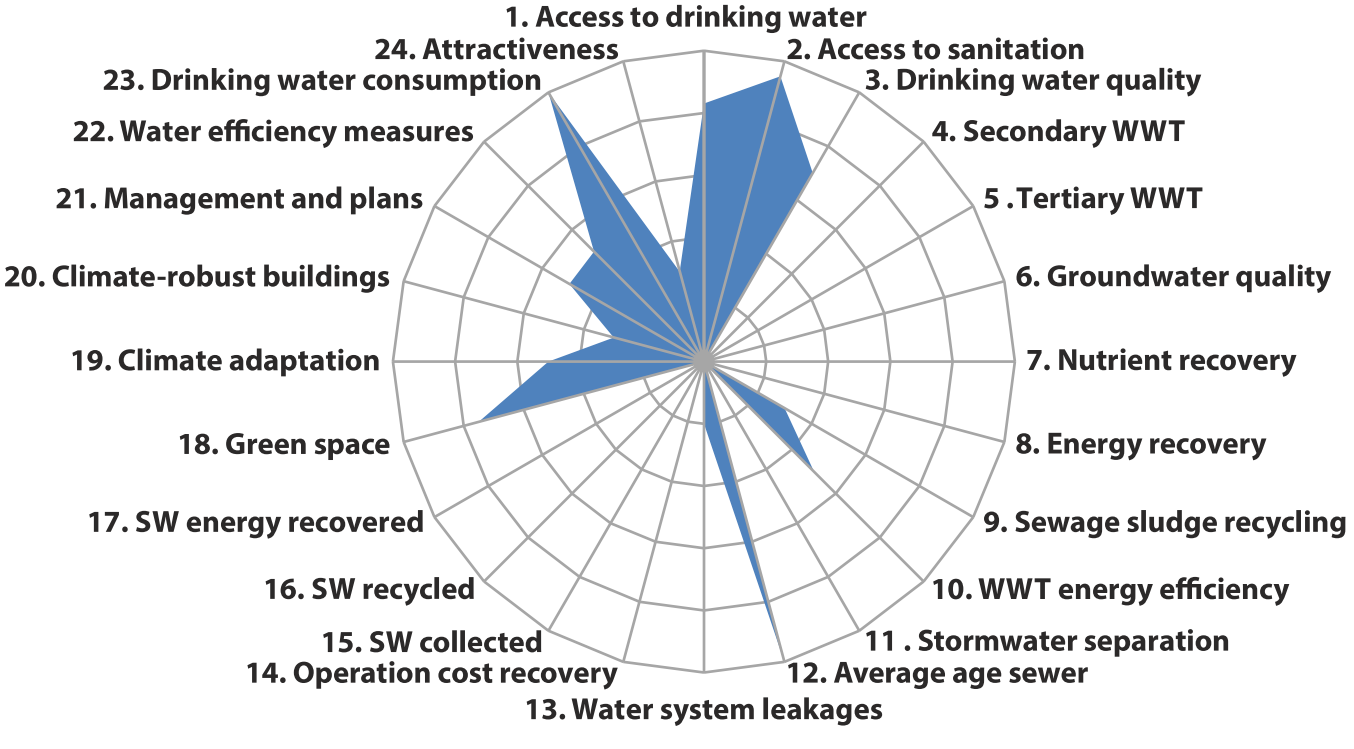
BCI: 2.6

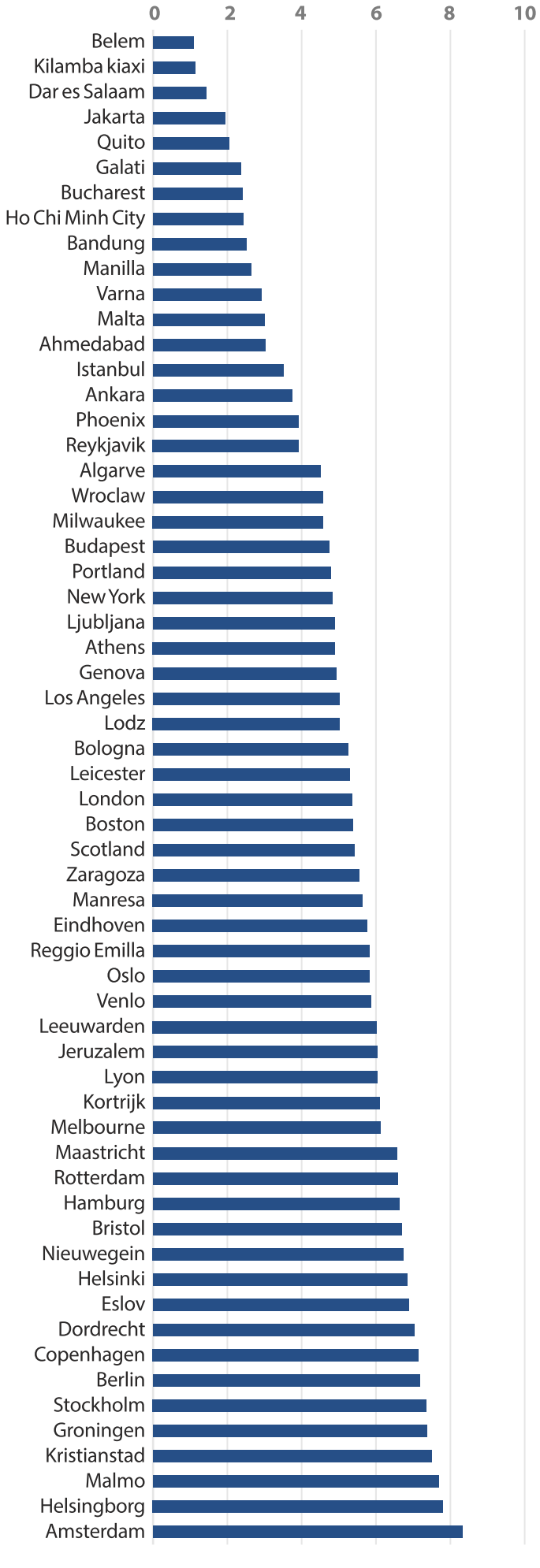
Wasteful City

BCI	Categorization of Cities
0 – 2	Cities lacking basic water services
2 – 4	Wasteful cities
4 – 6	Water efficient cities
6 – 8	Resource efficient and adaptive cities
8 – 10	Water wise cities

0 = Low Performance (Concern)
10 = High Performance (No Concern)

LEH CBF



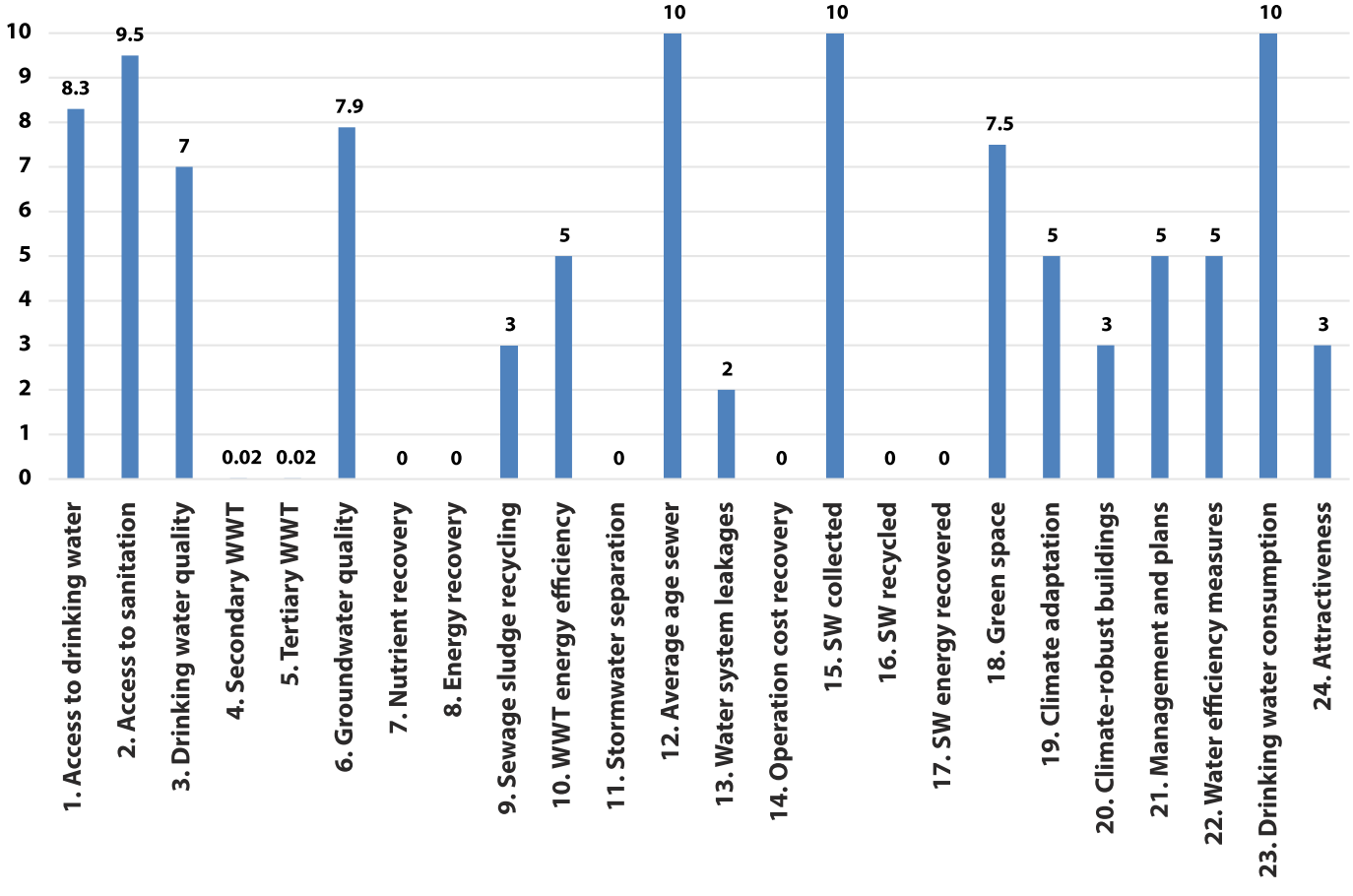


BLUE CITY INDEX BCI

60 Cities compared

BCI scores for
60 cities and regions.

How does
your city compare?



CBF **ANALYSIS**

The high score for the **average age of the sewers** (score 10) is an acknowledgement of the recent investments made in the **sewer network in Leh, which covers about 40% of the town**. The high scores for solid waste collection (score 10) and drinking water consumption (score 10) are a result of the relatively low per-capita water consumption and solid waste generation. In these cases, the high scores should not simply be interpreted as perfect-performance, but rather considered within the context of the overall low performance BCI score.

Indeed, the scores for **solid waste recycling (score 0)** and **solid waste energy recovery (score 0)** indicate there is **a lot of potential to improve solid waste management in Leh**. Revenue, compost and energy can all be generated from different solid waste recycling & management techniques. Plans are in place to establish a recycling depot with co-composting.

However, the data on solid waste generation, solid waste composition, the scale of existing informal recycling, and business potential is either unclear or not available. **Understanding, quantifying and valuing the solid waste management situation in Leh should be prioritized.** Decentralized service and management models should be investigated, as well as integration with other urban services.

The level of **access to drinking water (score 8.3)** is very good, but access can still be improved, and the PHED is continually working on this. However, the good level of access does not indicate how many hours of water supply residents have each day, which is about two hours a day on average. Furthermore, it does not indicate the quality of the water and currently drinking water is not treated before distribution. Indeed, one of the **key findings of the workshop process was that there is limited data on water quality available.**

Data that is available is often contradictory, or not comparable due to different methodologies and parameters being used to gather this data. For example, the **drinking water quality score (score 7) was essentially a compromise based on the contradictory data from different sources. Groundwater quality (score 7.9) score is very positive**, but it is based on an academic study which also stated 20% of groundwater samples were found to have high nitrate concentrations or microbiological contamination. Recent routine testing by PHED of town water supply sources have not shown any indications of contamination, but it is known that the pipe distribution network and tankers are potential sources of contamination.

The workshop participants were **very concerned about water quality** and desire **more regular testing of all key parameters, at source and within the distribution system, and to have a testing laboratory established in Leh**. This is highly recommended, and results could be used to accurately inform decisions on what type of drinking water treatment is required, if any, before distribution.

With regards to the PHED water supply, the City Blueprint indicates that **water system leakage (score 2) is a significant area of concern**. There was some debate during the workshop on how 'leakages' should be defined. Pipeline leakage was estimated at 20%, but due to the set-up of the water distribution system, most public standpipes do not have taps and flow freely even when no one is collecting water, and overflows from storage facilities are a regular occurrence. **Therefore, over 40% of the water supplied is actually wasted.**

The high rate of leakage has an impact on water supply and sanitation services **operation cost recovery (score 0)**. The operating cost of the PHED water supply system is 1,65,00,000 INR annually, while only 9,54,225 INR revenue is collected annually. Therefore, **cost recovery is only 5.8%**.

Interestingly, the Blue Water Company, which operates the **FSTP under a PPP contract, achieves full cost recovery and even makes a profit**. This suggests that a different business model and tariff structure for water supply could help improve operation cost recovery and, by extension, overall sustainability.

Further, **other sources of funding should be explored**. For example, a modest tourism tax on all incoming domestic and international tourists could cover most of the PHED current water supply operational costs. Similarly, a charge for groundwater abstraction, called a 'Water Conservation Fee' in some other parts of India, could be charged starting with businesses and hotels. Such fees should also be seen as a management tool for tackling groundwater scarcity and improving water use efficiency. With its newly established UT status **Leh should actively develop revenue raising regulations and by-laws to support the sustainability of its urban water systems.**

A water supply service achieving supply 24 hours per day, 7 days per week is a commendable goal to work towards. However, technological, institutional, financial and social aspects need to be analysed and addressed as with the existing water supply system, before piloting on a small scale as a learning exercise.

The idea of 24/7 water supply is appealing and can help improve water quality and leakage issues, but it will not automatically solve existing **issues of financing, staffing and sectoral integration for sustainable operations.**

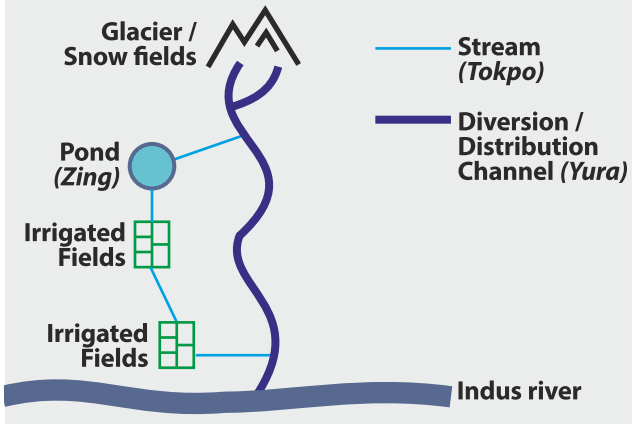
Access to sanitation scored very high (score 9.5), which is an excellent result. Nearly all households have toilets connected to soak pits or septic tanks. The gaps in access reportedly occur due to migrant worker housing and some businesses not having toilets. During winter months, traditional dry toilets are still used by most households.

However, it was also found that **secondary and tertiary wastewater treatment (score 0.02) and associated nutrient recovery (score 0) is extremely limited** in Leh. The planned STP aims to provide coverage to an estimated 40% of the town and the FSTP provides faecal sludge treatment capacity as well as producing compost in the future. This leaves **approximately 60% of the town without planned sanitation coverage**, and it is not clear what portion of this balance is served by functioning septic tanks. During the workshop **the need for more septic tanks**, the standardization of designs, and regulations enforcing their installation in households and businesses, were discussed repeatedly, as were the links with soak pits and poor-quality septic tanks to groundwater contamination.

This awareness and discussion needs to be taken to the communities that will not be served by the STP. All appropriate technical and management options (including greywater management) should include the consideration of **decentralized sanitation solutions** for both individual households and for different cluster levels (e.g. block, neighbourhood or ward).

Faecal sludge management is also measured partially in the City Blueprint by looking at the proportion of **sewage sludge recycled or re-used (score 3)** and while the FSTP is yet to produce compost, **traditional dry toilets** in Leh produce good quality compost. Rough estimates from the workshop process suggest that **8,00,000 kg of compost are produced each year, yet only about 30% of this is utilised for agriculture**.

However, this is not based on hard data and it is not even clear how many traditional toilets are actually in use. This is an interesting area that warrants **further study to quantify the compost volume and value, and to investigate potential business and management models** to effectively utilise this urban resource. Indeed, one option could be to expand the remit of the FSTP's range of service to include traditional toilet management.



Simplified layout of
Water Allocation System for **Agrarian Sector**
Source: *Akhtar - Tourism and Water Resources in Leh town*

Stormwater separation (score 0) is a measure of the proportion of the wastewater system for which sanitary sewage and stormwater flows are separated and managed independently.

The **56 km sanitary sewer pipeline that will serve the STP is an important infrastructure investment**, but there is currently no formal stormwater system in Leh. While annual rainfall is very low, what exists for the transportation of rain, spring water and snow melt is essentially the **traditional water management system**. This is mostly made up of open canals and drains (yuras) linked to old agriculture irrigation systems and ponds (zings) that are used to store water.

Currently the maintenance of the system appears to be limited and it is not clear to what degree the traditional management system (churpon) is functioning.

Is its role for supporting agriculture still relevant? **Can its role in retaining water flows and recharging groundwater in Leh be increased?** How can improved management reduce pollution and the risk of flash flooding events in Leh? **Revival, renovation and integration of the traditional systems into the modern urban water management system should be considered after an in-depth study.**

Climate adaptation (score 5) is a measure of the level of action taken to adapt and create resilience towards climate change threats. **Management and action plans (score 5)** are a measure of the application of the concept of integrated water management in the city and more broadly in the country. Local climate policies and plans do exist, but workshop participants were not aware of implemented examples in Leh.[22]

Participants also stated that **local precipitation is increasing, snowfall is decreasing, and increases in temperature are being noticed too**. They believe this is having a **negative impact on water resources and this in turn will affect local tourism, agriculture and other industries**.

Integrated water resource management guidelines are available in India at a national and state level, as are national and state level projects. Projects with basin level approaches have been ongoing for many years, but often more focused in rural regions. At the local level in Leh, there have been studies and there are ongoing projects that promote an integrated approach to water management. These are all excellent initiatives, but **increased efforts are required, such as the direct linking of climate-focused actions with integrated urban water management**.

[22]LAHDC 2018, 'Planning Leh's Future', State Action Plan for Climate Change (SAPCC)

Integration Assessment

The Integration Assessment was conducted during the workshop, using the methodology published by AdoptIUWM's Toolkit for Indian Cities. The assessment provides additional and complementary information which are in line with CBA findings. It determines the strengths and weaknesses of the current urban water management situation, as well as overall integration of different urban water sectors. The results are summarized below:

Final Score	***170 (/390)***
Existing status of integration in the city (Excellent, Good, Average, Poor, Critical)	**Average** Implications: • Some integration across urban water sectors exists • Measures towards integration need to be taken to solve issues related to urban water sectors
Recommended Focus Sector	**Wastewater**
Key Weaknesses	• Municipal and industrial effluent management • Water reuse • Consideration of water uses cases • Groundwater level changes
Key Strengths	• Water sources, • Water sharing patterns • Potable water distribution
Key Quick Improvement Areas	• Institutional mechanism for urban water sectors • Participatory process for integration of urban water sectors • Water quality monitoring • Traditional water management structures and systems

The Way Forward: Recommendations

The City Blueprint process and Integration Assessment have highlighted high performance areas and low performance areas, identified gaps, raised many questions, and started conversations between key stakeholders on urban water and sanitation issues and climate change in Leh.

The recommendations below provide practical actionable steps, ideas and guidance for Urban Local Bodies (ULBs) over the short to medium term.

It is highly recommended that a formal process be initiated by the ULBs to develop a comprehensive city-wide integrated plan using an IUWM approach linked to climate change and SDG actions. Active political leadership to support the process, institutional changes and opportunities to mobilize funding sources will be essential for long term success.

The process of building and implementing an IUWM approach for Leh, and establishing key partnerships along the way, should be viewed as a capacity building program for the ULBs, one that can offer appropriate progressive alternatives to generic conventional approaches institutionalised in India. This can help establish Leh's ULBs as leaders in the integration of urban water and sanitation services and climate adaptation through water management.

A sustainable and holistic approach to water management will have long term ecological, economic, social, and water security benefits. The process is slow by nature and takes many small steps within a multi-stakeholder approach, to achieve the ultimate goal of conserving the environment and improving liveability for all citizens in Leh.

The first small steps have been taken, but it is now up to the ULBs to continue to show leadership and to move the process forward.

Recommendations	Rationale / Explanation	Key Targets
Management & Leadership		
Step 1 Actively seek out more technical partners to assist in the development of integrated urban water management plans and services	No ULB can do everything alone. Existing cooperation's with organisations such as LEDeG and BORDA, for example, are very positive and should be maintained. However, donor funding sources are unstable and unpredictable, therefore it is important that the ULBs further diversify their partnership portfolio. Partnering with other municipalities, government agencies, IO/NGO/INGOs, private companies and/or universities can bring in technical, financial and capacity building support.	• More MoUs and cooperation agreements • Increased ULB technical capacity • Increased technical implementations
Step 2 Select an IUWM approach and commit to a formal IUWM process in partnership with ward-level stakeholders	Starting any formal or official integration process, even if it is small and has limited resources, is the key to longer term success and sustainability. Engagement with community-level stakeholders early in the process is also essential for sustainable and inclusive outcomes. The Army is a major resource user and polluter and should also be included. A true IUWM approach includes all stakeholders and users. The process should also be linked to wider urban planning processes. Select from existing approaches or toolkits. Do not try to develop a new framework, but rather build on what is already available. This approach will save time and resources.	• A clear, visible, senior level political commitment to IUWM • Focal point staff member & supporting budget allocated • IUWM approach/toolkit selected • Institutional arrangements related to IUWM reviewed • Key staff and stakeholders build IUWM knowledge and experience • Initiate IUWM policy development
Step 3 Prioritize allocation of municipal budget for IUWM related project implementations	Create specific budget lines for IUWM studies or assessments, and water and sanitation related infrastructure projects, or reallocate existing budget lines already earmarked for water and sanitation. Link to climate change and SDG related budget lines where possible. If full funding for assessments or infrastructure is not possible, allocate what is available, and use it as leverage with donors to secure more funding.	• Annual budgets include budget lines for IUWM activities
Step 4 Develop IUWM related policy and proposals to create and attract more funding sources	A newly established UT has many challenges, but there are also many opportunities to develop and apply progressive and locally adapted policies and by-laws. Even a very basic policy on IUWM can unlock more partnership options and funding sources. Clear policy direction gives donors more confidence. Policy related to revenue raising should also be included. For example, tourism tax or groundwater extraction fees for businesses. Policy examples from around the world are readily available to be adapted to the local context. Any policy should include the establishment of an IUWM unit to be responsible for oversight of IUWM activities. IUWM policy development also has benefits beyond financing, such as legitimising acceptance, supporting approvals for projects, promoting conservation, and increasing capacities of those involved in the process. Developing proposals for IUWM related projects or programmes to raise funds from 3rd party donors can reduce pressure on the municipality budget. Proposals should be distributed widely to government agencies, IO/NGO/INGOs, private companies and universities.	• Basic IUWM policy issued, including revenue raising measures • IUWM unit established within the Urban Development Department • Proposals for potential donors disseminated

Recommendations	Rationale / Explanation	Key Targets
Technical Aspects: Sanitation		
Conduct comprehensive study of sanitation gaps in Leh	Total coverage and status of toilets, soak pits and septic tanks to be assessed. Areas outside the STP service coverage to be assessed for feasibility of non-sewered decentralized sanitation solutions (e.g. DEWATS, greywater management, FSM & septic tanks etc). Dry toilets: Assessment of total coverage, status, compost production, O&M. Seek recommendations on modernisation of toilet designs; revenue raising opportunities; and new management models. Investigate sanitation related policies and examples of standardization of technical designs; community promotion; PPP, business models; O&M; tariffs; installation enforcement; phasing out of soak pits. Consider cross-cutting topics: climate change; energy efficiency; urban sectors integration; localized recycling and reuse	• Status report on Sanitation gaps in Leh, including policy direction • Decentralized sanitation solutions: Feasibility reports for single location or multiple location cluster on ward level • Proposal decentralized sanitation solution(s) • Dry toilets part of IUWM planning • Plan to phase out soak pits • **Implementation:** Phased but prioritized upscaling of decentralized sanitation solution(s) or decentralized sanitation solutions cluster(s)
Review and study current status of solid waste management	Fully understanding the current status of solid waste generation, collection and recycling (e.g. segregation, composting) is essential to be able to plan, upgrade and expand services. New management models (e.g. PPP, decentralized) and innovative technologies (e.g waste to energy) should be considered.	• Status report on SWM including recommendations on management solutions and technology options • **Implementation:** Solid waste segregation and recycling depot

Recommendations	Rationale / Explanation	Key Targets
Technical Aspects: Water		
Groundwater assessment	Quantify groundwater abstraction and groundwater resources with an in-depth professional Hydrogeological study in Leh. Understand glacier and snow resources and the impact of climate change on groundwater. Investigate policies and examples of successful management (water use efficiency), conservation (water demand reduction) and revenue raising approaches.	• Groundwater assessment report • **Implementation:** City-wide groundwater management, conservation and revenue raising approaches
Water quality assessment	All key water sources should be assessed including groundwater, surface water, springs, snow/glaciers (summer & winter)Water within the distribution system should also be assessed including tankers, pipelines, PSP, household taps. All relevant bacteriological, virological and biological parameters should be tested, based on national standards, where possible. Based on water quality results identify appropriate water treatment approaches for supply sources and household level treatment and storage if required.	• Water quality assessment report • **Implementation:** Conduct regular WQ testing making data publicly available online • **Implementation:** Establish water testing laboratory (water & wastewater) • **Implementation:** Phased upscaling of drinking water treatment system(s) • **Implementation:** Promotion of household level treatment and storage
Conduct traditional water management system review	Understand if the traditional system can be revived, renovated and integrated into the modern urban water management system. Can its role in retaining water flows and recharging groundwater in Leh be increased? Can traditional ponds be rejuvenated? Are traditional management systems still viable – community-based management? How can improved management reduce pollution and the risk of flash flooding events in Leh?	• Traditional water management system review report • Traditional water management system incorporated into IUWM approach • **Implementation:** Phased upscaling of Zing rejuvenation project(s) • **Implementation:** Phased upscaling of groundwater recharging project(s)

Recommendations	Rationale / Explanation	Key Targets
Technical Aspects: Water (continued)		
Assess water supply business models and technology options	Investigate different business and management models for the water supply system in Leh. Can the existing model be improved? Can a PPP model be applied? What are consumers willing and able to pay for water services? How can leaks and wastage be reduced (technology options: sensors, meters etc.), and operational costs be covered? What options are there for revenue raising? (supply metering; tourist tax; groundwater abstraction fees; land taxes etc.) Consider cross-cutting topics: climate; energy efficiency; water use efficiency; water demand reduction; urban sectors integration.	• Business models and technology options assessment report • Climate appropriate metering and sensor technology selected • Implementation: New revenue raising approaches • Implementation: Phased upscaling of 24/7 water supply project(s) with new business model and technology
Conduct flash flooding risk assessment	Within a disaster risk management framework assess flash flooding risk and mitigation strategies	• Flash flooding risk assessment report • Risk mitigation strategies incorporated into IUWM approach

Recommendations	Rationale / Explanation	Key Targets
Social Aspects: Community Engagement		
Engage community groups in participatory and inclusive IUWM planning, including women, youth, end users & the disabled	Planning and implementation from the ward level. Women, youth and water and sanitation users' groups should be included.	• Active community engagement leads to increased citizen ownership and sustainability of IUWM outcomes • **Implementation:** Regular ward level planning and coordination meetings
Engage community groups in inclusive and collaborative Water Quality studies and awareness raising on integrated water management and sanitation issues, including women, youth, end users & the disabled	Ward level participation in water quality studies (household, surface and groundwater) helps build knowledge and support in the community. Water management awareness raising with a focus on water use efficiency and water demand reduction Sanitation issues awareness raising with a focus on non-sewered decentralized treatment options (e.g. septic tank promotion) helps build knowledge and support in the community.	• Active community engagement leads to increased awareness, action on WASH issues, and behaviour change • **Implementation:** Water quality studies and awareness raising

Key Actions **Summary**

Start

1 Start an IUWM process to integrate all planning and implementation of urban water and sanitation

- Select IUWM approach and appoint focal staff
- Conduct an in-depth IUWM institutional assessment
- Prioritize IUWM policy development

Seek Out

2 Actively seek out new technical and financial partners

Update

3 Update all urban water sector budget lines to reflect IUWM and link to climate change and SDG budget lines

Assess

4 Assess and upscale alternative decentralized sanitation solutions and new business models

- Assess sanitation gaps in Leh
- Assess traditional dry toilets
- Assess Solid Waste Management
- Implement decentralized sanitation solutions

Assess & Understand

5 Assess and understand existing water supply sources/systems (traditional & modern) and water quality

- Implement laboratory
- Implement new business models
- Implement 24/7 water supply

Engage

6 Engage community groups in assessments, planning and implementations to increase awareness and ownership

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