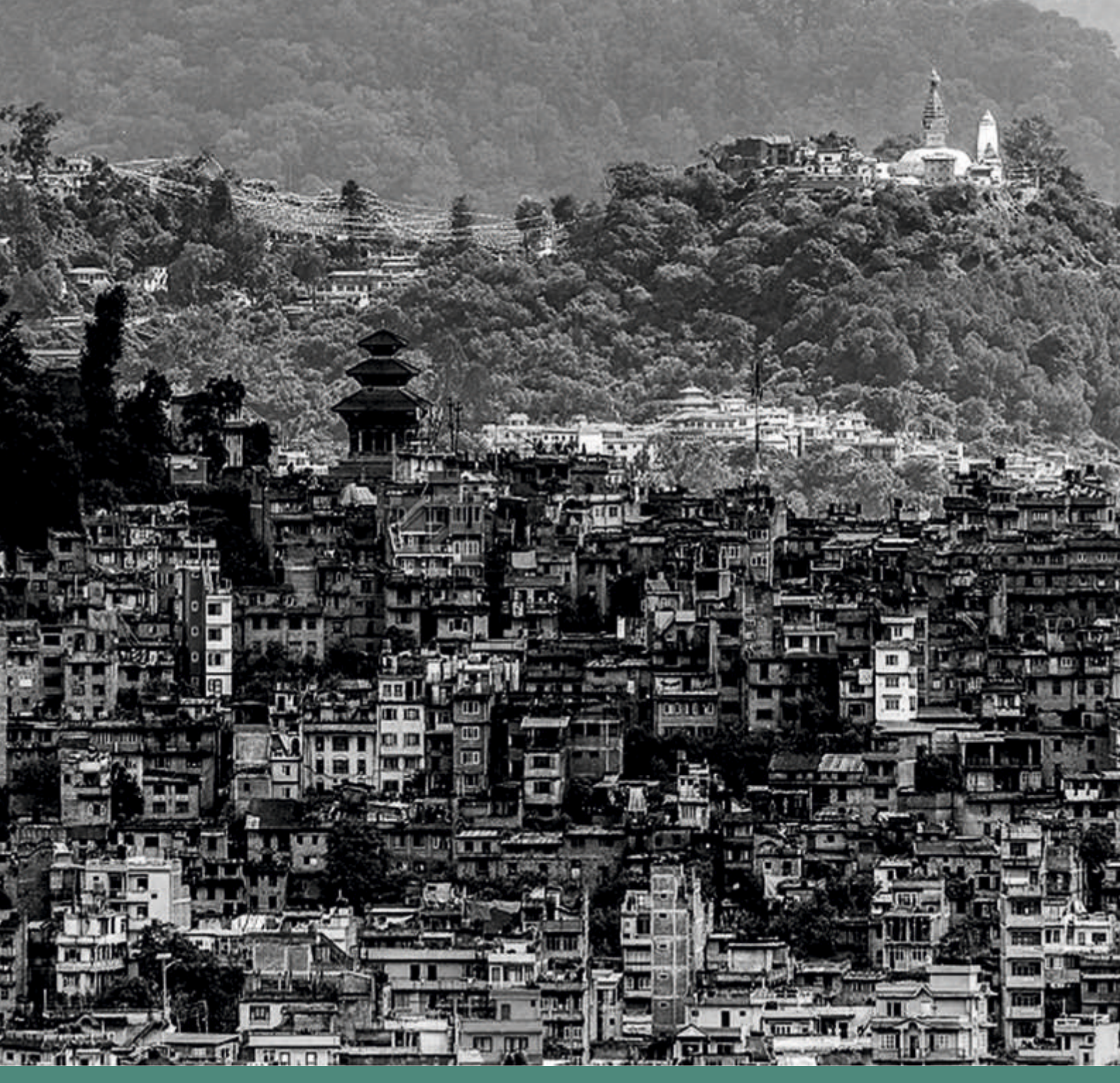

I U W M

Integrated Urban Water Management

RAPID ASSESSMENT

KIRTIPUR • NEPAL

ENPHO
Creating Eco Societies

BORDA

Published by:
Bremen Overseas Research and Development Association, South Asia (BORDA SA),
October 2020

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Author: Jagam Shrestha, Prashanna Pradhan

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Cooperation Partners:
Kirtipur Municipality, Kathmandu District, Bagmati Province, Nepal

Established in 1990, the **Environment and Public Health Organization (ENPHO)** envisages creating eco-societies by providing quality services on Water, Sanitation and Hygiene (WASH), environment and public health. Research, innovations and promotion of the WASH technologies and approaches have been the core priorities of ENPHO, a service-oriented national Non-Governmental Organization (NGO).
www.enpho.org

BORDA (Bremen Overseas Research & Development Association) is an expert NGO specialising in full-cycle decentralised sanitation. For over 40 years, their award-winning solutions have empowered people and set new standards in 20+ countries around the world.
www.borda-sa.org

Funded by: The Federal Ministry for Economic Cooperation and Development (BMZ)

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Front Cover : View of Kirtipur Municipality. Photo from sfd.susana.org

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Table of **Contents**

Introduction
to Partners & the Study

THE **PARTNERS**

ENPHO and BORDA have been working in partnership since 2004 to improve living conditions and to protect natural resources and climatic conditions in inadequately served urban and peri-urban settlements in South Asia. Concentrated in the field of urban sanitation, key achievements include technical support and scaling up of DEWATS, introducing FSM services in Nepal, local WASH capacity building, and innovations and demonstrations of new urban sanitation solutions.

More recently, they have been working closely on the BMZ funded 'Integrated urban water management at the centre of municipal public services' project (2018-2020). Designed in line with SDGs 6 (water) and 11 (sustainable cities), this project aims to support municipalities and environmental service providers to improve the living conditions of all inhabitants, protect natural resources, and develop liveable and inclusive cities.

ENPHO
Creating Eco Societies

BORDA

BMZ Federal Ministry for Economic Cooperation and Development

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION

11 SUSTAINABLE CITIES AND COMMUNITIES

THE **STUDY**

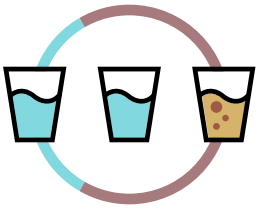
Due to a growing number of pressures related to urban water and sanitation, Kirtipur Municipality actively welcomed a rapid assessment of Integrated Urban Water Management (IUWM) and supported a stakeholder workshop in July 2020.

The purpose of this publication is not to answer all the questions or provide all the solutions, but to start stakeholders thinking about the issues and provide practical guidance and direction on how Kirtipur Municipality can actively move forward on the pathway for developing a productive and sustainable city-wide IUWM journey.

It is hoped that Kirtipur Municipality will consider employing an IUWM approach for the planning of a sustainable future for their region, to address current water-related challenges and build resilience to climate change, with the ultimate goal being to conserve the environment and improving liveability for all citizens in the municipality.

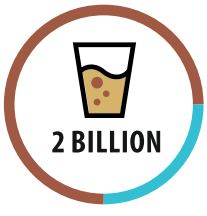
Background: **Global Context**

GLOBAL **WATER ISSUES**

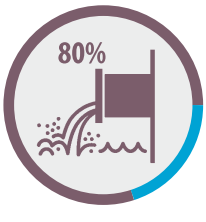


1 in 3 people worldwide, or **2.2 billion** people, currently lack access to **safe drinking water**.[1]

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]

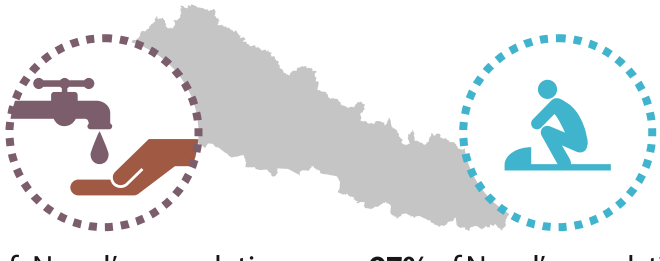


Over **80%** of global wastewater is released to the environment **without adequate treatment.**[3]

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]



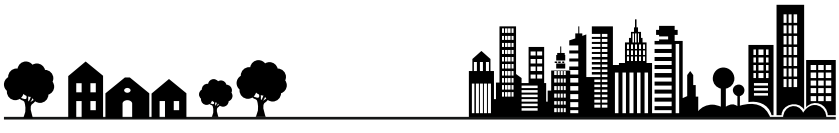
87% of Nepal's population has access to **basic water supply** facilities, with **91%** access in Bagmati Pradesh.[5]

97% of Nepal's population has access to **basic sanitation** facilities, with **98.8%** access in Bagmati Pradesh.[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] Budhathoki, CB 2019,'Water Supply, Sanitation and Hygiene Situation in Nepal: A Review', Health Promotion, 7, 65-76

GLOBAL **URBANIZATION**

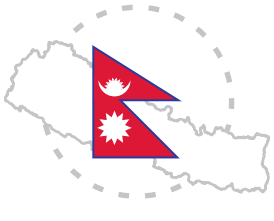
The current world population is 7.8 billion and it is expected to increase to 9.7 billion by 2050.[6]



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.

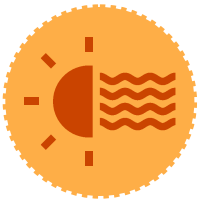
84% (2.1 billion) of the increases in urban population is expected to be in Asia and Africa, and concentrated in small and medium sized cities in low- and middle-income countries.[7]



For the period 2014-2050, Nepal will remain amongst the top ten fastest urbanising countries in the world. Urbanisation in Nepal is dominated by a few large and medium cities with an excessive population concentration in the Kathmandu Valley.[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] Bakrania, S 2015, 'Urbanisation and urban growth in Nepal (GSDRC Helpdesk Research Report 1294)', Birmingham, UK

CLIMATE CHANGE & CITIES



HEAT WAVES

DROUGHT

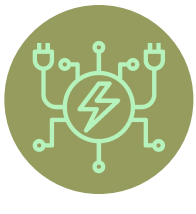
EXTREME PRECIPITATION

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

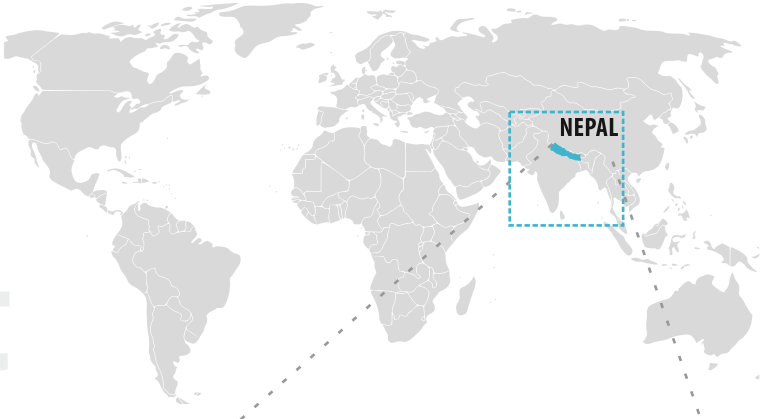
WATER

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

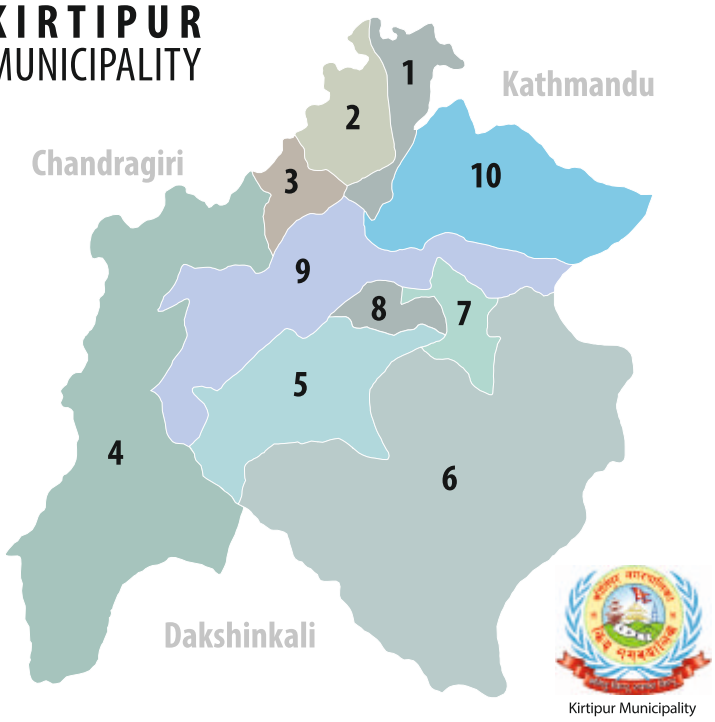
Background : **Kirtipur Overview** and **Context**

Background: Kirtipur Overview and Context



Kirtipur is an ancient city of Nepal, located in the Kathmandu Valley 5Km south-west of Kathmandu City. It is one of the old and typical Newar settlement of the valley and was listed as a UNESCO tentative site in 2008. It lies at 27° 38' 37" to 27° 41' 36"N and 85° 14' 64" to 85° 18' 00"E with altitude ranging from 1,284m to 1,524m above mean sea level.

KIRTIPUR MUNICIPALITY



Kirtipur Municipality

Kirtipur was declared as a municipality on 27th March 1997 by combining eight contemporary village development committees namely Layaku, Chithubihar, Palifal, Bisnudevi, Balkumari, Chovar, Champadevi and Bahirigaon. The municipality is divided into 10 administrative wards and covers 14.76 sq. km area. It is encircled by Bagmati River in the East, Chandragiri Municipality in the West, Kathmandu Metropolitan City in North and Dakshinkali Municipality in the South.

Altogether 19,441 households with a total population of 65,602 resides in the municipality. Besides, a large number of students from the country are rented to proceed with their higher-level education at Tribhuvan University located in the municipality. The annual population growth is for the municipality was reported at **4.8**.

Photo from www.tribhuvan-university.edu.np

Learn More:
http://kirtipurmun.gov.np/

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." [14]

- 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.[15] The three primary inefficiencies relate to infrastructure design and system management and system planning:

INFRASTRUCTURE DESIGN INEFFICIENCIES

- Large, rigid centralized infrastructure for urban water management.
- 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.[16]

SYSTEM MANAGEMENT INEFFICIENCIES

- Water-related services are planned and delivered in silos/isolation.
- Institutional fragmentation across different authorities[17]

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.

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

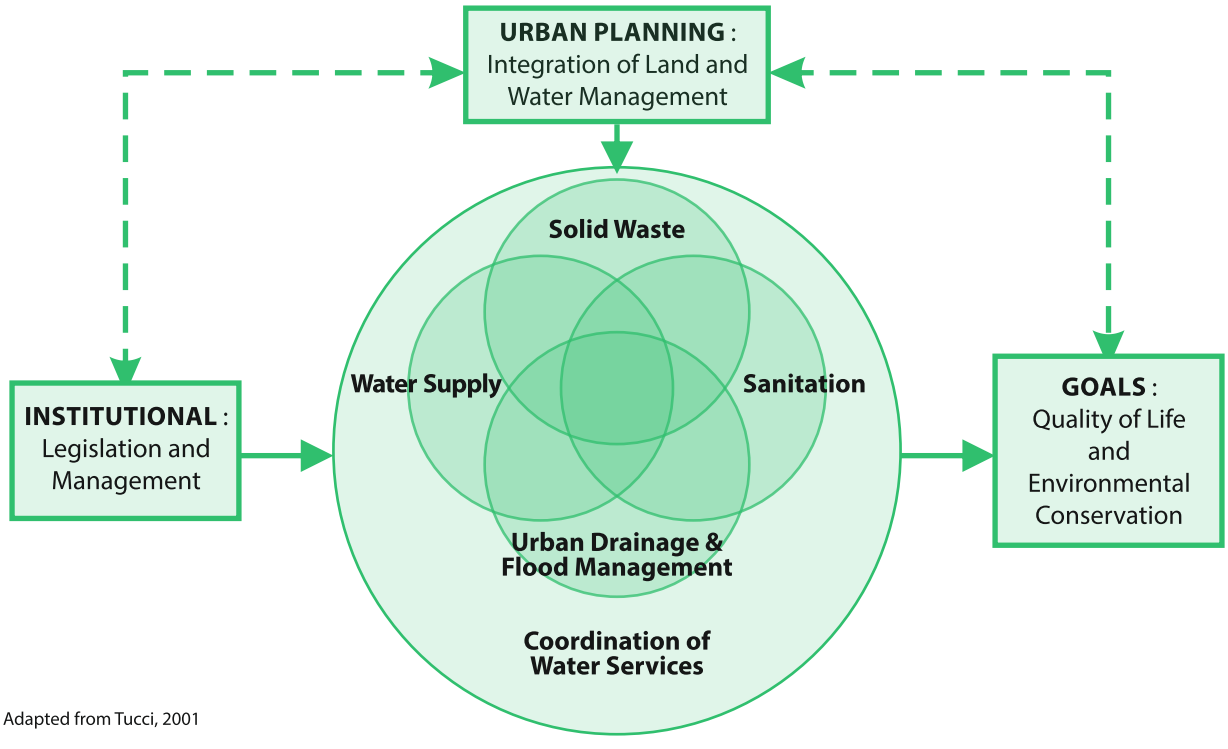
IUWM **Principles**

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**[14]	**EXPLANATION**[17]
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.

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

Example **Coordinating Structure** for IUWM

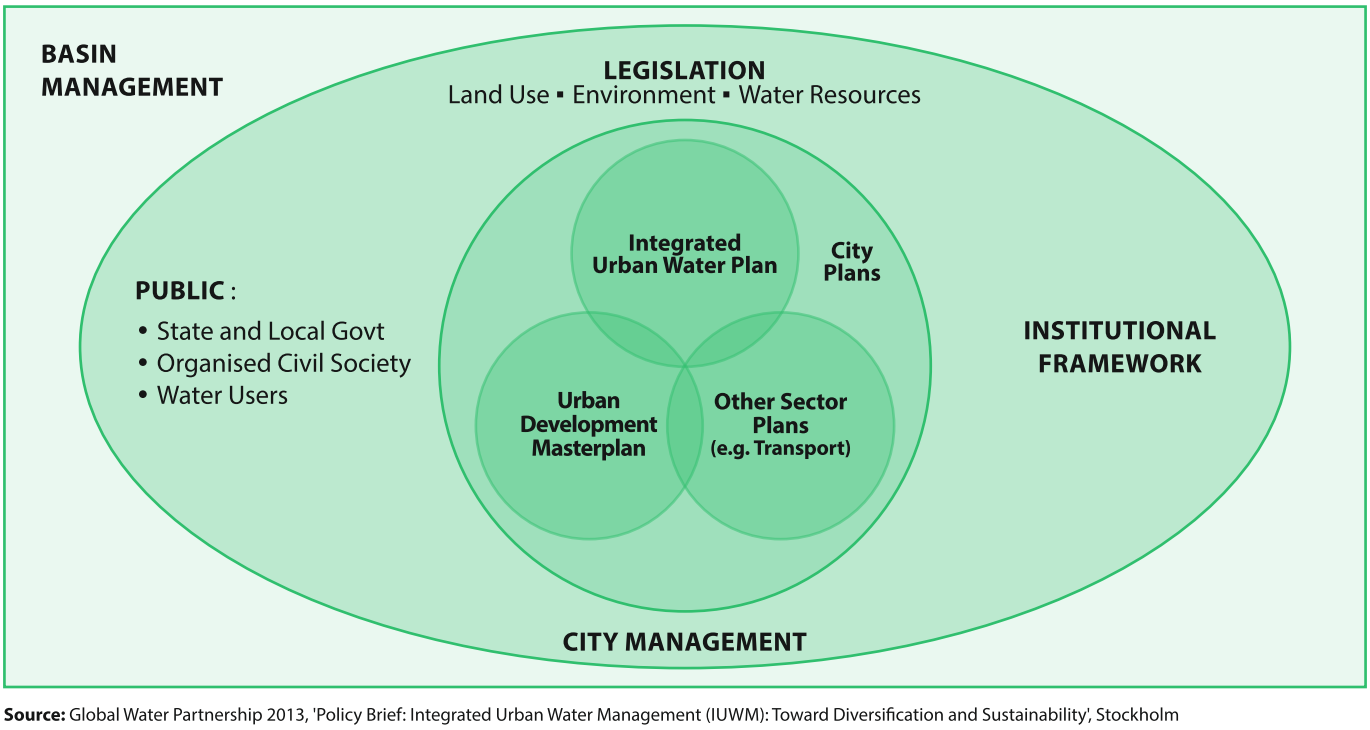


Source : Adapted from Tucci, 2001

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)**



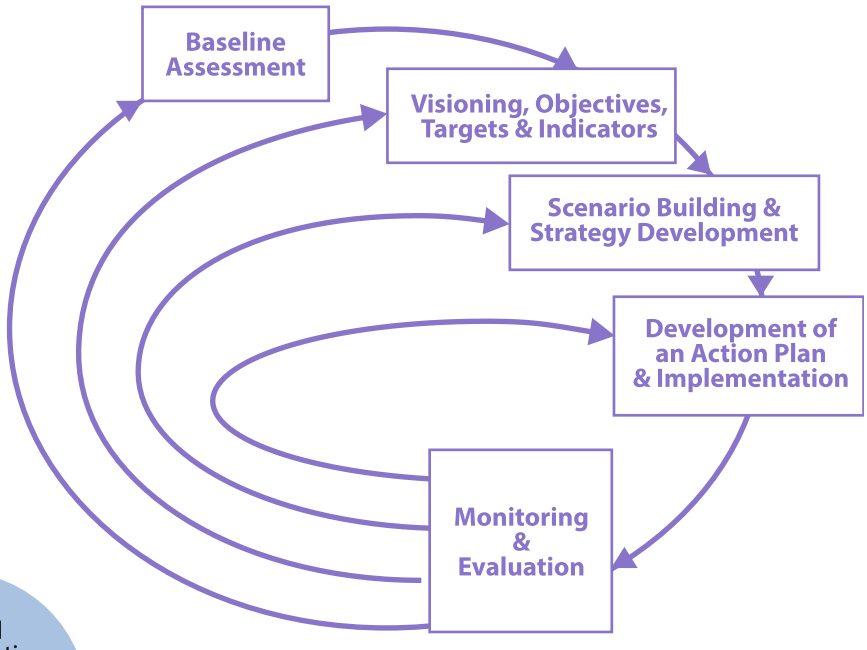
Source: Global Water Partnership 2013, 'Policy Brief: Integrated Urban Water Management (IUWM): Toward Diversification and Sustainability', Stockholm

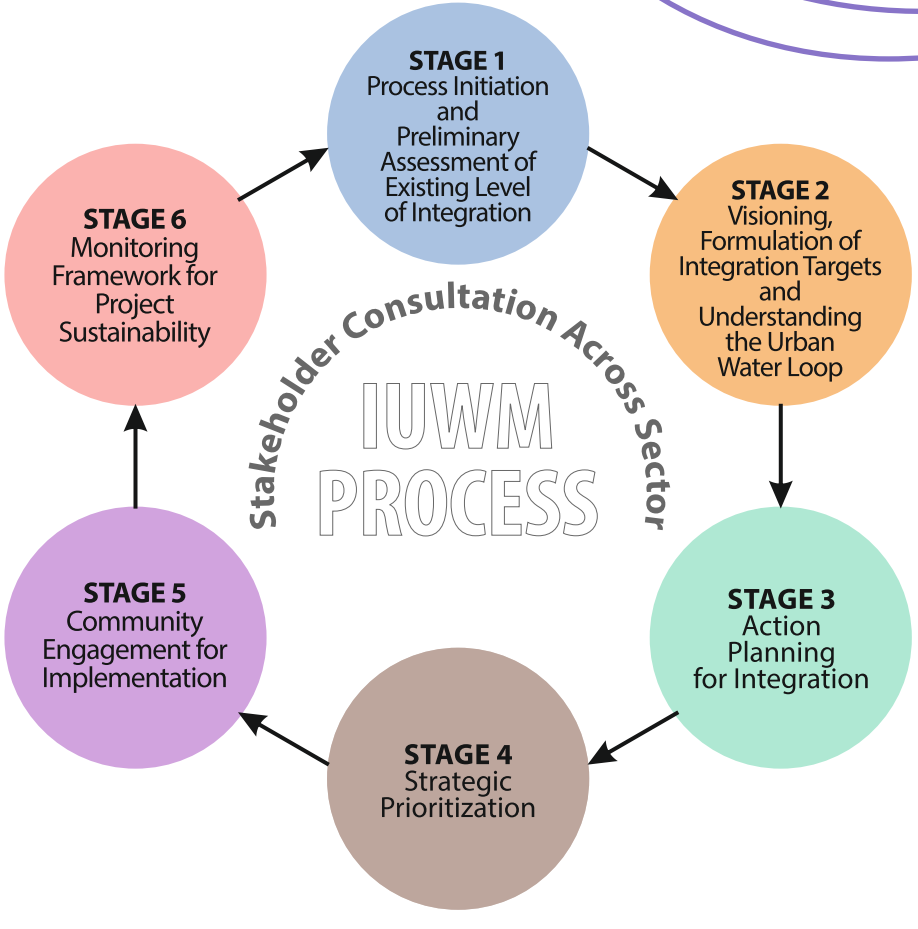
IUWM: **IMPLEMENTATION TOOLS**

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 slow 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/

Methodology: The **City Blueprint** Approach

Methodology: The **City Blueprint** Approach

Introduction

But how to get started on the IUWM journey? 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 the sustainability of IUWM in cities and towns, and it can act as the first step in a strategic planning process.

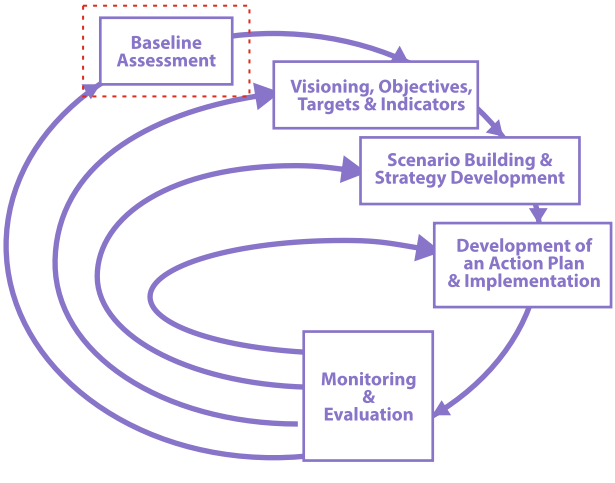
Since 2012, the CBA has been developed by Watercycle Research Institute in the Netherlands, as part of the European Innovation Partnership on Water and Watershare. The approach has been regularly reviewed and updated based on implementation experiences in 75 municipalities across 40 countries on every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

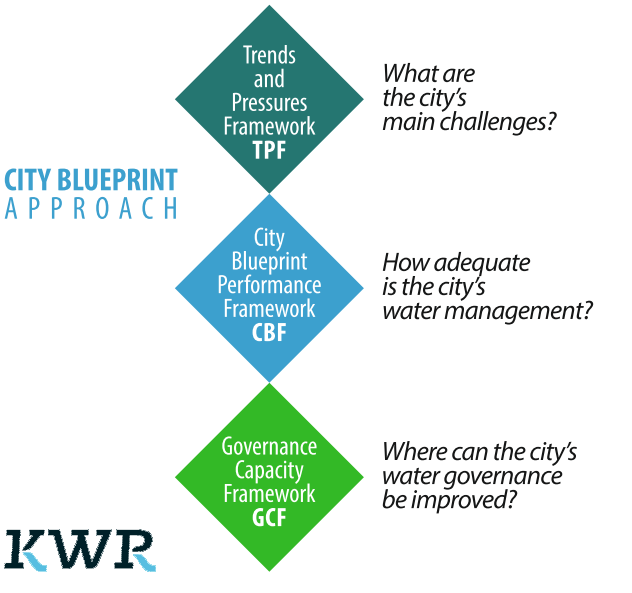
The CBA is a baseline assessment and a first step in the strategic planning process in cities, depicted in the red box below.

The CBA is a systematic and standardised assessment tool consisting 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 of the scope of the study in Kirtipur, and thus the study is limited to the TPF and CBF frameworks.

The required data 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, who provide feedback and additional inputs regarding the preliminary results.

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

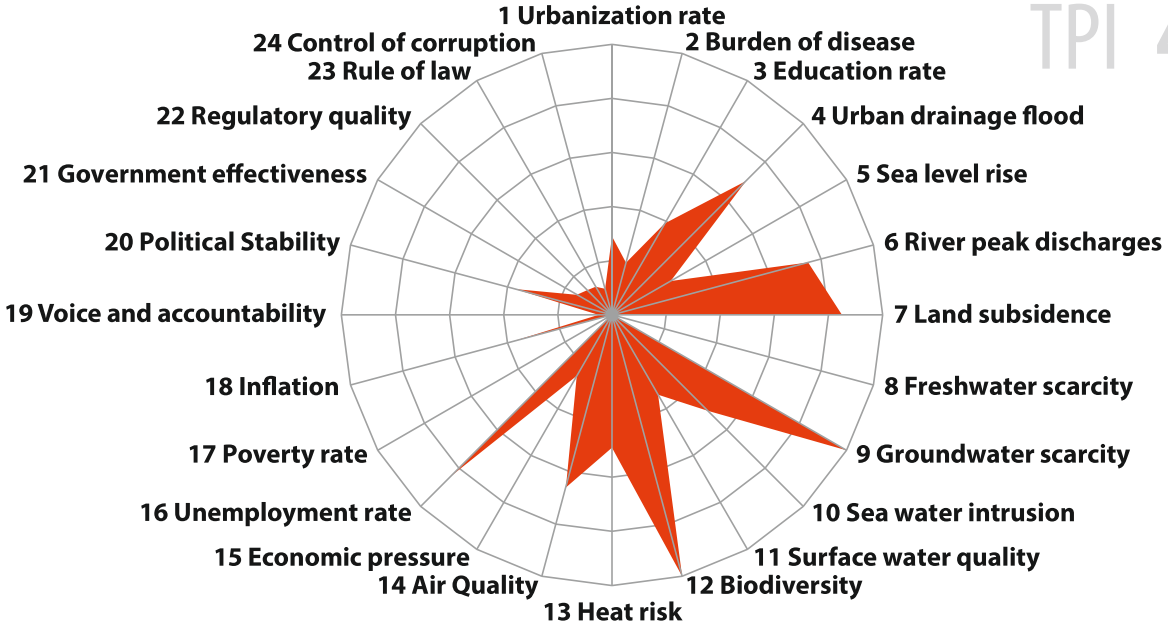
The 24 indicators are standardized to a scale of 0-10 and divided in ordinal classes expressed as a 'degree of concern' as shown below. A higher score means higher urban pressure or concern.

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**

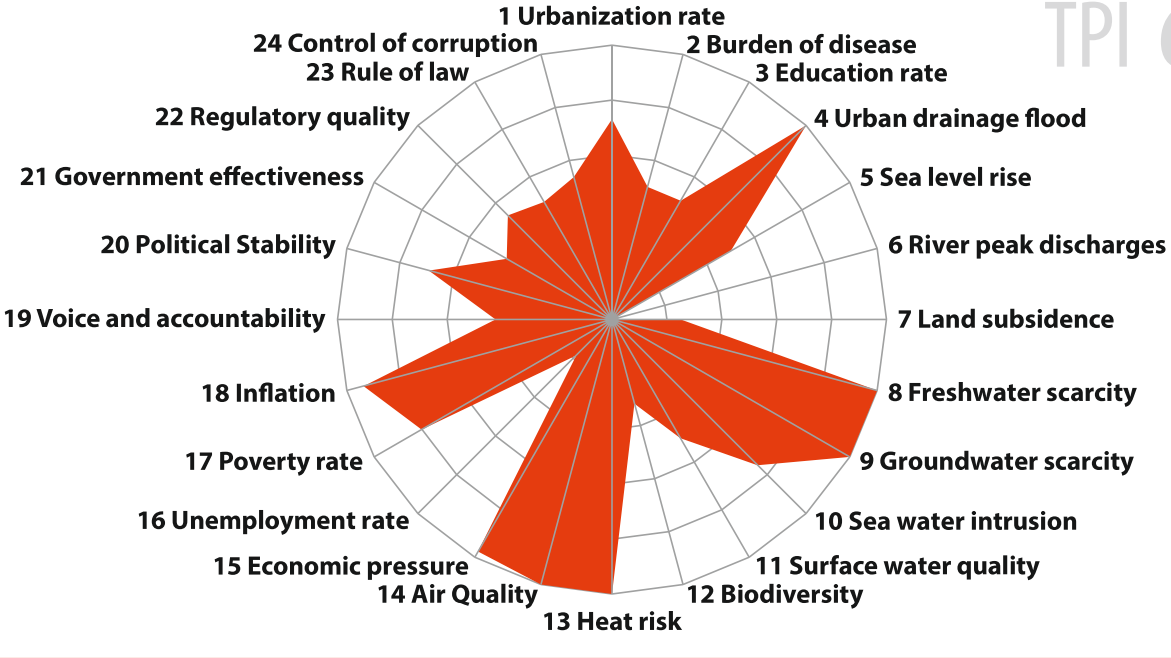
ANTWERP
TPI 4.09



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 seven broad categories that together strive to provide a comprehensive overview of a city's current state of IUWM competency.

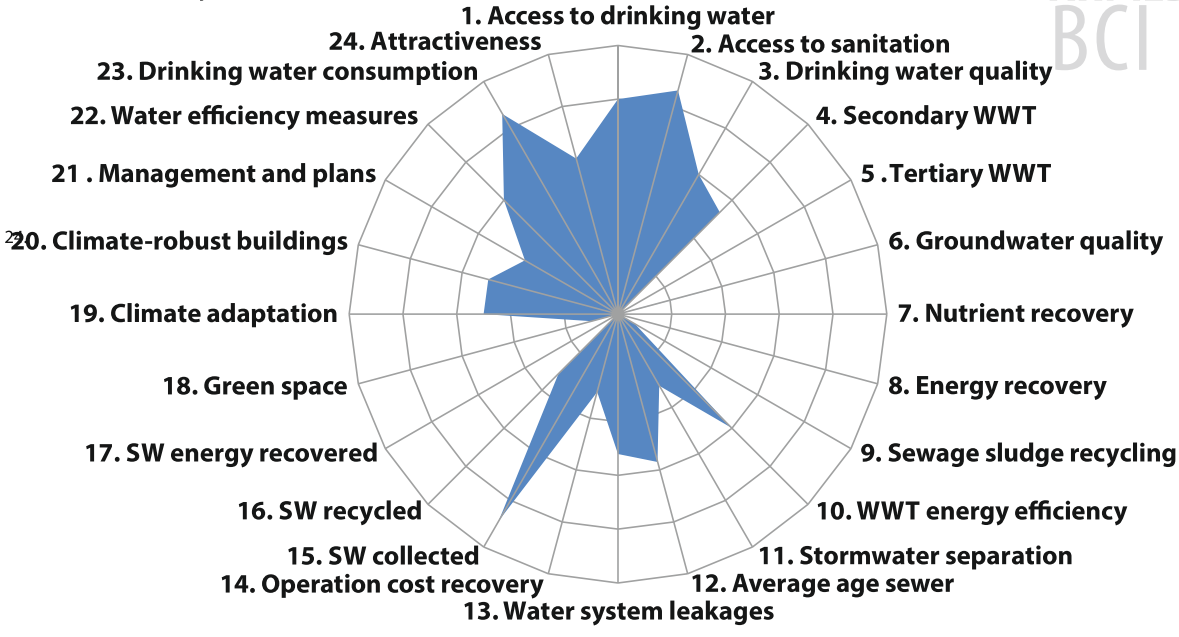
Category	Indicators
I Basic Water Services	01 Access to drinking water
	02 Access to sanitation
	03 Drinking water quality
II Water Quality	04 Secondary WWT
	05 Tertiary WWT
	06 Groundwater Quality
III Wastewater Treatment	07 Nutrient Recovery
	08 Energy Recovery
	09 Sewage Sludge Recycling
	10 WWT Energy 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.

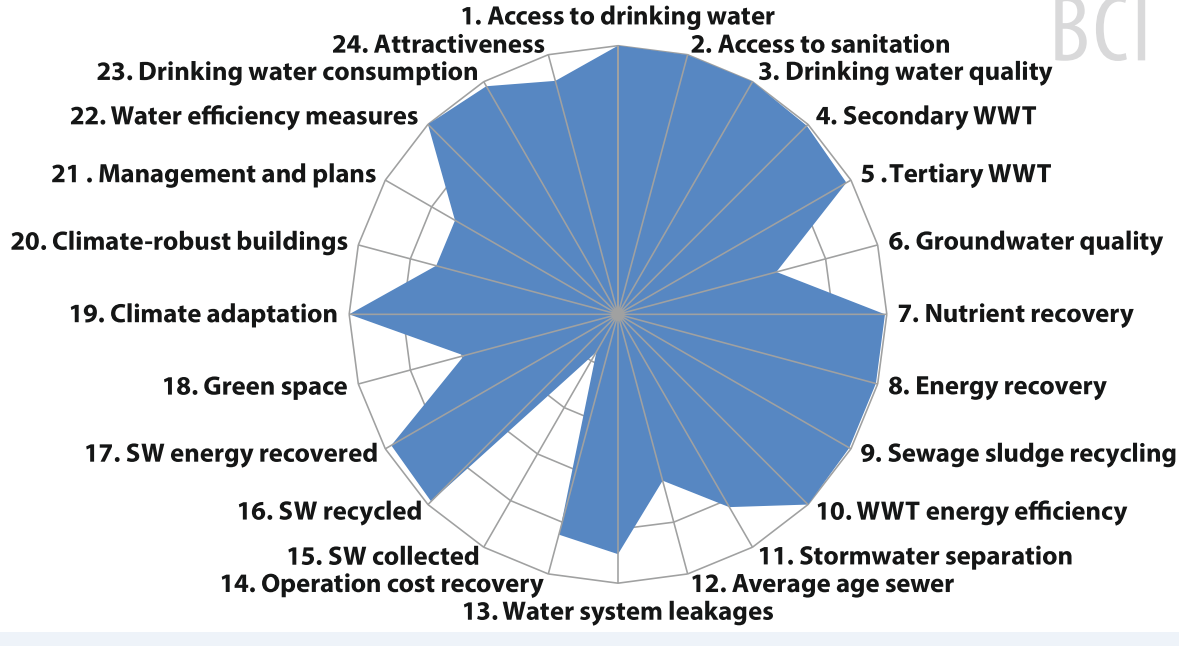
Ahmedabad, India **CBF**



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

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 Kirtipur, and does not account for improvements and plans that are under development or currently being implemented.

Thus, although Kirtipur municipality has many plans in development and projects underway to improve water and sanitation, they are not yet reflected in the results of the CBA assessment. Plans which will likely impact a CBA assessment once they're implemented, include Kathmandu Valley Wastewater Management Project where it is proposed to establish centralized wastewater treatment at Khokana, a downstream of Bagmati River. Also, a proposed Kirtipur Water Supply and Sanitation Project under co-financing water supply and sanitation project from the Department of Water Supply and Sewerage Management.

"The goal of the municipality is to establish an integrated sustainable drinking water and sanitation system by mobilizing the local people and the private sector with utilization of local resources."

Ramesh Maharjan,
Mayor,
Kirtipur Municipality

Trends and Pressures Framework (TPF)

Based on secondary data and the consultation workshop held in Kirtipur, an overall Trends and Pressures Index (TPI) score of **3.96** was calculated. On the TPI indicator scale, this score indicates that the external social, environmental and financial challenges and pressures the municipality faces should be considered a 'little concern'.

The results below describe the detailed results of the workshop; the current categories of trends and pressures Kirtipur faces, and their extent.

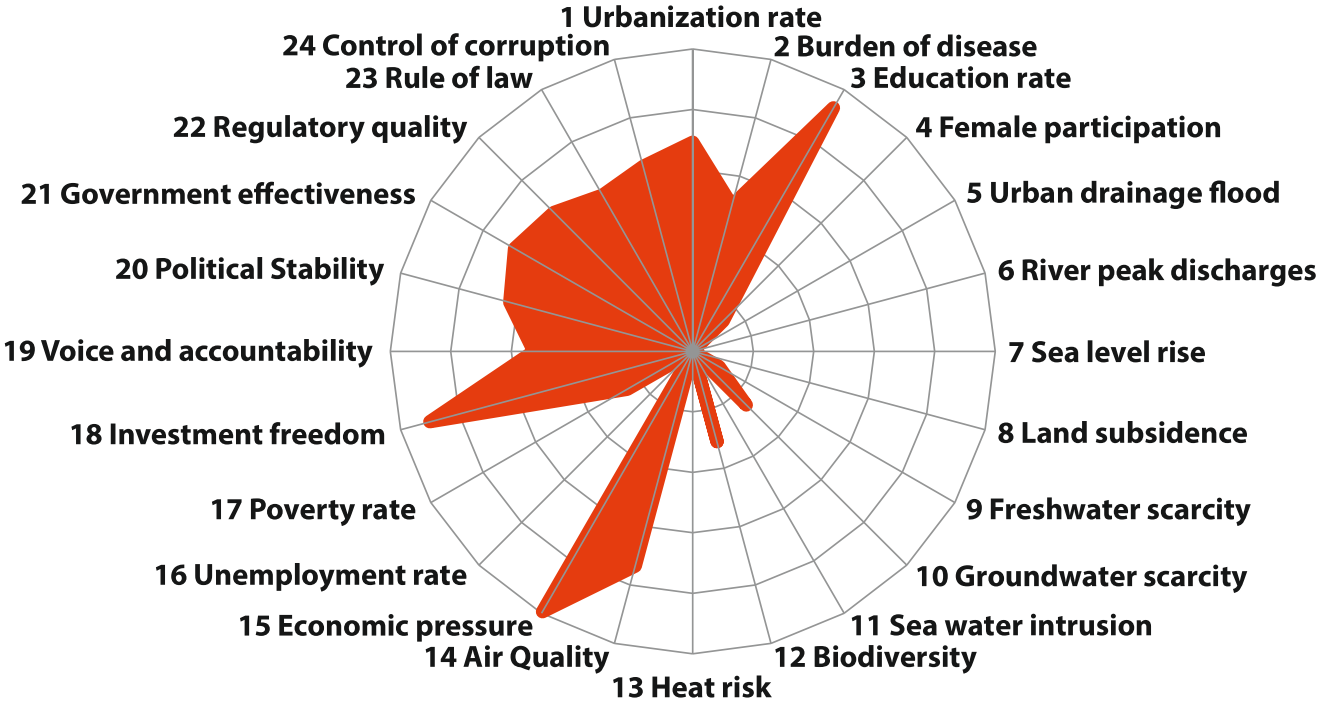
KIRTIPUR, NEPAL TPF

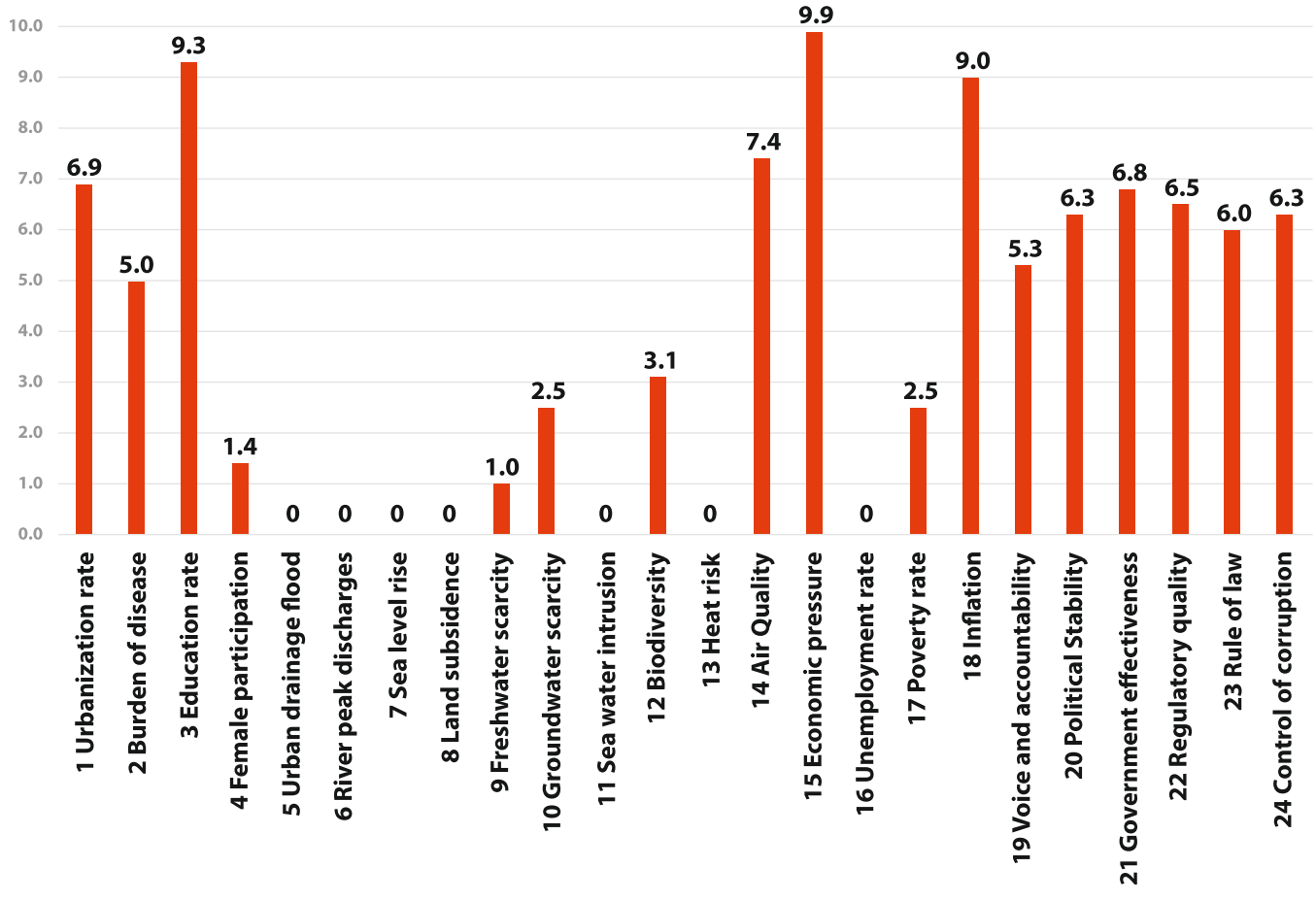
TPI: 3.96
Little Concern

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

KIRTIPUR TPF





TPF **ANALYSIS**

The specific trends and pressures which are of the **highest concern** to Kirtipur's development along an IUWM path, are related to **urbanization, economic pressure and education rate**. With a high urbanization rate of 3.15%, and its close proximity to the capital Kathmandu, **the challenges Kirtipur faces regarding its water systems and resources will likely increase over time**. Nepal's overall low GDP per capita translates into high economic pressure, which limits investments that Kirtipur can make in all sectors, including urban water and sanitation. The education rate, expressed as a percentage of primary school completions, of 77.5%, affects all sectors of society, but can have an especially strong negative impact on health and hygiene issues.

No less important, but identified as **little concerns** by the TPF, governance issues and surface water quality emerge as actionable priorities. Government effectiveness and regulatory quality are important elements of sustainable urban water systems that need to be cultivated over long time periods. Further, **rapid urbanization without effective integrated planning and lack of wastewater treatment facilities has caused the surface water mainly the rivers to be deteriorated.**

City Blueprint Framework (CBF)

Through the City Blueprint process an overall **Blue City Index (BCI) score of 2.2** was calculated for Kirtipur Municipality. This indicates that Kirtipur'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 Kirtipur, according to the CBF analysis.

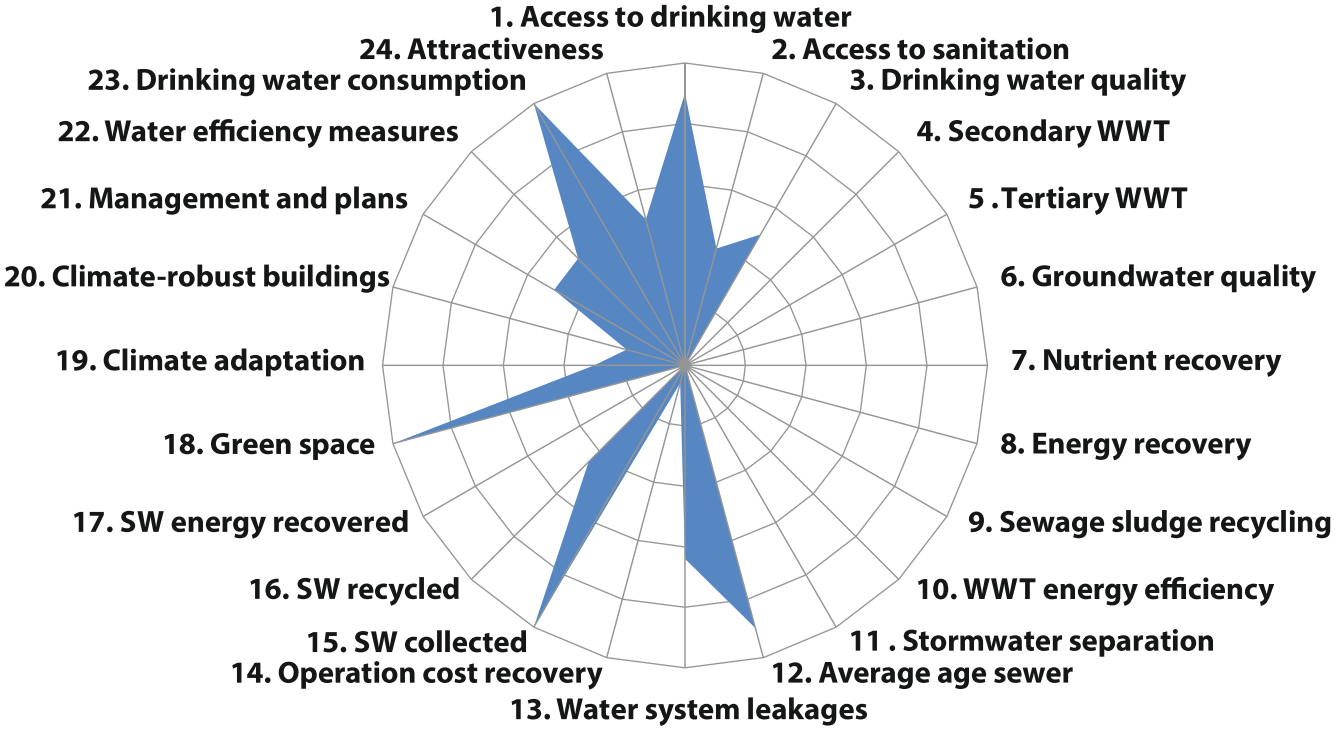
KIRTIPUR, NEPAL **CBF**

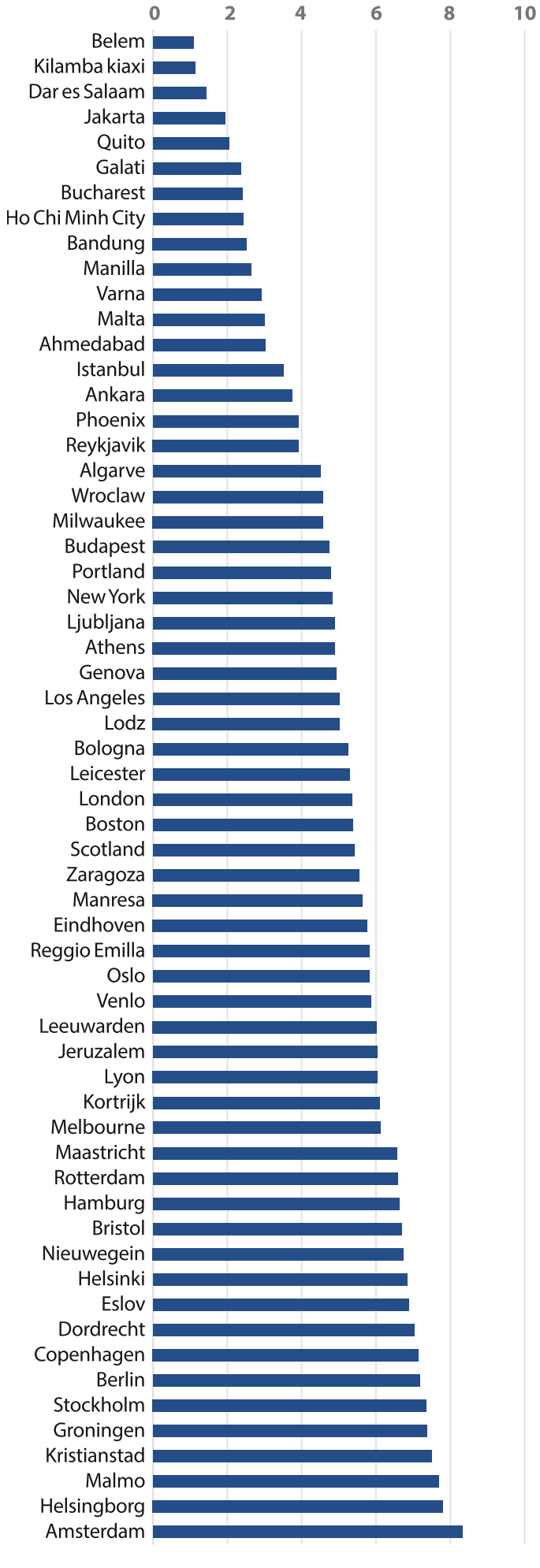
BCI: 2.2
Wasteful City

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)

KIRTIPUR CBF





BLUE CITY INDEX
BCI
60 Cities
compared

BCI scores for 60 cities and regions.

How does your city compare?

CBF **ANALYSIS**

The CBF score for **access to drinking water (9)** was based upon the situation of water supply and sanitation report published by the Department of Water Supply and Sewerage Management under Ministry of Water Supply on 2019. It has reported 89.9% of the population in Bagmati Province has access to basic water service out of which 73.93% has access to the piped water supply[18].

However, Kathmandu Upatyaka Khanepani Limited (KUKL), a licensed utility by Kathmandu Valley Water Supply Management Board, responsible for water supply service in the Valley, have connected 11,400 private metered taps and 14 unmetered public taps in Kirtipur municipality. Similarly, Naumule Water Supply User's Committee in ward number 6 has distributed 460 private taps. Thus, overall, only 62% of the population in the municipality has access to piped drinking water while remaining depends on other sources. Thus, the municipality has to focus on the extension of piped drinking water supply.

[18] MoW, 2019, Situation of Water Supply and sanitation , 2018, Department of Water Supply and Sewerage Management, Ministry of Water Supply, 2019.

Furthermore, the score for **water consumption (score 10)** reflects relatively low per capita consumption which should not be interpreted as perfect-performance. Currently, the total water demand in the municipality is 9 MLD and the average daily water production of the branch is 3.65 MLD[19]. It shows water deficit in the municipality is high and KUKL is unable to meet the demand which has reduced consumption of the water. The government of Nepal's capital investment and asset management program of 2010 has aimed to provide 135 litres per capita per day (lpcd) of the domestic water to a resident of the valley by 2025[20].

While the study by Shrestha S et al. in 2016 reported the average per capita water consumption was 121 litres per day in the valley. Also, it has pinpointed that piped water supply was extremely insufficient for meeting the demand and people has to spend a large amount of money for alternative options[21]. The issues will be piled up in near future as revealed by Udmale P and et al. in 2016, where it has estimated that demand in Kirtipur branch including all service area (Kirtipur, Dhashinkali and Chandragiri municipalities) will exceed to 19.6 MLD by 2021[22].

Some initiatives like prevention of **water system leakages (score 6.4)** through identification and repair of 611 points of leakages throughout the valley in 2019 and installation and replacement of 486 and 257 tap meters respectively has a remarkable achievement. The initiation has reduced water leakages from 24.6% to 20% from 2016 to 2019[23].

Further, improvement is essential to reduce the loss of water from the distribution network and unauthentic connection of taps. Nonetheless, the effort on improving **water quality (score 5)** is still a big challenge. It was reported 90% of samples met National Drinking Water Quality Standard for physiochemical parameters while only 65% of samples are within the standard for biological parameters in 2016[24]. Similarly, the study conducted by Koju N K, et al. in 2014, revealed bacteriological parameters are major issues with tap water in the valley.

The study showed that 80% of tap water (total sample from tap 46) and 36% of treated water (total treated sample 218) consists of total coliform[25].

In the municipality, Bagmati Province under constituency development fund has installed water treatment plant in water transmission pipe network where groundwater source is distributed. It is implemented through municipality and is suppose to operate by KUKL. However a operating mechanism is yet to be develop in the absence of effective coordinating mechanism and unclear roles and responsibility of utility, provincial government and local government.

Groundwater quality (score 1.5) from a shallow well, tube well and deep boring located at different places in the valley found vulnerable to drink due to presence of iron and coliform based upon quality analysis of 87 samples Total coliform bacteria extremely exceeded the WHO guidelines with only 8% of the total samples meeting CFU/100 mL. Maximum coliform was detected in shallow water whereas counts in tube well and deep boring was less most probably due to increased depth and properly covered top of groundwater sources[26]. Also, total coliforms (90.91 %) and E. coli (70.45 %) of samples could not meet NDWQS on the study conducted by ENPHO during 2015 in the post-earthquake scenario[27].

[19] Kathmandu Upatyaka Khanepani Limited Annual Report 2075.

[20] Parmeshwar Udmale ,et al, 2016, The Status of Domestic Water Demand : Supply Deficit in the Kathmandu Valley, Nepal

[21] M Sadhana Shrestha, Yoko Aihara, Naoki Kondo, Sudarshan Rajbhnadari, Arun P. Bhattarai, Niranjan Bista, Futaba kazama, Kei Nishida, hari P. Timilsina, Junko Shindo, 2016. Household water use in the Kathmandu Valley: A dry season survey, WASH_MIA Rapid Report, Interdisciplinary Centre for River Basin Environment (ICRE), University Yamanashi, Yamanashi, Japan

[22] Prameshwar Udmale and et al, 2016, The status of domestic water demand: supply deficit in the Kathmandu Valley, Nepal

[23] KUKL Annual Report 2076

[24] SEIU, MOWS, GON 2016, Water service providers: capacity assessment and benchmarking Data year 2014-15

[25] Koju N K, Prasai T, Shrestha S M, Raut P, 2014, Drinking Water Quality of Kathmandu Valley, Nepal Journal of Science and Technology Vol 15, No.1 (2014) 115-120

[26] Bhoj Raj Pant, Ground Water Quality

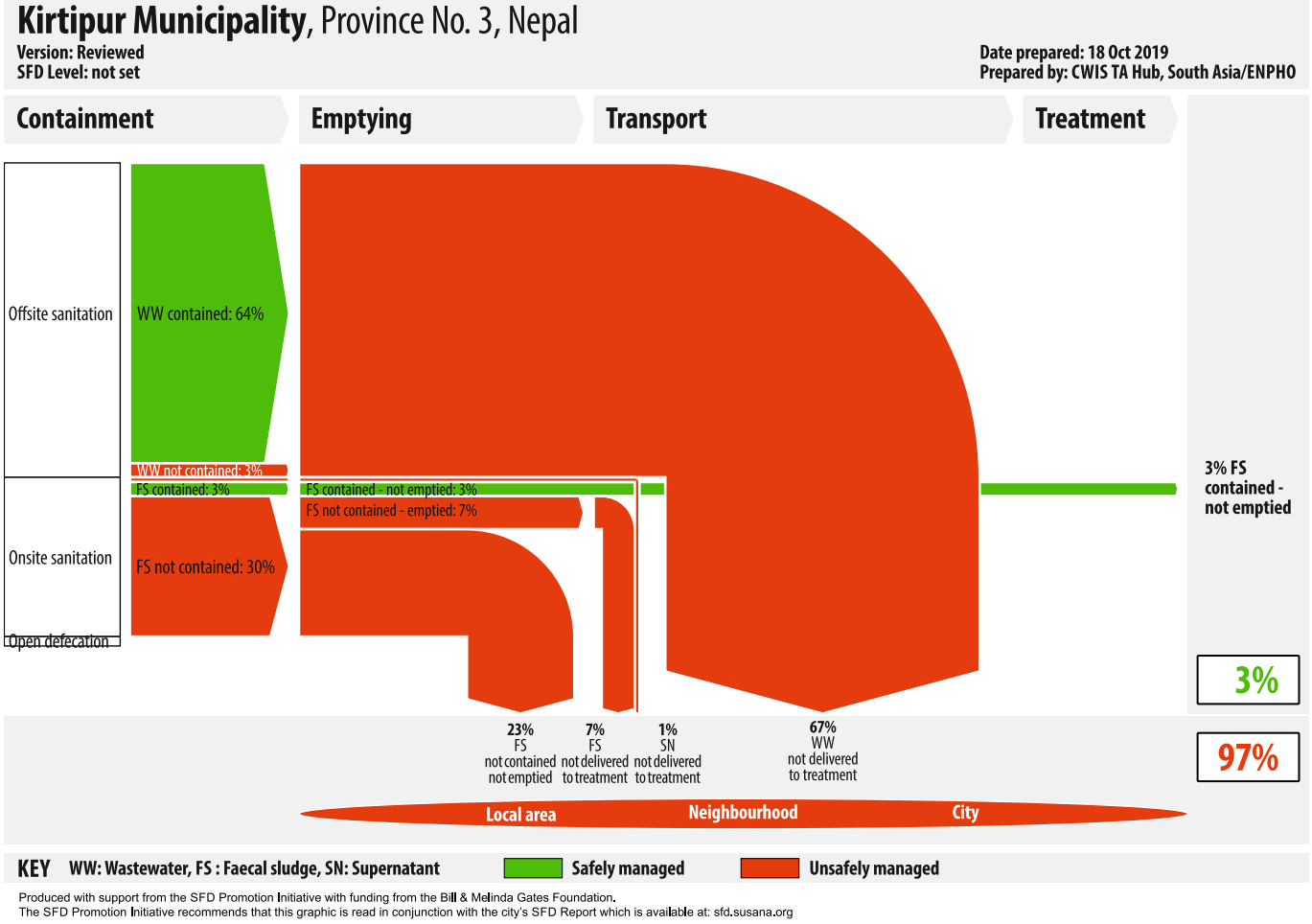
[27] ENPHO Annual Report 2016, Ground water quality of Kathmandu Valley in Post-Earthquake scenario (June 2015 to August 2015)

Similarly, Shrestha S et al. in their study of assessment of groundwater vulnerability and risk to pollution in Kathmandu valley in 2016 states that more than 50% of the groundwater basin area in the valley is susceptible to groundwater pollution and these areas are mostly in Northern groundwater district. Low and very low vulnerable areas account for only 13% and are located in Central and Southern groundwater districts. However, after taking into account the barriers to groundwater pollution and the likelihood of hazards release and detection, it was observed that most areas i.e. about 87% of the groundwater basin are at moderate residual risk to groundwater pollution[28].

Most probably, the degrading water quality can be linked with **access to sanitation (score 4)** and lack of adequate **wastewater treatment plants (score 0)**. Almost 68% of the households in the municipality are connected to sewerage networks and remaining rely on onsite sanitation technology[29].

The sewerage is directly discharged into the Bagmati River and Balkhu River without any treatment. The municipality has identified six sewerage discharge points throughout the municipality.

The overall sanitation situation of the municipality is also reflected by the shit flow diagram of the municipality, where 97% of the wastewater and faecal sludge is not managed[30].



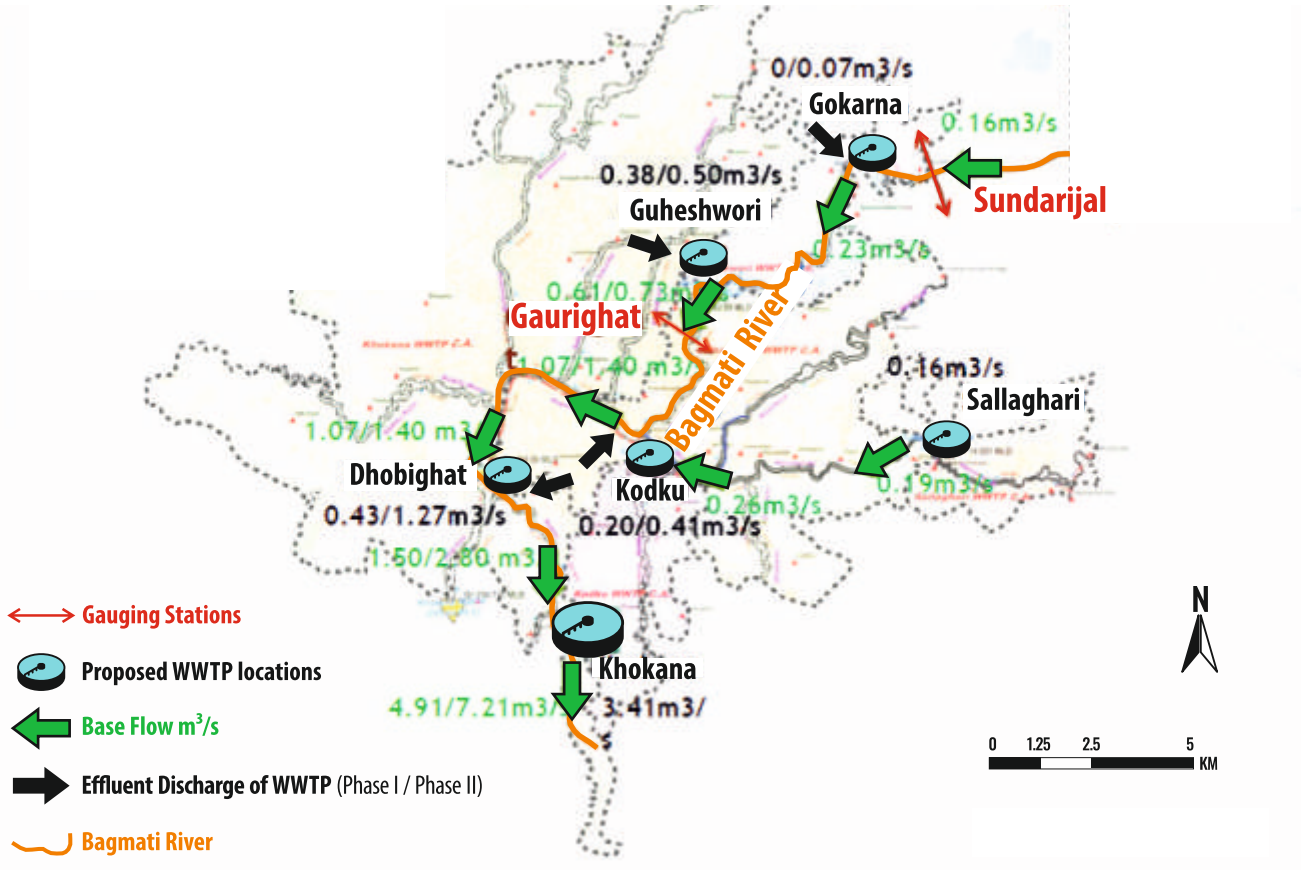
Produced with support from the SFD Promotion Initiative with funding from the Bill & Melinda Gates Foundation.
The SFD Promotion Initiative recommends that this graphic is read in conjunction with the city's SFD Report which is available at: sfd.susana.org

[28] Shrestha S, Semkuyu DJ, Pandey VP, 2016, Assessment of groundwater vulnerability and risk to pollution in Kathmandu Valley, Science of the Total Environment 556(2016) 23-25, http://dx.doi.org/10.1016/j.scitotenv.2016.03.021

[29] Municipal Profile

[30] SuSaNa 2019, Kirtipur Municipality Nepal

Flow Augmentation Scenario after **WWTP** and **Nagmati Dam**



The condition is believed to be improved when all the sewerage is conveyed and treated in the proposed construction of centralized wastewater treatment plants at Khokana, a downstream of Bagmati River[31]. There are many challenges such as land acquisition, funding sources and selection of effective technologies that has been hindering the implementation of the proposed WWT.

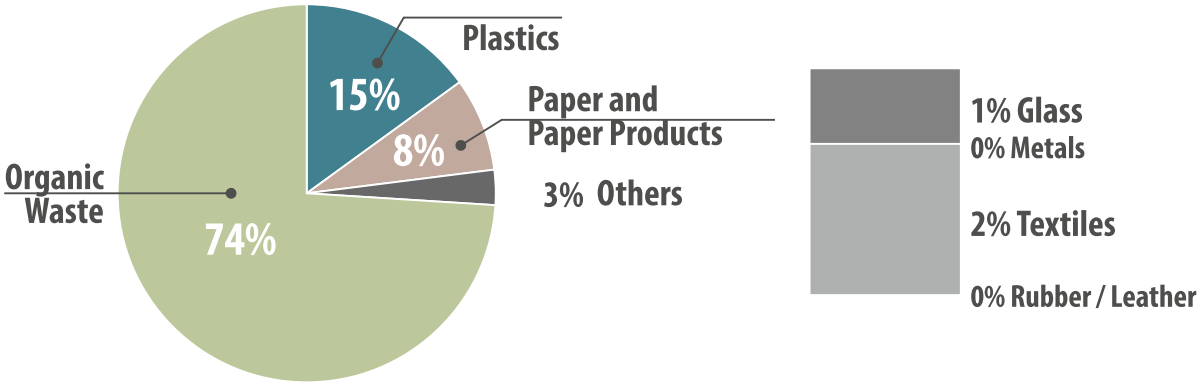
Thus, the municipality should proactively act upon itself for investing in decentralized wastewater treatment plants (DEWATS) and improving onsite sanitation system. The DEWATS is not a new approach and technology for Kirtipur Municipality, as the technology have been successfully demonstrated in community housing build for the urban slum in the municipality located at ward number 3 since 2006. Thus, the municipality should up-scale such technology with due focus on **nutrient and energy recovery (score 0)** form wastewater and sludge.

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.

[31] PID, KUKL, presentation of Water and Wastewater Management of Kathmandu Valley

Traditional stormwater drainage exists in the ancient core urban area of the municipality conveyed to a series of ponds located within the periphery of the settlement. The system ruined with the development of modern sewerage network since the 1990s.

Currently, the municipality has 39 Km of the sewer network. The population growth, open drain in some places and disposing of solid waste in sewers are some reasons, which cause sewerage problem in Kirtipur. The frequent overflow of sewage during the rainy season is a common phenomenon. The sanitary sewer has been converted into a combined sewer, which obviously cannot withstand stormwater.



Solid waste collection (score 10) is not necessarily be explained as perfect performance in the municipality, rather it is relatively low production of solid waste primarily due to low coverage of door to door collection.

At present, four private solid waste management entrepreneurs have a door to door collection services from approximately 8100 households and in an average of 7416 tons of solid waste is collected per year. Based on this information, 183 kg of solid waste is generated per capita per day. While the study conducted by Japan International Corporation Agency (JICA) in coordination with the Government of Nepal in 2005 has reported 300 g/capita/day waste is generated in Kirtipur Municipality[32].

Similarly, Asian Development Bank in 2013 has disintegrated the sources of waste as household (151.75 g/capita/day), commercial (5.93 tons per day) and institutional (0.86 tons/day) in Kirtipur Municipality. Thus in an average municipal waste per capita generation of the municipality was 253 g per day[33].

The composition of solid waste shows, 74% organic waste and 15% of plastic waste is generated in the municipality. Similarly, significant waste is contributed to paper and paper products that can be reused.

Solid waste recovered (score 4.5) must be prioritized for improvement in the municipality to reduce resources on transferring into landfill site located outside Kathmandu Valley. Currently, only Kirtipur Waste Management Service Pvt Ltd segregate organic waste.

Approximately, 15% and 30% of organic and recyclable waste are segregated for composting and recycling. The remaining waste is transferred into a landfill site. The compost is supplied in the local market however the demand is very low. Annual transaction from compost was only NPR 10,000 at the rate of NPR 45 per kg.

[32] JICA, Action Plan on Solid Waste Management Kritipur Municipality, 2005
[33] ADB, 2013, Solid Waste Management in Nepal: Current Status and Policy Recommendations

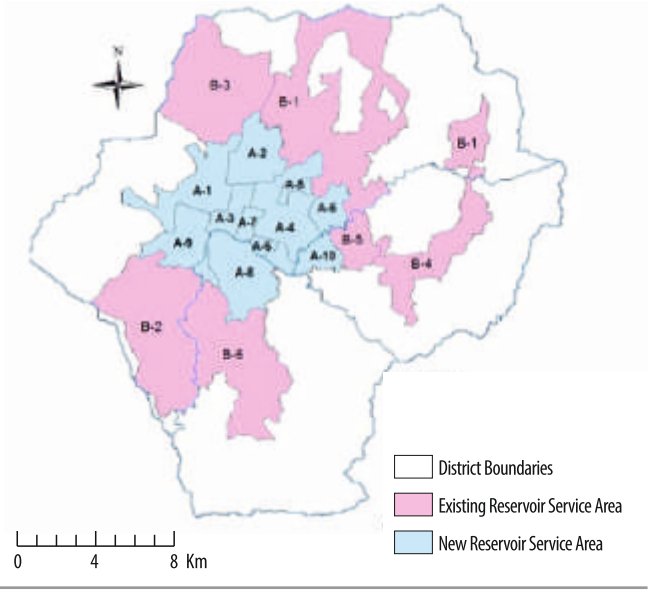
Availability of adequate green space is one of the major indicators for the liveable city.

The total area of the municipality is 14.67 sq km The municipality covers 2.406 sq km, 1.098 sq km and 0.462 sq km of residential, institutional and industrial areas respectively. While it has 3.262 sq km, 0.113 sq km and 6.657 sq km of forest, rivers and agricultural area[34]. While the study conducted by The International Centre for Integrated Mountain Development (ICIMOD) in 2003 on GIS for municipal planning based upon aerial maps from 1998 shows 21% of urban built-up area and 3.2% institutional area. Considering agricultural land, forest, horticulture research centre, water bodies and plantation area as green space, the total green space is 73.7%. While, Asif I. and et al. in 2018 has reported that from 1989 to 2016, the urban area has expanded with the conversion of 31% of agricultural land in the Kathmandu Valley[35]. The change is quite applicable to the municipality, thus the percentage of agricultural land is reduced to 30.4%. Hence, the current **green space** can be estimated to be 59.4% and score 10 but there should be land-use planning in place to sustain the urbanization in the municipality.

Climate adaptation (score 3) is a measure of the level of action taken to adapt to climate change threats. Ministry of Environment (MoE) in 2010 has formulated the National Adaptation Programme of Action (NAPA) to Climate Change. NAPA has been looked as instrumental in mainstreaming climate change into Nepal's development planning on implementation of adaptation actions to address the needs of the climate-vulnerable communities[36]. In 2017, Ministry of Population and Environment (MoPE) has initiated the formulation of National Adaptation Plan (NAP) to build on experiences in addressing adaptation through NAPA and it aims at reducing vulnerability to the impacts of climate change by building adaptive capacity and resilience, and by facilitating the integrationof climate change adaptation into development planning[37]. However, the municipality has not prepared a climate adaptation plan and is not reflected in its annual plan and programme.

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. Under the Kathmandu Valley Wastewater Management Project, it has planned to improve the bulk distribution system and service reservoir in the municipality.

The plan consists of upgrading storage tank into 55 MLD capacity with the potentially available head of 10.65m[38]. The planned service area is shown in the figure and the block A-9 represents the service area of Kirtipur municipality with the plan of installing a new reservoir in the municipality[39].



[34] Municipal profile

[35] Asif I et al. 2018, Rapid Urban Growth in the Kathmandu Valley, Nepal: Monitoring Land Use Land Cover Dynamics of a Himalayan City with Landsat Imageries

[36] GoN, MoE 2010, national Adaptation Programme of Action to Climate Change, Kathmandu Nepal

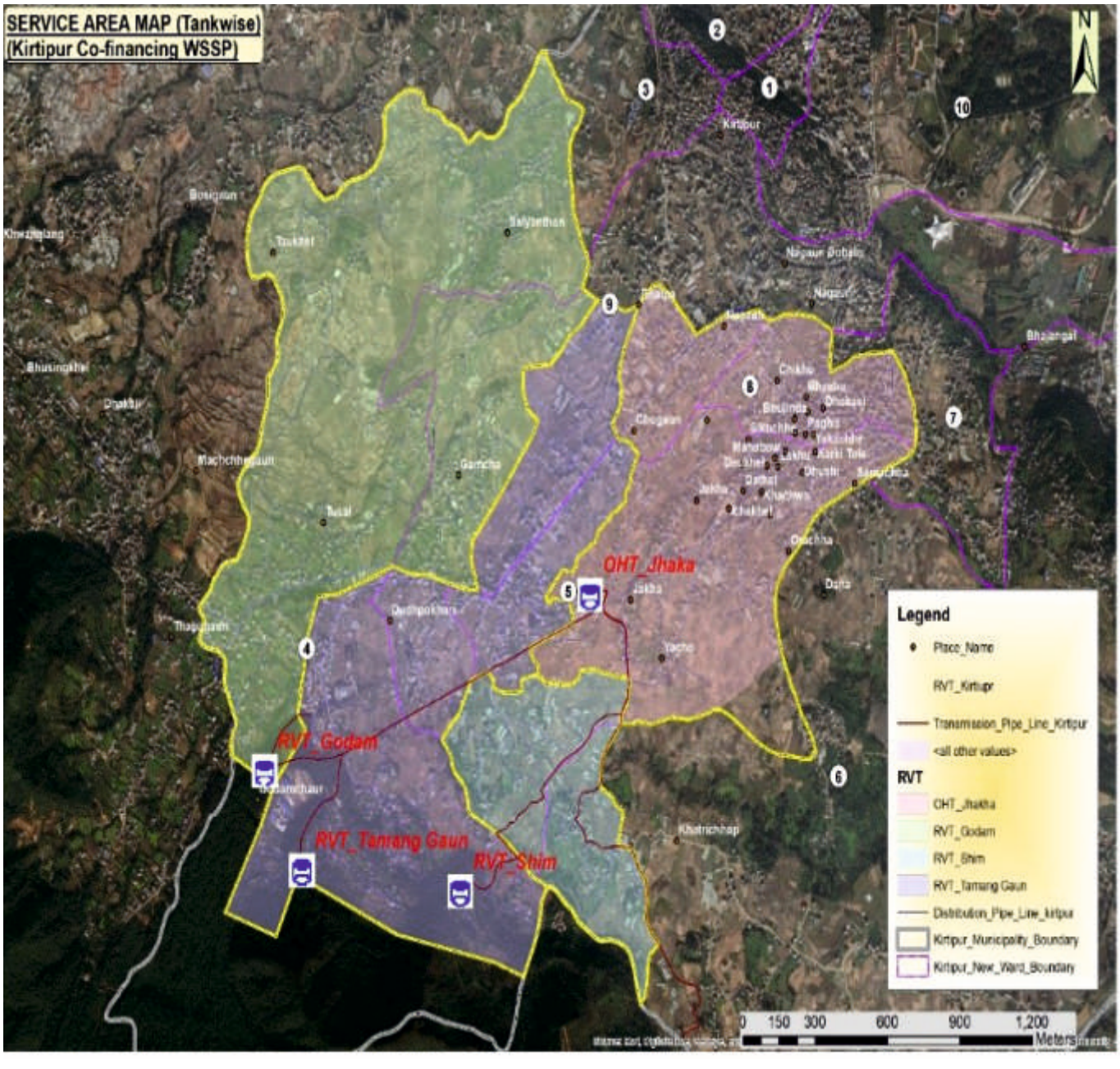
[37] MoPE. 2017, Synthesis of stocking Report for National Adaptation Plan (NAP) formulation Process in Nepal

[38] Kathmandu Upatyaka Khanepani Limited Annual Report 2075

[39] Ojha R et al. Water Price Optimization after the Melamchi Water Supply Project: Ensuring Affordability and Equitability for Consumer's Water Use and Sustainability for Utilities

Similarly, the Department of Water Supply and Sewerage Management (DWSSM) under Co-financing Water Supply and Sanitation Project has conducted a feasibility study on Kritipur Water Supply and Sanitation Project. The study has proposed improvement of water supply service in ward number 4, 5, 6, 8 and 9 through the installation of deep borings, construction of reservoirs and overhead tanks[40].

The plan has proposed transmission and distribution of water through the existing pipe network operated by the KUKL. However, the municipality, KUKL and DWSSM are unclear on how the partnership could be established and develop effective management models under the existing roles and responsibility. The proposed map of the service area is shown in the figure.



[40] DWSSM, Kirtipur Water Supply and Sanitation Project, Co-financing Water Supply and Sanitation Project: Salient Features PPT, 2019

The Way Forward: Recommendations & Targets

Kirtipur Municipality

The City Blueprint process has highlighted high-performance areas and low-performance areas, identified gaps and started conversations between key stakeholders on urban water and sanitation issues and climate change in Kirtipur municipality.

The recommendations below provide practical actionable ideas and guidance for the municipality over the short to medium term.

It is highly recommended that a formal IUWM process be initiated to provide structure, and city-wide integration of efforts should be linked to climate change and SDG actions. Through the process of building an IUWM framework for Kirtipur, and establishing key partnerships, the capacity of the municipality and its staff will increase. The process is, by nature, slow and takes many small steps to achieve the ultimate goal of conserving the environment and improving liveability for all citizens in the municipality.

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

Recommendations	Rationale / Explanation	Key Targets
Policy, Management & Leadership		
Increase political leadership from the municipality level to prioritize city-wide integration of urban water and sanitation services and linkages to climate change actions.	Political will and commitment are required to establish effective partnership and coordination between multiple funding and implementing bodies. Also, it guides to develop an investment plan in municipal prioritized program.	Kirtipur Municipality is a leader in demonstrating integrated urban water and sanitation services through effective partnership and coordination between multiple agencies.
Step 2 Select an IUWM approach and start a formal IUWM process in partnership with multiple stakeholders from central and provincial governments, water utilities and 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 all concern stakeholders early in the process is essential for sustainable outcomes. Select from existing approaches or toolkits. Do not try to develop a new framework, build on what is already available, this will save time and resources.	• Institutional set-up related to IUWM reviewed under either planning & development section or Sanitation & Water Services Section • IUWM approach/toolkit is selected • Key staff and stakeholders build IUWM knowledge and experience • Initiate IUWM policy development for the municipality
Step 3 Actively seek out technical partners to assist in the integration and development of urban water and sanitation services	No municipality can do it all alone. Partnering with other municipalities, government agencies, IO/NGO/INGOs, private companies and/or universities can bring in technical, financial and capacity-building support.	• MoUs and cooperation agreements • Increased municipal technical capacity • Increased technical implementations
Step 4 Prioritize allocation of the municipal budget for IUWM related project implementations	Create specific municipal budget lines for IUWM studies or assessments, and water and sanitation-related infrastructure projects. Where a possible link to climate change-related budget lines. If full funding for assessments or infrastructure is not possible, allocate what is available, and use it as leverage with other funding agencies to secure sufficient funding.	• Annual budgets include budget lines for IUWM activities
Step 5 Develop IUWM related policy and proposals to attract more funding sources	Local government have the power to issue their policies and by-laws. Even a very basic policy on IUWM can open up more partnership options and funding sources. Clear policy direction gives funding agencies more confidence. 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. 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. For example, DWSSM, and Water Supply and Sanitation Division are major supporting agencies from the central and provincial government. KVWSMB is the main utility responsible for water and sanitation programs in Kathmandu Valley. Ref: KVWSMB - Kathmandu Valley Water Supply Management Board.	• Basic IUWM policy issued • One proposal for DWSSM or KVWSMB or Water Supply and Sanitation Division • Proposals for other potential donors

Recommendations	Rationale / Explanation	Key Targets
Technical Aspects: Sanitation		
Study feasibility for decentralised wastewater management solutions in different locations	Given the topography, high cost of more conventional centralized sanitation infrastructure and uncertainty of proposed implementation of centralized wastewater treatment in Khokana, non-sewered decentralized sanitation solutions (e.g. DEWATS, FSM & septic tanks) should be prioritized	• Feasibility reports for a single location or multiple location cluster on ward level • Proposal decentralized sanitation solution(s) • **Implementation**: Pilot decentralized sanitation solution implementation or decentralized sanitation solutions cluster
Review and study the current status of solid waste management	Fully understanding the current status of solid waste generation, collection and recycling are essential to be able to plan, upgrade and expand services. New management models and innovative technologies (e.g waste to energy) should be considered	• Status report on SWM including recommendations on management and technology options • **Implementation**: Innovative technologies for efficient solid waste management
Implement the FSM project	Approximately 30% of households depend upon onsite sanitation system. Considering the high cost and topographic constraints for the development of conventional sewer network. Innovative technologies for the management of onsite sanitation should be prioritized.	• Status of onsite sanitation system and recommendation on management and technology options.

"In order to achieve sustainable development goals on water and sanitation, it is very important to plan and work in an integrated manner."

Gyanbazara Maharjan,
Chief,
Environment, Solid Waste & Sanitation Subsection,
Kirtipur Municipality

Recommendations	Rationale / Explanation	Key Targets
Technical Aspects: Water		
Water supply services technical and performance assessment	A ward by ward review of water service efficiency. Key focus points: service coverage, water quality (WQ test for all main sources, surface and groundwater), service performance (e.g. wastage & cost recovery). Use WQ data to identify appropriate water supply treatment approaches	• Technical and performance assessment report • **Implementation**: Pilot water supply treatment project
Conduct Water Quality (WQ) testing on household water storage systems	Promote household-level water treatment approaches. Use WQ data to identify appropriate household water treatment approaches	• Household WQ report • **Implementation:** Pilot household water treatment approaches
Conduct an assessment of the current status of traditional water systems, ponds and spouts	Link to stormwater management planning. Can traditional systems be revived? Can traditional ponds be rejuvenated? Can the traditional and modern systems be merged? Are traditional management systems still viable?	• Current status of traditional water systems report

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 WQ studies and awareness raising on integrated water management and WASH issues, including women, youth, end users & the disabled	Ward level participation in WQ studies (household, surface and groundwater) and WASH awareness raising (e.g. septic tank promotion, household water storage) sensitisation activities helps build knowledge and support in the community. Education on wastewater management solutions should be prioritized in line with National Standards for Domestic Wastewater Effluent (2019). Women, youth and water and sanitation users' groups should be targeted.	• Active community engagement leads to increased awareness, action on WASH issues and behaviour change • **Implementation:** Water quality studies and awareness raising

Key Actions **Summary**

Kirtipur Municipality

Start

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

Seek Out

2 Actively seek out new technical and financial partners

Assess

3 Assess and pilot alternative decentralized sanitation solutions

Assess & Understand

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

Engage

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

Photo credit : **Sudin Bajracharya**

BORDA

Kirtipur Municipality

with support from

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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