BENCHMARKING BOGOR'S WATER SENSITIVE PERFORMANCE

The Australia-Indonesia Centre
URBAN WATER RESEARCH CLUSTER
MONASH University
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Cluster Leaders

Institut Pertanian Bogor	**Universitas Indonesia**	**Monash University**
Prof Hadi Susilo Arifin	Dr Dwinanti Rika Marthanty	Prof Diego Ramirez-Lovering
	Prof Dr Ing. Ir. Dwita Sutjiningsih	Dr Briony Rogers

Research team

Institut Pertanian Bogor	**Universitas Indonesia**	**Monash University**
Dr Nana Mulyana Arifjaya	Dr Reni Suwarso	Dr Christoph Brodnik
Dr Regan Leonardus Kaswanto	Ms Louise Maryonoputri Mrs	Ass/Prof Megan Farrelly
Dr Nurmala Pandjaitan	Irene Sondang Fitrinitia	Dr Harsha Fowdar
Prof Dr Hidayat Pawitan	Dr Hendricus Andy Simarmata	Mr Alex Gunn
Dr Yanuar Purwanto	Dr Yoni Agus Setyono	Dr Jane Holden
Dr Suria Darma Tarigan	Mrs Rouli Anita Velentina	Mr Raul Marino
Dr Yuli Suharnoto	Mrs Wahyuni Pudjiastuti	Ass/Prof David McCarthy
Prof Dr Yusman Syaukat	Dr Ir. R Jachrizal Sumabrata	Dr Emily Payne
Dr Dwi Yuliantoro	Dr Komara Djaja	Dr Christian Urich
		Dr Ashley Wright

Coordinating/Administrative Team

Institut Pertanian Bogor	**Universitas Indonesia**	**Monash University**
Mr Martua Yan Steward Nababan	Ms Anisa Wulandari	Mrs Celine Goh

HDR & GRIP Students

Institut Pertanian Bogor (HDR)	**Universitas Indonesia (HDR)**	**Monash University (GRIP)**
Aqlima B. Shahra	Anisa Wulandari	Wikke Novalia
Astrini Widiyanti	Faris Zulkarnain	Vanessa Copa-Torez
Claudia Tyas	Rian Mantasa	Martijn Kuller
Muhammad Ramdhan	Rizki Putro Kurniawan	Erika Duncan Horner
Fittria Ulfah	Dimas Ario Nugroho	Joshua Nielsen
Edward Alfin	Daniel Mambo Tampi	Adam Charette-Castonguay
Atep Hermawan	Erikson Roy DS	Behzad Jamali

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URBAN WATER CLUSTER PUBLICATIONS:

“Leapfrogging Pathways for a Water Sensitive Bogor”

B Rogers, D Ramirez-Lovering, DR Marthanty, HS Arifin, A Gunn, W Novalia, M Farrelly, H Fowdar, J Holden, R L Kaswanto, D McCarthy, R Marino, E Payne, R Suwarso, Y Syaukat, C Urich, A Wright, D Yuliantoro.

“Benchmarking Bogor's Water Sensitive Performance”

B Rogers, C Brodnik, A Gunn, DR Marthanty, HS Arifin, D Ramirez-Lovering, M Farrelly, R L Kaswanto, N Pandjaitan, Y Suharnoto, R Suwarso, Y Syaukat.

“Governance for a Water Sensitive Transition in Greater Bogor”

M Farrelly, A Gunn, R Suwarso, Y Syaukat, C Brodnik, YA Setyono, B Rogers, RA Velentina.

“Review of the application of green infrastructure for water management in Bogor”

E Payne, H Fowdar, DR Marthanty, H Pawitan, D Marsudiantoro D McCarthy.

“Guidance on developing infrastructure adaptation scenarios for Bogor’s water sensitive transition”

A Wright, C Urich, DR Dwinanti, F Zulkarnain, Y Purwanto, N Mulyana Arifjaya,

“Pulo Geulis Revitalisation 2045: Urban Design and Implementation Roadmap”

D Ramirez-Lovering, R Marino Zamudio, HS Arifin, RL Kaswanto, HA Simarmata, D R Marthanty, M Farrelly, H Fowler, A Gunn, J Holden, N Panjaitan, E Payne, B Rogers, Y Syaukat, Y Suharnoto, R Suwarso, I Sondang, C Urich, A Wright, L Desrainy, C Brodnik, D Yuliantoro

“Griya Katulampa: Lessons Learned Case Study Report”

D Ramirez-Lovering, R Marino Zamudio, HS Arifin, RL Kaswanto, HA Simarmata, DR Marthanty, , M Farrelly, H Fowler, A Gunn, J Holden, N Panjaitan, E Payne, B Rogers, Y Syaukat, Y Suharnoto, R Suwarso, I Sondang, C Urich, A Wright, C Brodnik, L Desrainy, D Yuliantoro,

“Situ Front City: Transition Strategy to WSC”

D Ramirez-Lovering, R Marino Zamudio, HS Arifin, RL Kaswanto, HA Simarmata, D R Marthanty, M Farrelly, H Fowler, A Gunn, J Holden, N Panjaitan, E Payne, B Rogers, Y Syaukat, Y Suharnoto, R Suwarso, I Sondang, C Urich, A Wright, L Desrainy, C Brodnik, D Yuliantoro

“Sentul City: Lessons Learned Case Study Report”

D Ramirez-Lovering, R Marino Zamudio, HS Arifin, RL Kaswanto, HA Simarmata, D R Marthanty, M Farrelly, H Fowler, A Gunn, J Holden, N Panjaitan, E Payne, B Rogers, Y Syaukat, Y Suharnoto, R Suwarso, I Sondang, C Urich, A Wright, L Desrainy, C Brodnik, D Yuliantoro

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Glossary and abbreviations

APBD	*Anggaran Pendapatan Belanja Daerah*, Local government budget
Bappeda	*Badan Perencanaan Pembangunan Daerah*, Regional Development Planning Board
Bappenas	*Badan Perencanaan Pembangunan Nasional*, National Development Planning Agency
BPDAS	*Balai Pengelolaan Daerah Aliran Sungai*, Watershed Management Center
DAS	*Daerah Aliran Sungai*, watershed
DLH	*Dinas Lingkungan Hidup*, Environmental Office
ESDM	*Energi & Sumber Daya Mineral*, Department of Energy & Mineral Resources
FGD	Focus group discussion
IPB	*Institut Pertanian Bogor*, Bogor Agricultural University
IPAL	*Instalasi Pengolahan Air Limbah*, Wastewater Treatment Plant
IWM	Integrated water management
Kelurahan	An administrative division which translates as village; beneath the subdistrict, *kecamatan,* and headed by an appointed official
KSM	*Kelompok Swadaya Masyarakat*, User-manager groups
MU	Monash University
Musrenbang	*Musyawarah Perencanaan Pembangunan,* Development Planning Consultation
PAL	*Pengelolaan Air Limbah, Wastewater Utility*
Pokja	*Kelompok Kerja,* Working Group
PDAM	*Perusahaan Daerah Air Minum*, Drinking Water Supply Company
PSDA	*Dinas Pengelolaan Sumber Daya Air*, Department of Water Resources Management
PTTGR	Raw water supply company
PUPR	*Dinas Pekerjaan Umum dan Penataan Ruang*, Department of Public Works and Spatial Planning
SANIMAS	*Sanitasi Oleh Masyarakat,* Sanitation by Communities
Situ	A Sundanese word for lake, usually one that is dammed.
SPAL	*Saluran Penyaluran Air Limbah,* Wastewater Network
UI	*Universitas Indonesia*, University of Indonesia
UPTD	*Unit Pelaksana Teknis Daerah, Regional Technical Implementation Unit*
UWC	Urban Water Cluster
WSC	Water sensitive city

Executive Summary

This report presents a profile and benchmark of the water system in the Greater Bogor region of Indonesia as part of the Australia-Indonesia Centre's Urban Water Cluster (UWC). It is one of eight deliverables for the UWC.

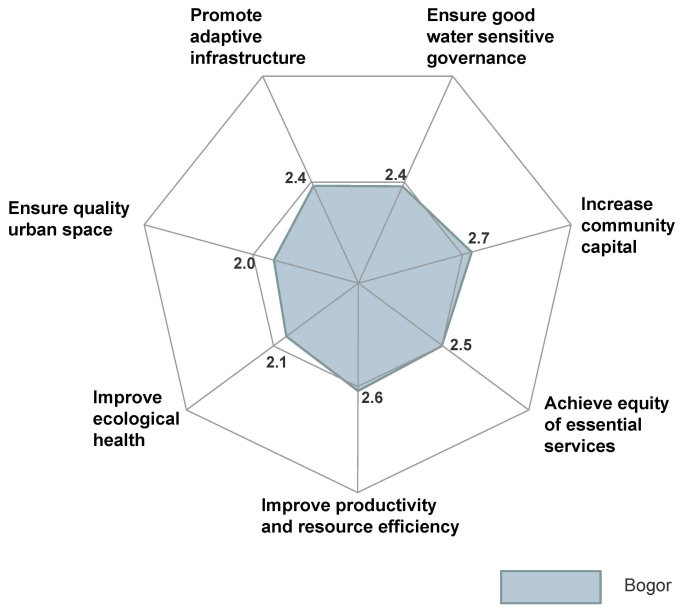
Benchmarking Approach

The current performance of water planning and management in Greater Bogor is measured using a water sensitive city framework, which takes a holistic and integrated view of urban water systems and their role in supporting the resilience, liveability, productivity and sustainability of cities. The tool used for benchmarking is the Water Sensitive Cities Index (WSC Index), developed by the Cooperative Research Centre for Water Sensitive Cities. It enables diagnosis of key strengths and improvement needs for 34 indicators across 7 goals to inform prioritisation of actions and provide a framework for ongoing monitoring and evaluation of a city's water sensitive performance.

Assessment with the WSC Index's involves engagement with key sectoral stakeholders for the region under investigation. Scoring for the Bogor case study was conducted across multiple engagements between November 2017 and August 2018 with approximately 50 research, policy and practitioner experts in disciplines and practices relevant to the indicators. Experts called on their professional judgement as well as primary and secondary evidence relevant to Bogor's water system to determine a score out of 5, based on the criteria defined for each indicator.

WSC Index Results for Greater Bogor

The following figure summarises the performance of Greater Bogor, averaged across the indicators for each of the 7 goals of a water sensitive city.

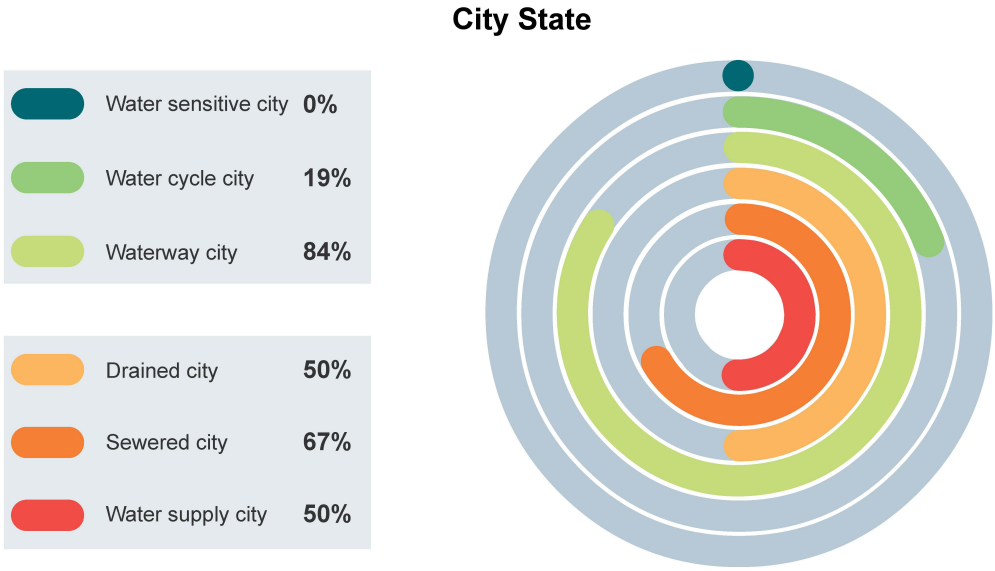


Goal	Score (/5)	Justification
Ensure good water sensitive governance	2.4	Sustainability is afforded some prioritisation in government strategies, although in practice urban development is typically prioritised over sustainable and integrated water management, and the traditional delivery of essential water-related services dominates funding decisions. Integrated water planning is largely absent from strategic consideration. There are skills shortages in key areas. There are legal requirements for representation and community inclusion. Greater Bogor governments have encouraged public participation in water management, but engagement typically involves information delivery rather than residents influencing decisions. Some cross-sector institutional arrangements are present, but there are gaps in coordination and information exchange.
Increase community capital	2.7	There is increasing community participation in water-related education activities. Environmental education is institutionalised at different levels of schooling. Some parts of the community in Bogor have strong connections with their local waterbodies and environments. There is a high level of shared ownership and management of water assets such as wells and wastewater distribution systems, though there are gaps in responsibility for resource management and maintenance that have affected groundwater supplies in the city. Disaster response is generally well-planned and coordinated. Social media and message services strengthen community responses to disaster. Some agencies facilitate flood preparation and mitigation. It is not clear how well-informed the public is about disaster response plans.
Achieve equity of essential services	2.5	Water supply is generally reliable, though less than half of households are thought to have access to decent potable water supply to the home. Most households have private sanitation facilities, nearly all of which are connected to onsite septic systems, although with inconsistent maintenance. Flooding tends not to be a significant hazard, though minor flooding near waterways appears to be commonplace in the wet season. Flooding is more a concern for areas downstream of Bogor, which creates a need for better management of urban runoff. Water-related assets offer amenity values in several areas of the city, though access is generally difficult.

Goal	Score (/5)	Justification
Improve productivity and resource efficiency	2.6	End-user potable water demand is low. The physical and administrative losses in the system (i.e. leaking pipes and water theft) are high, estimated at about 50%. There are quite low levels of resource recovery, limited to small-scale reuse of sewage sludge. On a local scale, different small-scale business opportunities are present. However, virtually no water-related benefits are made for other sectors through water-related services.
Improve ecological health	2.3	There are some areas of healthy and biodiverse habitat, with some functioning ecological systems given the development context, but overall there is a need for greater habitat connectivity. There is policy in place to conserve areas with significant ecological value, with mapping of vulnerability to identify such areas. There is some action to treat wastewater, but this is limited to large-scale industrial polluters. Urban run-off is not managed and domestic septic systems are generally poorly maintained. Surface and groundwater quality is poor in many areas. Groundwater abstraction is leading to aquifer depletion in some areas.
Ensure quality urban space	2.0	Pleasant urban green space is scattered throughout the city, but is difficult to access and not well-connected. However, there is policy to improve connectivity and accessibility, centred on the botanical gardens. There has been some implementation of green infrastructure in demonstration sites to fulfil stormwater treatment, groundwater infiltration and amenity functions, but overall only a small proportion of urban space functions as an integral part of the water system. Bogor has a low degree of vegetation canopy coverage.
Promote adaptive infrastructure	2.4	The water system is supplied by a centralised network of treated surface and groundwater and dispersed untreated domestic groundwater from small bores and springs. There is a reasonable degree of flexibility for consumers with sufficient financial resources. There are some examples of multi-purpose water system infrastructure in Bogor but there are no policies or strategic management approaches in place that support this multi-functionality. The water system is sensitive to stresses with moderate failure rates and drainage inefficiencies. There is a fair degree of decentralisation and use of onsite systems, though there is a need for more integration, and system maintenance overall needs more attention.

Analysis with the Urban Water Transitions Framework

The indicators of the WSC Index are mapped to six states of water system performance, adapted from the Urban Water Transitions Framework (Brown et al. 2009). Cities achieve certain performance markers associated with the priorities of the six developmental states as they journey towards a water sensitive city. This transition journey is not necessarily linear.



Water supply and sewered city: There is limited accessibility and reliability of safe and reliable water supply and sanitation services for a large proportion of residents which will need attention to improve these scores.

Drained city: Infrastructure drains stormwater away from built up areas and protects people and property from floods. Bogor experiences intense rainfall events that stress the drainage system. Drainage channels regularly accumulate sediment and litter due to poor erosion control and domestic solid waste management.

Waterways city: Community is encouraged to participate in water system management, and they have some awareness of and connection to water issues. However, pollution of waterways is persistent, with wastewater treatment mostly limited to large industrial discharges and urban runoff treatment non-existent.

Water cycle and water sensitive city: Some elements of integrated water cycle management are present but often not through strategic system planning and design. There remain financial, technological and institutional barriers to be overcome for Bogor to become a Water sensitive city.

This application of the WSC Index to Bogor has provided stakeholders with a system-oriented lens to urban water management. This can inform the prioritisation of management actions and shape a holistic approach to water system evaluation and strategic and operational planning in the future.

Chapter 1

Introduction

INTRODUCTION

The purpose of this report is to present a socio-technical profile of the Greater Bogor region of Indonesia as part of the Australia-Indonesia Centre's Urban Water Cluster (UWC). The method by which the profile was obtained was by applying the WSC Index – a collaborative benchmarking tool.

The structure of this report is as follows:

Section 1 introduces the project, tools and frameworks, and methods applied.

Section 2 provides an overview of the planning context for the Greater Bogor region.

Section 3 presents the summary findings of the WSC Index for Bogor.

Section 4 provides the detailed analysis of the 34 indicators of the WSC Index.

Section 5 presents some concluding remarks.

OVERVIEW OF WSC INDEX

A water sensitive city (WSC) is one that is resilient, manages water to enhance the health of people and ecosystems, supports an innovative economy, and involves citizens in planning and management. It incorporates elements of integrated water management (IWM), provision of ecosystem services, and collaborative governance.

The purpose of the WSC Index is to help understand the current performance of the urban water system against 34 indicators representing the attributes of an ideal water sensitive city.

The WSC Index aims to:

- Describe and communicate the key attributes of a WSC for government and the water industry
- Guide discourse about the goals of a WSC
- Benchmark a city's water-sensitive performance through application of standardised measurement criteria
- Evaluate progress towards achieving a WSC by comparing assessments of the same city over time
- Assist decision-makers to prioritise actions, define responsibility and foster accountability for practices that are incompatible with the WSC.

WSC Index assessment is intended to be a collaborative process involving key sectoral stakeholders for the region under investigation.

The WSC Index has been designed by the Cooperative Research Centre for Water Sensitive Cities (www.watersensitivecities.org.au) in collaboration with partners in the Australian water sector.

WSC INDEX FRAMEWORK

The WSC framework recognises that the management of the water system in cities has untapped potential to benefit the city's liveability, sustainability, productivity and resilience. Water sensitive cities strive to enhance biodiversity, encourage connected communities, and foster cultural significance. They also protect the health of waterways, reduce flood risk, and create multi-functional public green spaces. Ultimately, a water sensitive city recognises how water can both meet the basic needs of society and also contribute to the creation of connected, vibrant and liveable communities.

As cities seek to adopt this approach, they need to understand both their present status with regard to urban water management and define their short and long-term sustainability goals. An analytical tool has been developed specifically for this purpose: The Urban Water Transitions Framework (Brown, Keath & Wong, 2009) (Figure 1). The framework identifies six distinct developmental states that cities may move through on their path toward increased water sensitivity. The transition journey is not necessarily linear, as a city may show indicators of later developmental states while not fully satisfying earlier states; this is particularly evident when flooding remains a hazard to a city's liveability although other attributes of waterway health and aesthetics are maintained.

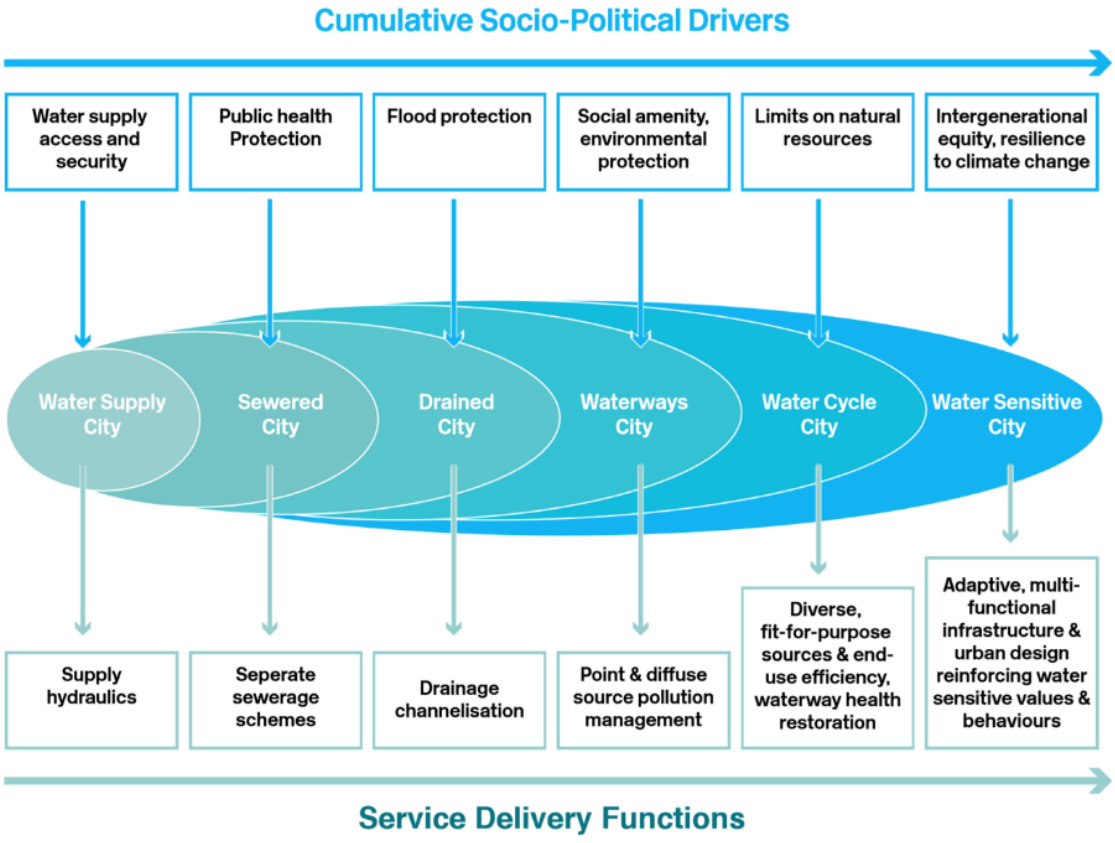


Figure 1. Urban Water Transitions Framework (Brown et al., 2009)

Figure 2 describes each of the city-states in more detail. This understanding can help planners and policy-makers to shape the short- and medium-term high-level transition directions for the city or urban area.

While a city's local WSC vision may not emphasise all indicators of the WSC Index to the same degree, the tool enables diagnosis of key areas of strength and weakness. This insight can then inform the prioritisation of actions and it provides a framework for ongoing monitoring and evaluation of a city's water sensitive performance.

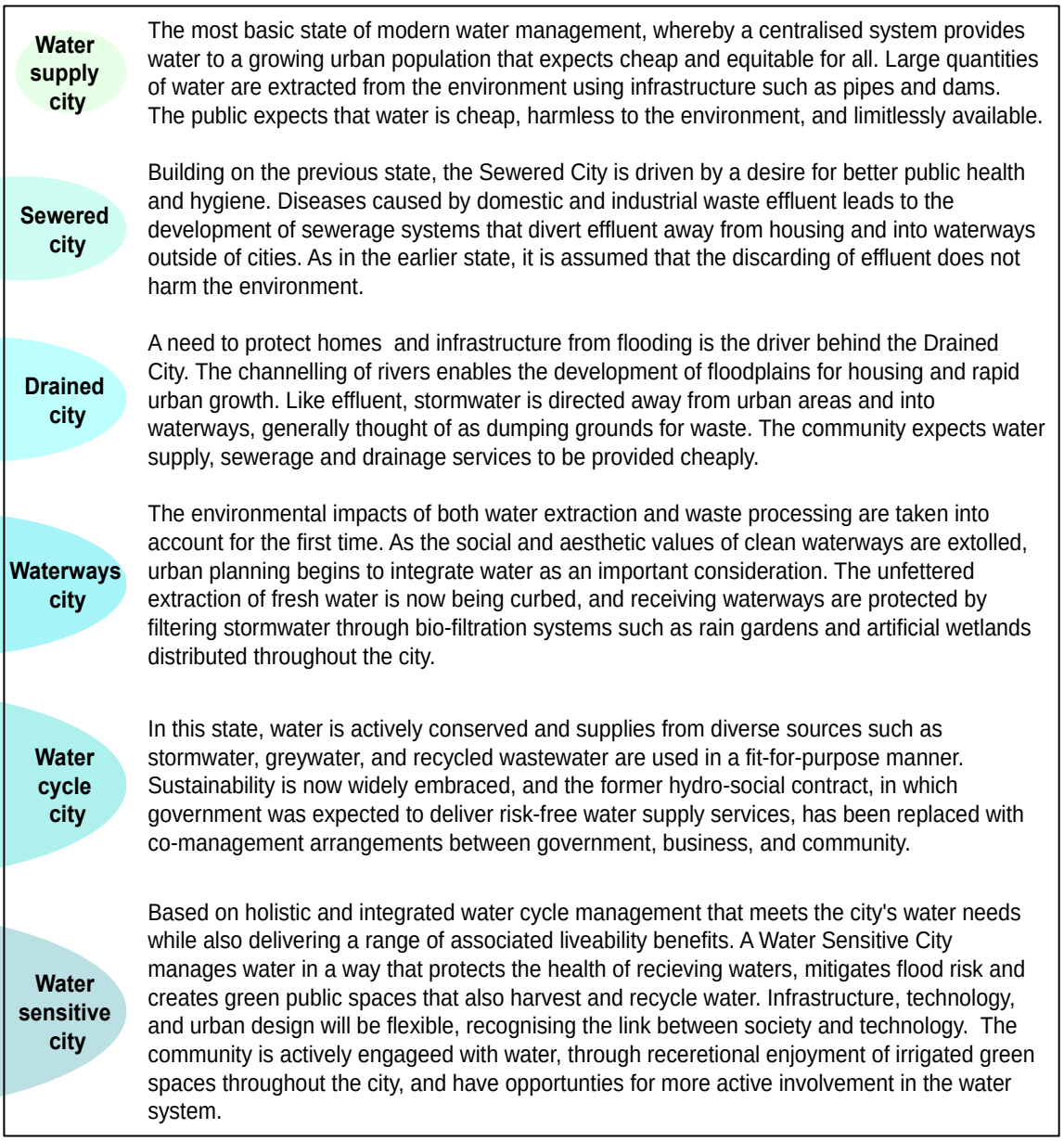


Figure 2: Descriptions of each state in the Urban Water Transitions Framework (Brown et al., 2016)

METHODOLOGY

The WSC Index comprises 34 indicators, which represent important attributes of a water sensitive city across social, technical and ecological domains (Chesterfield, Rogers et al. 2016). These indicators are organised under seven thematic goals to help compartmentalise the scoring process (refer to Table 1). Scoring for each indicator is qualitative, with a rating from 1 to 5 assigned according to the description that best fits the city's current situation. Indicators scores are reached through discussion and consensus, and half fractions are permitted when performance is considered 'between' ratings.

Although usually scored in a single full-day workshop, scoring for this case study was conducted over several months. This was designed to build understanding in the Index methodology and to allow sufficient time for the collection of evidence to support scores. Scores were reached during a series of focus group discussions (FGDs) that are outlined in Table 2. As well as expert knowledge, these discussions were informed by evidence from secondary data, including scientific articles and grey literature such as policy and strategy documents for Bogor. Key references are provided in the scoring justifications in this report.

The only modification to localise the WSC Index related to Indicator 2.5, which for Bogor was modified from *Indigenous involvement in water planning* to *Local wisdom in water planning*. This change was made due to the inapplicability of the original indicator's intent to the Javanese context.

Table 1. WSC Index goals and indicators in use for this case study

Goal 1. Ensure good water sensitive governance	1.1 Knowledge, skills and organisational capacity 1.2 Water is key element in city planning and design 1.3 Cross-sector institutional arrangements and processes 1.4 Public engagement, participation and transparency 1.5 Leadership, long-term vision and commitment 1.6 Water resourcing and funding to deliver broad societal value 1.7 Equitable representation of perspectives
Goal 2. Increase community capital	2.1 Water literacy 2.2 Connection with water 2.3 Shared ownership, management & responsibility 2.4 Community preparedness and response to extreme events 2.5 Local wisdom in water planning
Goal 3. Achieve equity of essential services	3.1 Equitable access to safe and secure water supply 3.2 Equitable access to safe and reliable sanitation 3.3 Equitable access to flood protection 3.4 Equitable and affordable access to amenity values of water-related assets
Goal 4. Improve productivity & resource efficiency	4.1 Maximised resource recovery 4.2 Low GHG emission in water sector 4.3 Water-related business opportunities 4.4 Low end-user potable water demand 4.5 Benefits across other sectors
Goal 5. Improve ecological health	5.1 Healthy and biodiverse habitat 5.2 Surface water quality and flows 5.3 Groundwater quality and replenishment

	5.4 Protect existing areas of high ecological value
Goal 6. Ensure quality urban space	6.1 Activating connected green - blue space 6.2 Urban elements functioning to mitigate heat impacts 6.3 Vegetation coverage
Goal 7. Promote adaptive infrastructure	7.1 Diversify self-sufficient fit-for-purpose water supply 7.2 Multi-functional water infrastructure 7.3 Integration and intelligent control 7.4 Robust infrastructure 7.5 Infrastructure and ownership at multiple scales 7.6 Adequate maintenance

Table 2. WSC Index benchmarking method for Greater Bogor

Month/Year	**Benchmarking step**
November 2017	FGDs held over five days involving 30 researchers from UI, IPB and MU and 19 policy makers and practitioners from other organisations. Secondary evidence collected for all indicators
April 2018	FGD involving 16 researchers from UI, IPB and MU to examine evidence and determine preliminary scores for indicators in Goals 2, 4, 5, 6, 7
May 2018	Indicator analysis reviewed individually by researchers from UI and IPB, leading to amendment of *Productivity and resource efficiency* goal
June 2018	Meeting of six researchers to examine evidence for and score the *Good governance* goal
July 2018	Remaining indicators in the *Equity of essential services* and *Good governance* goals reviewed and scored. Scores in several other Goals also refined
August 2018	Benchmarking analysis subject to further feedback and review by researchers at IPB and UI. Some indicators rescored following further data collection.

Chapter 2

Context

CONTEXT

BIOPHYSICAL CONTEXT

Bogor metropolitan area is located approximately 60 km south of Jakarta. This proximity means many residents commute to work in Jakarta or have a primary residence in Jakarta and second or 'holiday home' in Bogor. Located at a higher elevation than Jakarta, Bogor is generally cooler than the capital. Bogor encompasses the municipalities of *Kota Bogor* (Bogor City) and *Kabupaten Bogor* (Bogor Regency). The former includes the historic centre of the city, and the latter accommodates more recent suburban sprawl around Bogor City.

Bogor has a wet tropics climate, with year-round warm temperatures and average annual rainfall of 4100-4400 mm, but with a distinct wet season between October and April. Several rivers traverse the region and there are numerous man-made water bodies and some natural lakes within Bogor.

While Bogor's water supply and sanitation services rank highest compared to other local government areas across Indonesia (WSSI, 2018) there are a number of urban water related issues. For example, Bogor experiences localised flooding during heavy rain events, has areas of informal settlement that are built on highly vulnerable land, with issues of poor sanitation, decrease in availability of clean water and associated health impacts.

In Bogor City, there are six locations of springs, four groundwater aquifers and two shallow groundwater aquifers. The capacity of the springs and ground water has decreased when compared to 2011 levels (Bappeda, 2017).

Several rivers flow from the south towards the north through Bogor, before terminating at the Bay of Jakarta. The two largest ones are the Ciliwung and the Cisadane rivers which run next to the historic centre of Bogor. The Ciliwung has a river basin area of 165.8 km^2 and the average flow was 11.2 m^3/sec at Katulampa in 2016 (Statistical Yearbook of Indonesia, 2018). The Cisadane has a river basin area of 850 km^2 and 2016 average flow was 74.7 m^3/sec at Cibaliung (Statistical Yearbook of Indonesia, 2018).

Both have had water quality and flow impacted on by land use changes in the catchment associated with population growth and urbanisation. The water quality status of the Ciliwung is "heavily polluted" (Statistical Yearbook of Indonesia, 2018). Bogor's rivers fulfil many functions, such as drinking water supply (e.g. Cisadane), irrigation water, fish production, and drainage.

There are several small lakes in Bogor City and 95 lakes across Bogor Regency, though far fewer within Greater Bogor itself. They are important for irrigation purposes, water retention purposes as well as recreation.

Mean annual temperature have been recorded increasing in Indonesia. There has been a decline in annual rainfall in the southern regions of Indonesia and an increase in precipitation in the northern regions, though there has been a more pronounced seasonality to rainfall trends. These trends are projected to continue due to global climate change. Jakarta is projected to become 5 to 15% drier during June-August

which may translate into higher drought risk. Increased rainfall during already wet times of the year may lead to high flood risk.

Despite the highly urbanised area, there is considerable agricultural production in the Bogor region. Prominent crops are corn, cassava, tomato, guava, durian, rambutan and rice. Fish farming is also an important agricultural product.

GOVERNANCE CONTEXT FOR WATER & URBAN DEVELOPMENT

The study area includes the areas of two municipalities within the province of West Java. The study area comprises the whole of the municipality of Bogor City (*Kota Bogor*), which has an area of 118.5 km^2 and population of 1,016,687 (BPS-Statistics of Bogor City, 2018). The surrounding municipality of Bogor Regency (*Kabupaten Bogor*) includes satellite suburbs of Bogor such as Cibinong, Ciomas and Sentul City, but also a large area of rural land with no urban connection to Bogor metropolitan area. The Bogor Regency districts of Cibinong and Babakan Madang, where the case studies of Situ Front City and Sentul City are located, were estimated to have a total population 534,087 in 2016 (BPS-Statistics of Bogor Regency, 2017).

As most economic and social data is published at the scale of municipalities, it is difficult to draw an accurate population profile Greater Bogor. The population may be as high as 3.3 million people if the 2016 population estimates of the Bogor Regency districts (*Kecamantan*) adjoining the boundary of Bogor City are added to the 2016 population of Bogor City. This figure provides an upper estimate of the region's population.

Water resources management and the provision of water services are predominantly public sector activities in Indonesia. Nevertheless, due to the low reliability of centralised potable water supplies, private sector bottled water businesses are an important part of the urban water picture.

The responsibilities for water management are defined by laws covering a range of functions subject to decentralisation as well as regulation specific to water services. The general principle is that a local government has responsibility for waterways and water services that are contained within its boundaries. When there are cross-boundary impacts with another government at the same level, jurisdiction is assigned to the next level up in the government hierarchy, such that rivers that flow through multiple provinces are the responsibility of the national government. This is the case for the Ciliwung and the Cisadane rivers. Despite this principle of decentralisation, most water utility responsibilities are functionally managed at the local government level, whereby each City or Regency government will operate its own water supply business and wastewater collection and treatment system. Broad responsibilities for agencies at national, provincial and local government levels are outlined in Table 3.

Table 3. Agency functions and responsibilities in the water space

Level	Agency	Water sector				Function
		Supply	Sanitation	Drainage	Environment	
National	Bappenas	●	●			National development planning; coordinates development, utilisation and conservation of natural resources
	Ministry of Public Works and Settlements	●		●		Spatial planning and the development of infrastructure and public facilities and management of water resources and water quality; includes BBWS, BPPSPAM
	BBWS	●		●		Management of river basins classed as Category A; approves permits for river water extraction and works on rivers (e.g. dredging)
	BPPSPAM	●				Recently established to help governments improve organisation of their drinking water supply systems
	Ministry of Home Affairs				●	Supports local government (LG) environmental management planning
	Ministry of Environment & Forestry				●	Conservation standards, EIA regulation, environmental data
Provincial	Department of Settlement and Housing	●	●	●		Planning and coordination of development and formal authority over water supply and wastewater treatment systems that cover multiple local government jurisdictions; coordination of drainage through settlement infrastructure
	Water Resources Agency (DPSDA)	●		●	●	Water resources management for irrigation; plans and manages development & use of rivers, lakes and dams; SDA permits
	Watershed Management Agency (BPDAS) Citarum-Ciliwung			●		Planning, institutional development and evaluation of watershed management, primarily forest conservation and forestry management
	Department of Energy & Mineral Resources (ESDM)	●				Groundwater licensing (100 m below ground level and deeper)
	PTTGR	●				Raw water supply company
City / Regency[1]	Bappeda	●		●		Development planning and coordination
	Department of Public Works and Administration (PUPR) -Bogor City	●	●	●	●	Formulation of policy for potable water supply, domestic sewerage regulation and infrastructure construction and operation; flood planning; through River and Channel Management branch, maintains and cleans water channels
	Department of Highways and Water Resources - Bogor Regency	●	●	●	●	Formulation of policy for potable water supply, domestic sewerage regulation and infrastructure construction and operation; flood planning; through River and Channel Management branch, maintains and cleans water channels

[1] Agencies mirrored across Bogor City and Bogor Regency unless specified.

Level	Agency	Water sector				Function
	PDAM Tirta Pakuan – Bogor City	●				Raw water treatment and supply to residential and business customers
	PDAM Tirta Kahuripan – Bogor Regency	●				Raw water treatment and supply to residential and business customers
	UPTD-PAL	●				Division of PUPR responsible for wastewater treatment plant operation
	Department of Health		●			Supports user-managed communal wastewater treatment systems (SANIMAS)
	Environment Department (DLH -Bogor City / LHK - Bogor Regency)		●		●	Management of non-domestic wastewater; conservation and rehabilitation of natural resources; quality monitoring and pollution control (i.e. environmental regulations)
	ESDM (Regency)	●				Processes intergovernmental sale of raw water
	KSM / Kelompok Pengelola dan Pengguna	●				User management organization for water supply (e.g. from springs and wells) and sanitation facilities (e.g. septic tanks and SANIMAS) outside PDAM service areas

Chapter 3

WSC Index Benchmarking

Figure 3 summarises the performance of Greater Bogor, averaged for the seven goals of a water sensitive city. The results of Index assessment indicate that goal scores are relatively even. The average scores of the goals were in the range of 2.0-2.7 out of 5, the highest being *Increase community capital*.

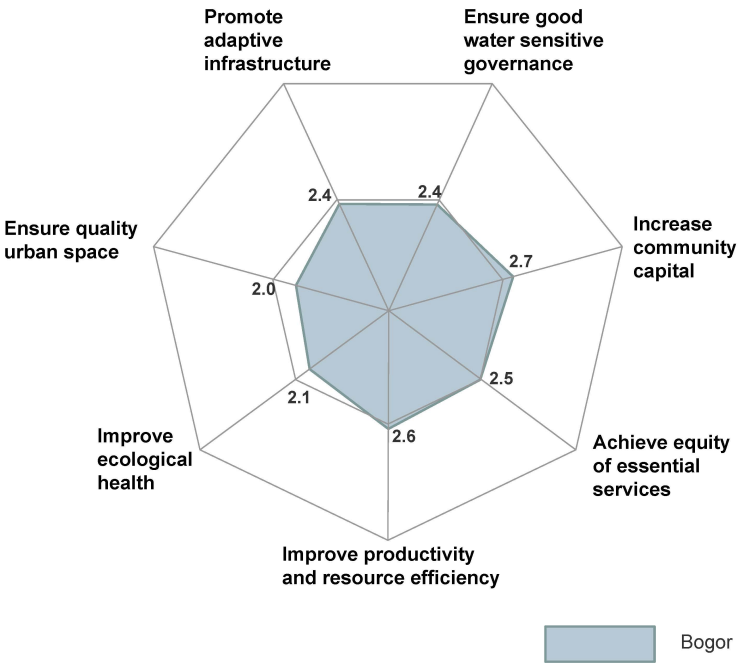


Figure 3. WSC Index footprint for Greater Bogor

Figure 4 summarises the city-state benchmarking results for Bogor. Percentage performance against measures relevant to each city-state ranged from 50% as a *water supply city* through to 0% as a *water sensitive city*. This section summarises the key elements that contribute to the overall performance relevant to each city state.

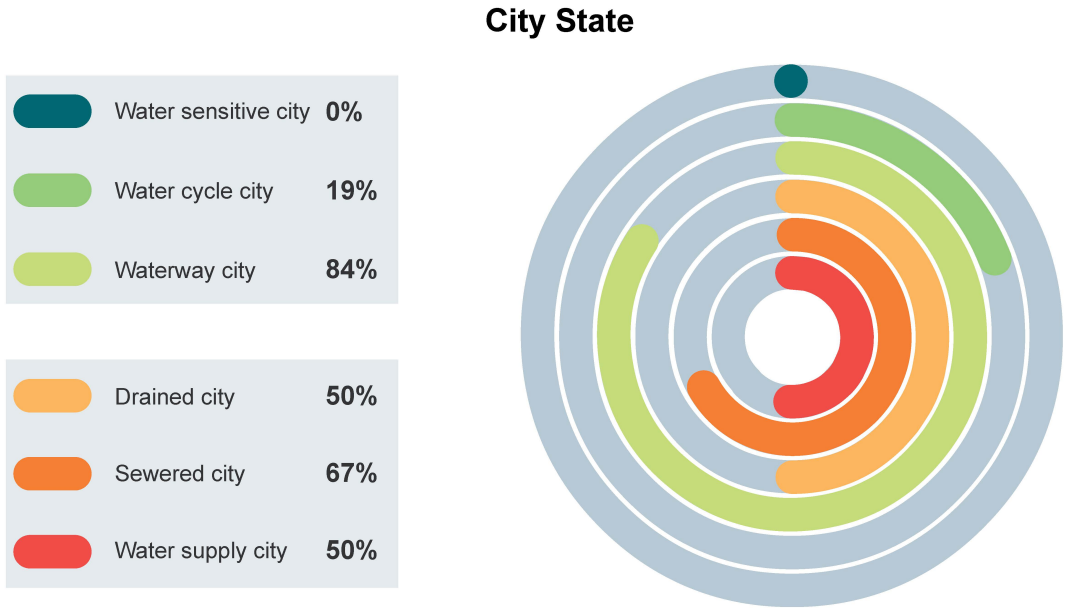


Figure 4. Summary of Bogor's performance against each city state.

50% Water supply city

In the Bogor region, a minority of households are thought to have access to decent drinking water supplies, and fewer households have access by means of reliable piped water. For example, only 28% of households in Kota Bogor used mains water for drinking in 2017. The water supply is generally secure, however.

67% Sewered city

Not all residents of Bogor region have access to safe and reliable sanitation. About 74% of households in Kota Bogor, for example, have access to a waste disposal system such as septic tank, IPAL or SPAL (integrated waste disposal system with a dedicated waste treatment plant). The most common form of waste disposal is by septic tanks managed by private householders. There are reported to be maintenance issues with septic tanks in the region, and it is common for septic tanks to discharge to the environment without adequate treatment, leading to groundwater contamination.

50% Drained city

Due to its wet tropics climate, Bogor regularly experiences intense rainfall events. However, the drainage system in Bogor is lacks integration, meaning that separate parts of the drainage system are not connected. Increased urban development and land use changes in the upper catchment cause soil erosion and sediment accumulation in the drainage channels, which is usually addressed by dredging. Erosion control during construction is currently very limited. Many of the manmade larger drainage channels in Bogor were originally designed as irrigation channels. Their design as irrigation channels makes their drainage functions less efficient. Interconnections between the drainage system and the irrigation system effectively

reduce the capacity and function of both systems. The dumping of household waste into rivers, drainage channels or vacant land can lead to the blockage of drainage channels which has been directly related to flood events in Bogor.

84% Waterways city

A *waterways city* state marks the shift from a focus on technological solutions to water servicing to a consideration of other values, particularly amenity, sustainability and waterway health. The anomalously high score of this benchmark indicates that this shift has begun to occur for Greater Bogor, though not likely to the degree the score suggests; surface water and groundwater pollution is largely unchecked due to a lack of oversight of domestic wastewater disposal and the community have generally not accepted a role in protecting waterway health.

Nevertheless, government agencies in Bogor have been involved for some time in information sharing and policy coordination, and there is some evidence of cooperation across jurisdictions to achieve water system objectives. There have also been steps taken by local governments to encourage public participation by initiating collaboration with civil society organisations such as Sanitaria and Forum Kota Sehat Bogor, as well as the general-purpose *Musrenbang* forum. There is also some consideration of water in high-level urban planning.

The community is generally increasing its awareness of water issues through educational programs run by schools and civil society organisations. This is helping to reinforce the strong connection to water that many residents already possess by living near water bodies like rivers or situ, and by accessing water from the environment through springs or wells. Many residents also participate in agriculture and aquaculture activities that are dependent on natural water.

19% Water cycle city

For the *water cycle city*, water conservation is a key management driver, water is derived from diverse fit-for-purpose sources, and there is a high degree of shared management of water assets. Bogor's partial performance in the *water cycle city* state is the result of some elements of these attributes being met.

A principle of the *water cycle city* is co-management of water system by government, business and the community in order to facilitate access to water sources at local scales as part of an integrated system. There is a high level of shared ownership, management and responsibility for water assets in Bogor due to the high numbers of privately owned septic tanks and privately-owned groundwater wells at the household level. They are key infrastructure for fulfilling basic needs and are owned and operated by the individual householders.

The diversity of water assets in Bogor means that to some degree there is also a diversity in the sources of supply. There are supply systems operated and administered by the local water management organisations (PDAM), and most people in Bogor rely on multiple water sources – groundwater, surface water and bottled water – for their daily water needs. Given its relative abundance, rainwater is notable for its absence from use in homes. More study is warranted into the role that rainwater harvesting could play in Bogor's water supply.

Although conservation is not a significant driver of practice – demonstrated by the over-extraction of groundwater in some areas – residential water demand is low. This is likely a product of a development context in which water is generally not required for outdoor use and the lack of convenience for some sources of supply.

To progress Bogor's performance in the water cycle state, planners should give greater attention to integrating elements of urban form such as drainage and open space into the urban water system. This has only occurred in one or two development areas in Bogor to date. It would also important that a sense of environmental stewardship be more widely practiced by Bogor's community. In doing so, diffuse-source pollution of waterways would likely be better managed.

0% Water sensitive city

Most cities begin their progression to a *water sensitive city* by achieving high levels of equity in access to safe and secure water supplies and safe sanitation. Although this is a priority for all governments concerning Bogor, it appears that there are considerable financial, technological and institutional barriers to be overcome.

For Bogor to become a *water sensitive city*, it will also need to fulfil the multiple objectives of ecosystem protection and restoration, security of supply, flood control, public health, amenity, liveability and economic sustainability, among others.

WATER SENSITIVE CITY INDEX SCORING SUMMARY

Table 4. WSC Index scores (Goals and Indicators) for Bogor

WSC Index Goal and Indicators	Score /5	WSC Index Goal and Indicators	Score /5
1. Ensure good water sensitive governance	**2.4**	**4. Improve productivity and resource efficiency**	**2.6**
1.1 Knowledge, skills and organisational capacity	2.5	4.1 Benefits across other sectors because of water-related services	1
1.2 Water is key element in city planning and design	2	4.2 Low GHG emission in water sector	2.5
1.3 Cross-sector institutional arrangements and processes	2.5	4.3 Low end-user potable water demand	5
1.4 Public engagement, participation and transparency	3	4.4 Water-related commercial and economic opportunities	3
1.5 Leadership, long-term vision and commitment	2.5	4.5 Maximised resource recovery	1.5
1.6 Water resourcing and funding to deliver broad societal value	2	**5. Improve ecological health**	**2.1**
1.7 Equitable representation of perspectives	2	5.1 Healthy and biodiverse habitat	2
2. Increase community capital	**2.7**	5.2 Surface water quality and flows	1.5
2.1 Water literacy	2.5	5.3 Groundwater quality and replenishment	2
2.2 Connection with water	2.5	5.4 Protect existing areas of high ecological value	3
2.3 Shared ownership, management and responsibility for water assets	2.5	**6. Ensure quality urban space**	**2**
2.4 Community preparedness and response to extreme events	3.5	6.1 Activating connected urban green and blue space	2
2.5 Local wisdom in water planning	2.5	6.2 Urban elements functioning as part of the urban water system	2
3. Achieve equity of essential services	**2.6**	6.3 Vegetation coverage	2
3.1 Equitable access to safe and secure water supply	2.5	**7. Promote adaptive infrastructure**	**2.4**
3.2 Equitable access to safe and reliable sanitation	3	7.1 Diverse fit-for-purpose water supply system	3
3.3 Equitable access to flood protection	2.5	7.2 Multi-functional water system infrastructure	2.5
3.4 Equitable and affordable access to amenity values of water-related assets	2	7.3 Integration and intelligent control	2
		7.4 Robust infrastructure	2
		7.5 Infrastructure and ownership at multiple scales	3
		7.6 Adequate maintenance	2

Chapter 4

Detailed Benchmarking by Indicator

DETAILED BENCHMARKING BY INDICATOR

This section outlines the supporting evidence for the score. Scores are displayed to the right of the indicator alongside the confidence level for the score.

1. GOOD GOVERNANCE

1.1 Knowledge, skills and organisational capacity 2.5 / 5 (High)

Currently, only a quarter of the people who would be required for adequate water service provision are employed in the sector (Bappeda, 2011). While the numbers of administrative staff are generally high, urban water and city development agencies lack staff with skillsets required to fulfil organisational functions and responsibilities (Wieriks, 2011). Key water-related ministries at the national level lack staff with particular skill sets required to fulfil organisational functions and responsibilities .

There appears to be a growing number of people learning about water conservation, empowerment and water-related disaster management. This is indicated by increasing participation in learning activities regarding water both in the field and in the classroom, by attending seminars and workshops, and by acquiring tertiary education qualifications in water-related fields.

Staff rotations are used as a means to prevent corruption at government organisations. This process is vulnerable to political influence rather than for the benefit of a particular program. Staff rotations usually only happen between departments within one government organisation and because they are a requirement, may hinder the development of field-specific in-depth knowledge of public servants and the discontinuation of particular projects. Knowledge management processes that assist knowledge transfer during staff rotations are not in place.

Mono-disciplinary expertise (primarily engineering) dominates the organisations responsible for water and city development services in Bogor. Other disciplines such as political science, legal studies, economics, environmental studies, and health studies have been involved in some work programs and consultations (e.g. disaster management caused by flood). However, connections between organisations and academia are ad-hoc and short term and mostly limited to individual connections of key individuals who work across different organisational boundaries. Rather than having formalised strategic long-term partnerships, academia-industry exchanges only take place when particular organisations need specific advice or when academic consultancy is required.

1.2 Water is key element in city planning and design 2 / 5 (Medium)

There is general policy on sustainability in place but there is a lack of focus on integrated water system planning. Bappeda's regional and city planning processes and long term and mid-term strategic plans are guided by sustainable development as well as good governance principles and entail water sensitive city ideas (Bappeda, 2017). However, capacity gaps of planners, data sharing and monitoring and evaluation deficiencies stifle the alignment of these principles with integrated water planning practice. Additionally, little coordination between urban planning and water service planning is present and only happens on a project-by-project basis.

Coordination and integration are limited to a focus on essential service provision. As a result, planning for population growth and housing is rarely linked to more sustainable or integrated forms of urban water management.

In general, matters of sustainability in city planning and city development are typically reduced to the economic pillar of sustainability. As such, urban development is seen as a key driver for economic growth and is often prioritised over environmental and social sustainability.

Additionally, enforcement of planning regulation is generally weak. This is compounded by unclear and overlapping responsibilities in development planning between national and local government levels.

Water is key element in city planning & design: example from Sentul City & Cibinong

In some newly developed areas, water has become a prominent feature in the urban planning and designs. Two high profile examples for this are Sentul City, a newly developed satellite city on the outskirts of Bogor and the Cibinong Situ Front City Master plan. In Sentul City, IWM practices are a key element of the development plan and sustainable urban water management practices such as storm water treatment with water sensitive urban design features in many areas of the development. Similarly, the Cibinong Situ Front City development is a contemporary example of city development in which water features prominently in the development of an urban area. The master plan for the Cibinong Situ Front City includes different water sensitive urban design elements such as rain gardens, vegetated swales and constructed wetlands.

1.3 Cross-sector institutional arrangements and processes 2.5 / 5 (Medium)

Many organisations are involved in the management of water related services and the development of urban areas. Some relevant cross-sector institutional arrangements are present in strategies, laws and regulations and joint taskforces, but coordination between agencies is scarce and informal. Collaboration between organisations predominantly happens when specific organisational leaders spearhead collaborative efforts with other organisations in the sector, but these efforts depend on the good will of leaders and, usually, aligned political interests. This horizontal fragmentation is compounded by unclear or overlapping responsibilities across different levels of government with limited coordination or information exchange between these layers. This leads to inefficient infrastructure development because opportunities for the provision of different services in the same project (e.g. construction of water infrastructure and roads) are not taken.

One example of coordination across agencies within government is the Sanitation Task Force (*Pokja*) that facilitates, coordinates and plans water facilities and infrastructure including drinking water, sewerage, domestic waste management, and stormwater drainage. *Pokja* was formed by Mayoral Decree with the Secretary of the Bogor City government as the Chairperson. This *Pokja* is considered successful in coordinating stakeholders, for instance IUWASH (Indonesia Urban Water, Sanitation, and Hygiene) and the central government. The central government assists *Pokja* through funding and access in regulation making. During the period of research, *Pokja* was awaiting approval of the local parliament regarding regulation on domestic waste.

The case of the authority to issue a permit for groundwater extraction illustrates the task ahead for governments in Greater Bogor. The power to issue groundwater extraction permits is assigned to the central government. At the national level, there should be coordination between the Ministry of Public Works and Public Housing, which manages surface water, and the Ministry of Energy and Mineral Resources, which manages groundwater with depth exceeding 100 m. In practice, the two ministries have issued regulations that are considered to contradict each other, and purportedly support conflicting projects. With respect to decision-making over groundwater extraction permits, local government generally possesses the most current and useful information. In many cases, however, permits are issued without any coordination with the municipality.

The high number of privately owned and operated infrastructure at the individual household level (wells and septic tanks) adds another layer of complexity for establishing effective horizontal and vertical institutional arrangement and processes between private and public stakeholders.

Cross-sector institutional arrangements for Ciliwung DAS (watershed) management

Ciliwung River is categorised as national river, which requires river management to be overseen by the central government, ostensibly with the cooperation of provincial government and local government. However, pressure is frequently exerted on local government to resolve management issues, such as local river flooding.

Since 2006 a joint regulation has been issued by Jabodetabekjur Development Cooperation Agency (BKSP), which has the duty to facilitate cooperation of the central, provincial and district / city governments in the management of the Ciliwung watershed. BKSP has succeeded in signing governments to various Memoranda of Understanding and Memoranda of Agreement over Ciliwung River management, including related to flood management, dam management, and *situ* revitalisation.

Moreover, in 2007, the central government regulated the general pattern, norm, standard, procedure and criteria for DAS management, determination of priority watersheds and plans for integrated watershed governance. The provincial government considers the management plan in the implementation of provincial-level watershed management, and local government considers the plan for district / city-scale watershed management. In 2012, the Minister of Environment, the Minister of Public Works and the Minister of Home Affairs were appointed as the driver of cross-ministerial cooperation for Ciliwung watershed affairs. (Alfian & Vitaloka, 2018).

1.4 Public engagement, participation and transparency 3 / 5 (Low)

Public participation in some areas of water governance occurs through volunteering, membership of community organisations, public meetings, and consultation undertaken on key issues relating to water. The opportunities for public participation are facilitated by government, NGOs or individual community leaders. The Bogor Regency and Bogor City governments have encouraged public participation by initiating collaboration with civil society organisations such as Sanitaria and Forum Kota Sehat Bogor. However, public participation is more likely function as a form of information distribution by government instead of promoting active participation. Often, community participation happens after a policy or project has been developed and when certain outcomes need to be negotiated or discussed (e.g. compensation payments).

Opportunities for public engagement and participation exist at the lowest administrative level, the *Kelurahan* (village), in the form of community working committees (CWCs) and through the annual *Musrenbang* process, a largescale participatory planning forum. However, it is fair to say that the influence of these forums on IWM has not been evident. Community aspirations are often undermined by bureaucratic processes.

An example of collaboration between the government and community that is more long-term and formal is the implementation of a clean-up program for Ciliwung River by the Department of Environment of Bogor City and *Eco Village Community*. This involves training facilitators and providing facilities and promotional material to assist with Eco Village Community activities. There are other examples of public engagement involving community NGOs or through the local community leaders. However, there is a risk that engagement is connecting with a select group of active community members who are wearing many hats.

It should also be noted that to assist information sharing and transparency an open information policy has been established which requires that formal policy documents (e.g. strategic plans) must be made available to the general public.

1.5 Leadership, long-term vision and commitment 2.5 / 5 (Low)

Organisational and public leaders support water sensitive principles particularly around improving levels of essential services and urban liveability. Examples of these leaders are evident in Greater Bogor. However, this support is not embedded in formal policy which means that changes in leadership and changing short term political goals often hinder water sensitive practices and outcomes from emerging and being established.

At government agencies, a culture of risk aversion is widespread, which hinders champions at project or middle management level to emerge. There are very few initiatives to support champions at different organisational levels.

The current vision for Bogor is expressed in its mid-term strategic plan (2015 – 2019): "Comfortable Bogor City, faithful and transparent". The term ‘comfortable” captures different conditions that relate to the quality of the environment such as levels of pollution, climatic condition or beauty and odour. “Faithful” captures a range of religious meanings but also relates to a community concern for the environment. It relates to elements of harmony between people but also between people and their environment. “Transparent” encapsulates processes of city administration, urban development and citizen engagement.

1.6 Water resourcing and funding to deliver broad societal value 2 / 5 (Low)

The traditional delivery of essential water related services dominates funding decisions. In this decision-making process, however, special consideration is given to servicing poor households and developing urban areas that require particular attention. This is implemented through cross-subsidisation of water tariffs by PDAM. Loans from the World Bank or the Asian Development Bank for water infrastructure are often used to guarantee access to clean water in rural areas.

In general, water-related resourcing and funding can be subject to financial analysis in which some consideration is given to societal or environmental outcomes. Particularly for high profile developments matters of environmental sustainability, resident well-being and urban liveability are incorporated in financial analysis. In practice, however, water resource management is dominated by business interests. Drinking water supply via bottled water is dominated by foreign corporations.

1.7 Equitable representation of perspectives 2 / 5 (Low)

The principle of inclusion and representation of relevant different perspectives in governance arrangements and decision-making for water is expressly stated in the constitution and applicable laws and regulations. There are sometimes formal opportunities for marginal and disadvantaged groups to be heard parliamentary hearings and by government officials at different levels in the decision-making process. Policy at least reflects the need to service marginalised groups and the importance of providing essential services for them. At a very high level this is demonstrated by Indonesia's commitment to the Sustainable Development Goals. However, the influence of marginal groups on the decision-making is very small when compared with business groups and powerful individuals.

2. COMMUNITY CAPITAL

2.1 Water literacy 2.5 / 5 (Medium)

The people of Bogor are generally familiar with the basic elements of the water cycle but this is mostly limited to those who have gone through a middle or high school education. Older citizens of Bogor and people who come from rural areas or live at the outskirts of metropolitan Bogor have 'local wisdom' around water and water management issues. This however, is slowly eroding and at the danger of becoming lost.

The *Adiwiyata* education program at elementary school, middle school, and high school level provides instruction in eco-friendly behavior. In the *Adiwiyata* program, environmental knowledge is generated through environmental-based policy and curricula. There are 19 schools in Bogor City and 18 schools in Bogor Regency that have implemented behavior principles based on *Adiwiyata* principles

The strongest awareness of water cycle elements coincides with connections to community livelihoods and the fulfilment of basic needs. People know what they are paying for when it comes to water supply. However, not many know that they are paying for more than just the quantity of the water but also the costs associated with providing a certain quality. In a 2014 survey of 2,720 households across Bogor City undertaken by the municipality for the Environmental Health Risk Assessment, 24% of households discharged sewage directly to waterbodies. (Bogor City, 2014). For households who had septic tanks installed, only 20% of respondents could recall if their septic tank had been emptied in the previous 10 years. Similarly, 37% of respondents did not know who was in charge of emptying the septic tanks. The prevalence of poor domestic solid waste disposal practices, with approximately 14% of households reported to dump domestic waste into waterbodies, suggests a lack of awareness of the link between river health, flood management and sound waste

disposal (Bogor City, 2014). Government is working on addressing knowledge and awareness gaps in different communities and target community education by providing different educational campaigns and in some cases prosecuting persistent offenders.

2.2 Connection with water 2.5 / 5 (Low)

Some parts of the community in Bogor have strong connections with their local waterbodies and environments. This is particularly true for communities that have lived in close proximity to water for a long time (e.g. Pulo Guelis) or where particular water features, such as springs, play an important role for a community's daily water needs (e.g. Griya Katulampa). Pulo Geulis is an island between anabranches of the Ciliwung River upon which hundreds of households have established with informal land tenure. Griya Katulampa makes uses of subsurface water flow as 'springs' to meet daily water needs (although not exclusively, as PDAM also services the area). Griya Katulampa residents also use this groundwater for household fish farming.

More generally, Bogor's citizens feel connected to the many situ of Bogor due to their recreational and amenity benefits. *Komunitas Peduli Ciliwung* (Ciliwung Care Community), formed in 2009, is an example of the contribution being made to waterway clean-up and environmental health by community members.

However, there is concern that the community's connection to water is not multi-dimensional and that it has little understanding of the contribution of water to green infrastructure or broader liveability benefits such as human health and the environment. The relative tolerance of damage to situ by development may also indicate that water has a limited contribution to a sense of place for many citizens.

2.3 Shared ownership, management and responsibility of water assets 2.5 / 5 (Medium)

There is a high level of shared ownership, management and responsibility for water assets in Bogor due to the high numbers of privately-owned septic tanks and privately-owned groundwater wells at the household level. They are key infrastructure for fulfilling basic needs and are owned and operated by the individual householders. In general, it can be said that the civil society sector is very active in the water sector and in management of different water assets (Asian Development Bank, 2012). The construction and maintenance of these assets can be problematic, however, with limited consideration for environmental effects (e.g. pollution, smell, etc.). The strategic integration of these assets within a larger centralised network or a coordinated effort for a shared management approach between individuals and authorities is low.

The impact of littering on environmental pollution or downstream flooding events appears to be understood by most people of Bogor. Despite this, the rate of pollution of water bodies is high. The proportion of households that use rivers and drainage channels as well as vacant land to dump their rubbish in Bogor City is 20% according to the Environmental Health Risk Assessment survey (Bogor City, 2014). Similarly, small private companies such as car-washes and privately-owned businesses discharge some of their wastewater into nearby rivers. There are some campaigns that aim at bridging these behavioural gaps, particularly around littering and

environmental pollution. Similarly, regular cleaning programs of the Cilliwung river are undertaken by different community groups.

2.4 Community preparedness and response to extreme events 3.5 / 5 (High)

Regional governments and civil society organisations at the community level are a cornerstone of developing disaster response capacity in Indonesia. There is reasonable funding of regional disaster planning by the National Disaster Management Agency (BNPB), which also undertakes coordination of regional agencies and community members. There is formal municipal flood preparation in several sites of Bogor City involving multiple emergency response agencies.

Social media and other messenger services strengthen community responses to disaster as they are used to share information about imminent events or to assist in disaster responses. This includes effective websites maintained by Bogor City and Bogor Regency that, for example, map critical disaster 'hotspots' and education material to support community disaster preparedness. These means of communication are also coupled with formal early warning systems (e.g. official early warning system at Katulampa flood gate) and assist authorities in communicating information and early warnings more quickly with the public.

BNPB and Bogor City have organised several supporting activities to prepare for and mitigate against flooding, including a mass campaign to construct *biopori* holes to support stormwater infiltration. This activity is carried out by various groups of society. In addition, The Regional Disaster Management Agency (BPBD) Bogor Regency is currently active in organising training for volunteers targeting 40 districts in Bogor Regency (Fauzy, 2018). Those volunteers come from the representatives of communities. The volunteers will be trained on how to encounter disasters and first aid for the victims.

In recovery from flood events, official disaster relief agencies such as the disaster mitigation office (BPBD and Red Cross) work together with different communities in Bogor in flood prone areas. However, as the most flood-prone areas tend to be those occupied by the lowest income percentiles, recovery capacity of households in these areas is impacted.

2.5 Local wisdom in water planning 2.5 / 5 (High)

There are some acknowledgements of the importance of local wisdom in water planning and decision-making but these remain informal. Attempts to incorporate this knowledge in decision making are present, for example in the promotion of groundwater infiltration wells and distribution of groundwater. However, it is not formally recognised yet and there are not formal processes or policy to incorporate this knowledge in decision making or planning processes.

3. EQUITY OF ESSENTIAL SERVICES

3.1 Equitable access to safe and secure potable water supply 2.5 / 5 (High)

In Bogor City, 53% of households are customers of PDAM. However, not all these households used mains water for drinking. Only 28% of households used mains water for drinking in 2017, and only 44% of households were reported as having access to decent drinking water supplies. Decent drinking water is considered water supplied by pipe, rainwater, or protected wells more than 10 m from the nearest waste disposal site (i.e. it does not include bottled or rechargeable water, and does not take into account water quality measures). The proportion of households using mains water for household cleaning and washing was 52% in the same period. Most of the remaining households used pumped groundwater or shallow springwater for washing.

Most of the people of Bogor (82%) say that they have never experienced shortages of water supply while the rest have experienced difficulties in the past but only for a few hours. While regular tests on the quality of PDAM water are carried out, these results have never been made available to the public.

Gallon water that comes from recharge stations or bottled water is the most common means of access to drinking water for Kota Bogor households in the top 60% of household expenditure. For the bottom 40%, the most common means of access are wells and mains. Even though gallon water from recharge stations is generally considered safe and while refill kiosks use filtration systems the quality of the gallon water heavily depends on the original source water used. A study by IPB found hepatitis A and E. coli bacteria in some of the water gallons. Additionally, water from gallons is more expensive than water from the reticulated networks.

Water supplied by pumping groundwater from (deep) wells is the third most common form of drinking supply in Bogor City (21.8% in 2017). This water is of variable quality as it can be contaminated by waste disposal.

Statistics are not readily available at the district level and therefore the rural and exurban populations of Bogor Regency cannot be separated from the Bogor urban area within the Regency.

3.2 Equitable access to safe and reliable sanitation 3 / 5 (High)

The percentage of Bogor City households with a private toilet was 86% in 2017, and those with a shared facility was 10% (BPS-Statistics of Bogor City, 2018). The percentage of households with access to a waste disposal system such as septic tank, IPAL (an intermediate wastewater treatment plant receiving sewerage by tanker truck) or SPAL (an integrated piped waste disposal system with a dedicated waste treatment plant) was 74% in 2017 (BPS-Statistics of Bogor City, 2018). It appears that the majority of these households are using on-site septic tanks – data from 2010 indicates that on-site septic tanks managed by the private households represented 98% of all sanitation in Bogor City (Bappeda, 2011).

The poor management of onsite septic systems is believed to have consequences for the environment, with direct soil infiltration common. In 2010, only 37% of septic systems were deemed “acceptable” according to the Bogor City government. A large

proportion (63%) are thought to never be emptied (Bogor City, 2014). Also from data collected in 2010, only 3% of Bogor City households used sludge removal services (Bappeda, 2011). More recent figures suggest an improvement in the proportion of households served by an acceptable wastewater system in Bogor City: 72% in 2017 (Pekerjaan Umum dan Penataan Ruang, 2018). However, between 2010 and 2017 there was no change in the number of municipal sludge removal trucks in operation, and there was only minor increase in the number of households connected to intermediate or off-site wastewater systems (totalling about 3,000 households by 2017) (*ibid*, 2018).

The percentage of households that dispose of waste directly to a waterway or field was 22% in 2017 (BPS-Statistics of Bogor City, 2018). This is particularly the case for informal settlements near river banks where often very little to no wastewater treatment exists at all.

There are no national or local regulations governing septic tank sludge management or disposal.

UPTD-PAL is the sewerage operator within Bogor City PUPR, the Public Works and Spatial Planning department. It has a target to reach 695 new house connections to the sewer network by the end of 2019 (Pekerjaan Umum dan Penataan Ruang, 2018).

3.3 Equitable access to flood protection 2.5 / 5 (High)

While several areas of Bogor City are flood prone due to the condition of the drainage system (Bogor City, 2017), 94% of all households in Bogor city never experienced any type of flooding (Bogor City, 2014). Nevertheless, intense rainfall events have caused major flooding in Bogor as a result of the underperforming drainage network.

The drainage channel density in Bogor is high with a total length of 270km (Bogor City, 2017). Different larger and smaller rivers fulfil important drainage functions and the drainage system tends to directly discharge into the Ciliwung and the Cisadane River. Small scale drainage channels usually follow next to the road networks with some of them being interconnected while others are stand-alone (Bappeda, 2017a). At the community level, small scale drainage infrastructure is often built and maintained by people and householders themselves.

The drainage system in Bogor is lacks integration, meaning that separate parts of the drainage system are not connected (Bappeda, 2017). Increased urban development and land use changes in the upper catchment cause soil erosion and sediment accumulation in the drainage channels which is usually addressed by dredging. Erosion control during construction is currently very limited (Bappeda, 2017). Many of the manmade larger drainage channels in Bogor were originally designed as irrigation channels. Their design as irrigation channels makes their drainage functions less efficient (Bogor City, 2017). Interconnections between the drainage system and the irrigation system effectively reduce the capacity and function of both systems. The dumping of household waste into rivers, drainage channels or vacant land can lead to the blockage of drainage channels which has been directly related to

flood events in Bogor (The Jakarta Post, 2017). Agencies responsible for clearing channels of litter than obstruct drainage are understaffed.

> *Cibinong flooding*
> As Cibinong is further downstream from central Bogor, flooding may occur more frequently. Flood events reported in the recent past include December 2015 (knee deep flooding at Pelapuran Street, Pabuaran *Kelurahan*), March 2016 (Ambar housing complex, in Harapan Jaya *Kelurahan*) and March 2017 (some sections of the streets along Cibinong City).

3.4 Equitable and affordable access to amenity values of water-related assets 2.5 / 5 (Low)

In many cases, people of lower socio-economic status live closer to water assets such as rivers and lakes even though these settlements are mostly illegal as current regulation prohibits housing or development on riverbanks or lakesides. While riverbanks are often difficult to access, *situ* are generally more accessible to the general public and provide important amenity and recreational benefits to a range of citizens in Bogor.

Recently, there is a trend to develop more expensive real estate closer to water assets. While these developments are usually landscaped, show more green space and water features they are exclusively developed as high-value market segment and only affordable for a minority in Bogor.

4. PRODUCTIVITY AND RESOURCES EFFICIENCY

4.1 Benefits across other sectors because of water-related services 1 / 5 (Low)

Water-related benefits for increased property values are somewhat articulated and understood. Besides these commercial cross-sector benefits for the building sector however, other benefits for other sectors are not well recognised or articulated.

4.2 Low GHG emission in water sector 2.5 / 5 (Low)

The topography, in some parts of metropolitan Bogor, allows for a gravity supported water supply and therefore lowers the GHG emissions associated with the supply of water. However, in other parts of metropolitan Bogor energy intensive pumping devices are used to pump water to higher altitude areas, or for groundwater. In general, the concept of lowering GHG emissions in the water sector is of low importance, with limited concern.

While there is no direct measurement and data available of the GHG emissions of the water sector it is important to note that the main energy source in the electricity grid is coal, and renewable energy sources of electricity (hydro, geothermal and

solar) make up a small proportion: less than 10% of Indonesia's electricity production (in Mwh) in 2016 (Ministry of Energy and Mineral Resources, 2017).

4.3 Low end-user potable water demand 5 / 5 (Low)

For Bogor City, the total volume of mains distributed water in 2016 was just over 38,153 ML (38,153,871 m^3). Between 2012 and 2016, the volume of mains water distribution increased 19%. There were 138,705 customers in the household category for PDAM in Bogor City in 2016, for an average supply of 229,000 l/household/year (BPS-Statistics of Bogor City, 2018). This is equivalent to 154 l/person/day for households supplied by PDAM. However, this represents only 53% of households in Bogor City. Demand is uncertain for the remainder of households, but is expected to be significantly lower for households dependent on wells, springs and gallon water. Taken as a whole, it is likely that end-user potable water demand is less than 100 l/person/day.

The guidelines for developing water supply capacity for Bogor City follows the national standard of 240l/person/day. However, the physical losses in the system (e.g. leaking pipes) are high and estimated to be at around 30%. Similarly, the administrative loses (e.g. illegal tapping) are high and estimated at around 20%.

Commercial users such as hotels, which consume large amounts of water, usually use groundwater wells as a backup water supply system to support the reticulated water supply from the grid.

4.4 Water-related economic and commercial opportunities 3 / 5 (Medium)

There are some large-scale and small-scale water related private sector business opportunities across Bogor. Additionally, PDAM is also supplying spring water directly to small scale private water retailers which then fill this water into gallons and sell it in their local communities. Springwater extraction and distribution has relatively long history in Bogor (Kurniawan, 2017). Bottling integrates extraction, packaging and trucking.

On a local scale, different small-scale business opportunities are present. For example, floating fish cages are used widely for fish breeding in different water bodies. Even though there has been some recent restriction on the commercialisation of this practice, it is still widespread in Bogor. Importantly, some business opportunities capitalise on water sensitive business opportunities by offering rainwater tanks for stormwater harvesting or pervious surfaces to assist groundwater infiltration.

4.5 Maximised resource recovery 1.5 / 5 (Medium)

Resource recovery in Bogor is limited to some SANIMAS facilities (i.e. communal septic tanks) and a communal wastewater treatment plant. SANIMAS combines a communal septic tank with a bio-digester. The bio-digester fulfils a pre-treatment function and also produces biogas which can be used as alternative energy for cooking. In 2016 more SANIMAS facilities were being built with the aim of developing 26 across Bogor (Bogor City Government, 2016). Additionally, a small scale privately owned communal wastewater treatment plant is equipped with a bio-digester to

capture emissions of methane from domestic wastewater. This renewable energy source is used for domestic use and in 2014 served 47 households (ICLEI, 2016).

5. ECOLOGICAL HEALTH

5.1 Healthy and biodiverse habitat 2 / 5 (Low)

The topology of Greater Bogor is quite diverse. In this area can be found plain, undulating and hilly areas. The ecological conditions of this region are also diverse, with botanical gardens, urban forests, urban parks, cultivated land for agriculture both wet and dry land, water bodies such as rivers, irrigation channels, or *situ*, and other different ecological conditions evident. Nevertheless, the proportion of green open space is below that required by national law.

Regarding biodiversity, habitats with high biodiversity are scattered across Bogor, patchy and not well connected. This is also the case for biodiversity hotspots in Cibinong for which detailed data has been collected (Nisrina & Arifin 2016). Plant diversity at three *situ* in Cibinong is rated as “Medium”. There are dominant species at the *situ*, such as *Jati putih* (Gmelina arborea) and *jeunjing/sengon* (Falcataria moluccana), but overall the *situ* health is categorised as in good condition. Another urban area with plant diversity and green open space is Sentul City.

The hotspots of biodiversity in Greater Bogor are located in Bogor Botanical Garden, the Safari Park, in urban forest, *situ*, rivers, and many other areas. Bogor Regency is also preparing to build two small ‘urban forests’ in the Cibinong area. The two planned urban forests will be named “Hutan Kota Tegar Beriman” and “Hutan Kota Pondok Rajeg”. Tegar Beriman Urban Forest is planned to be built with an area of 2.7 ha. Meanwhile Pondok Rajeg Urban Forest will have 6 ha of area.

5.2 Surface water quality and flows 1.5 / 5 (Low)

Point source water pollution is somewhat addressed, but this is limited to large-scale industrial polluters. Pollution that comes from small-scale private businesses close to waterbodies is not well managed. For these small-scale polluters, regulation is often not enforced. Similarly, diffuse source pollution, in particular household waste (litter as well as wastewater discharge), is not well managed and is severely impacting the quality of different waterbodies. Storm water runoff pollution is generally not addressed.

Independent water quality testing in major waterways is undertaken two to three times per year. Overall, water quality measurements of the Ciliwung and Cisadane Rivers indicate high pollution levels across various indicators and measuring locations. In particular, biological oxygen demand, sulfate, ammonia and total coliforms are exceeding national recommendations. Water quality measurements at *Situ* Gede and *Situ* Panjang show similar results.

Surface water in the Greater Bogor area is generally contaminated with E. coli from human and animal waste. Both the Bogor City and Regency governments regulate wastewater (including blackwater), wastewater treatment plants (WWTP), as well as water pollution and water conservation. Despite this regulation for the protection of

the environment, there remains relatively high rates of illegal waste disposal to water bodies without treatment.

Some housing clusters within Sentul City are serviced by an integrated WWTP, but it is recommended that all housing clusters be connected to integrated WWTP. Stormwater receives passive treatment via raingardens.

5.3 Groundwater quality and replenishment 2 / 5 (Medium)

Groundwater is a key water source for many citizens in Bogor through wells. Water quality testing of wells across Bogor have shown that the quality of the quality of the well water fluctuates significantly. Most problematic are the pH levels of the groundwater as well as the presence of E. coli (Bogor City, 2011b). A source of groundwater pollution (especially for shallow groundwater aquifers) comes from the poor waste management in the city and due to leakage and percolation from landfills. While some management strategies are in place that will have beneficial effects for groundwater quality (e.g. solid waste management strategies), there are currently no direct actions taken aimed at improving groundwater quality specifically.

Due to land use changes in the upper catchment of the Cilliwung and Cisadane rivers as well as high rates of urbanisation and associated levels of imperviousness the groundwater recharge rates are reducing. As a result, groundwater tables are dropping significantly and in some areas groundwater conservation is critical (Bappeda, 2017). Despite this recognition, domestic, agricultural, non-commercial research and government abstraction of groundwater does not need a permit under provincial law if less than 100m^3 is taken per month or if the pipe is less than a two-inch diameter. While domestic use of groundwater is not subject to a groundwater tax, large scale groundwater users, such as hotels, are subject to regulation with the aim to manage their groundwater abstraction.

Groundwater replenishment in Bogor is supplemented by infiltration wells. This technology is used in some governmental buildings and in some other areas to facilitate stormwater infiltration. A more common technique for facilitating groundwater replenishment is by *biopori*. However, *biopori* are also repositories for organic waste, which has unclear effects on groundwater quality. Figure 5 shows critical groundwater replenishment zones in Bogor City. Areas in red mark sites where groundwater has been blighted, and areas in pink are sites of critical groundwater condition.

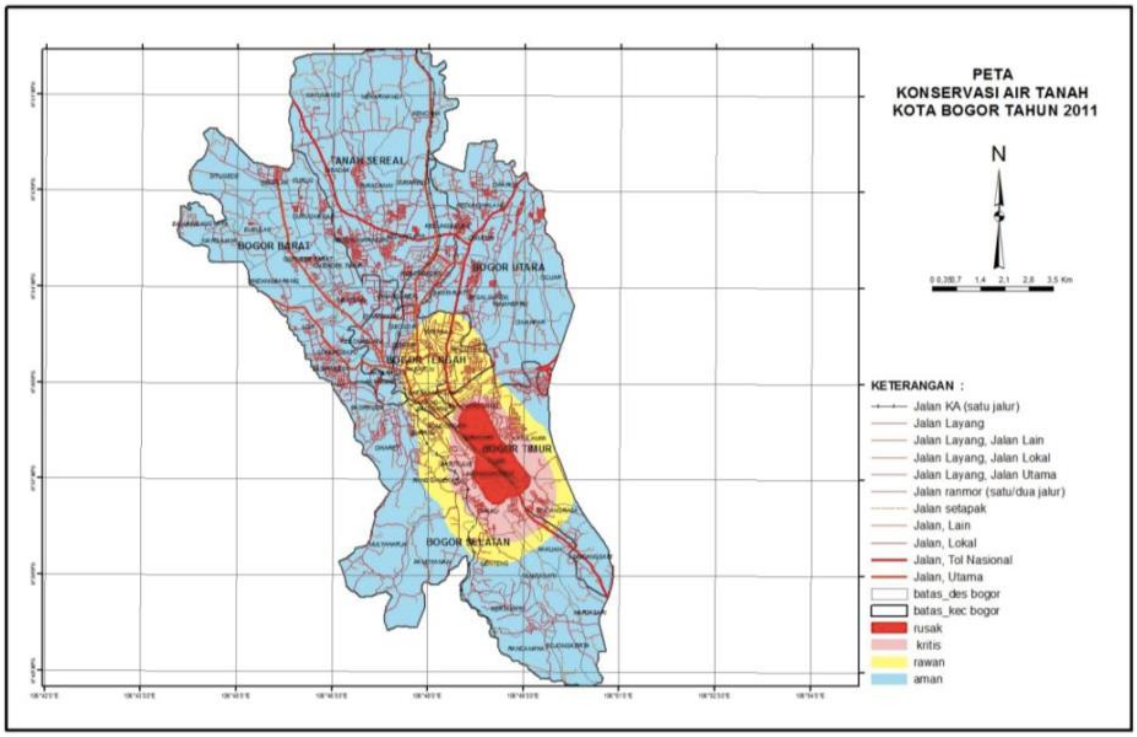


Figure 5. Critical groundwater replenishment zones (Bogor City, 2011a)

5.4 Protect existing areas of high ecological value 3 / 5 (Low)

Bogor has several conservation areas that lie within its urban footprint as well as in the surrounding land. Within its urban footprint an important conservation area is the botanical garden. It fulfils an important role for protecting existing habitat and endemic species. Additionally, it also contains the biggest collection of tropical rainforest species and wet lowland species in the world, and showcases iconic flora such as the famous titan arum, the largest flower in the world. Additionally, the IPB Dramaga Campus and the Forest Forda CIFOR are important conservation zones. On the outskirts of Bogor are different conservation areas such as the nature reserve Arca Domas, Dungus wool, and Yanlapa. Other important conservation areas are: Mount Halimun Salak National Park and Mount Gede National Park.

Policy or local regulations regarding the protection of flora and fauna is present (Bogor District No. 6 of 2016) and is consistent with the list of protected species at national level. Areas of protection are based on species and vulnerability mapping to identify and protect areas of high ecological value. Mapping occurs at the local administrative *Rukun Warga* / *Rukun Tetangga* level and, in combination with existing conservation laws, provides the basis for limiting and restricting development in certain areas.

6. QUALITY URBAN SPACE

6.1 Activating connected pleasant urban green and blue space 2 / 5 (Med)

Bogor is considered the city of public parks and many different parks are scattered throughout the city. Many of these parks, however, are fenced, can be described as 'ornamental' and are designed to be looked at rather than for providing recreation and engagement opportunities. Some blue-green assets such as ponds and wetlands are present, but can be difficult to access and are not well-connected or maintained. Nevertheless, the connection of these parks with each other through 'green networks' is emphasised in Bogor's Mid Term Strategic Plan of 2015 in which the botanical garden plays a significant role. Complementary laws and policies operate at the national, provincial and municipal levels.

The botanical garden is central to the private and public life as well as identity of Bogor and is considered by many as Bogor's most iconic landscape feature with national significance. Due to its central location, the botanical garden also provides an anchor point for Bogor's Walkability Campaign in which Bogor has committed to building 22.5 kilometres of pedestrian and cycle paths by 2020. The first phase of the project has been concluded and the newly built paths around the botanical garden are equipped with tag tiles, bicycle lanes, green areas and are connected with public transport stations and public places of interest. In general, there has been less attention to blue and green open space provision in the outer parts of Greater Bogor more than 5 km from government centres.

6.2 Urban elements functioning as part of the urban water system 2 / 5 (Low)

While Bogor is known for its cooler and more pleasant climate, urban heat island issues are increasingly becoming a problem due to the loss of green space and vegetation coverage. Nevertheless, Bogor still shows an abundance of street trees due to its tropical climate. Moreover, green infrastructure, in particular swales and green walls, have been implemented in isolated high-profile demonstration sites (e.g. Sentul City) to fulfil stormwater water treatment, groundwater infiltration and amenity functions (ICLEI, 2016).

Drainage in Greater Bogor is still largely patterned on the irrigation system from which it has been adapted. With rapid land conversion to urban uses, there has generally been little attention to how urban elements can be integrated into the drainage system. However, drainage masterplans are being prepared to progress integration.

6.3 Vegetation coverage 2 / 5 (Low)

The amount of green open space in Bogor City is currently at 11% which includes the botanical garden. The national law number 26/2007 stipulates that cities should have at least 30% green and blue open space (which includes blue & green space as well as public and private space). Vegetation coverage in Bogor is believed to be higher than 11% due to the abundance of street trees particularly outside Bogor City itself. However, this has not been quantified. Nevertheless, analysis of land use change in Cibinong region between 2005 and 2017 indicates that rural land is being converted to urban use (Fajrianti et al., 2017).

7. ADAPTIVE INFRASTRUCTURE

7.1 Diverse fit-for-purpose water supply system 3 / 5 (High)

While there is a single centralised supply system which is operated and administered by the local water management organisations (PDAM) most people in Bogor rely on multiple water sources for their daily water needs. Groundwater, surface water and bottled water are used by many for different purposes to fulfil a variety of daily water related needs (e.g. river water for washing, bottled water for drinking, etc.). However, some of these sources are not safe and sometimes not reliable. This source-diversity is partly due to the low connection rates to PDAM reticulated water supplies as well as the colonial legacy of water services provision and infrastructure development – a privilege that was not equally available to all parts of society.

7.2 Multi-functional water system infrastructure 2.5 / 5 (Medium)

Some multi-purpose water system infrastructure exists in Bogor but there are no policies or strategic management approaches in place that support this multi-functionality. In particular, *situ* fulfil different functions such as flood retention, irrigation reservoirs or recreation and are accessible to the general public. New high-profile developments, such as the Cibinong Situ Front City or Sentul City have started to capitalise on the opportunities that *situ* provide and have begun to realise their potential through a deliberate urban design and water management approach.

7.3 Integration and intelligent control 2 / 5 (Low)

Bogor's river level monitoring systems assess water levels in Bogor and Katulampa which serve as an early warning system for flooding in Jakarta. While these systems support disaster-related decision making, they are not fully integrated yet and are limited to flood disasters. Early warning and flood monitoring systems also rely on private individuals and social media tools as means of collective monitoring, information sharing and rapid people-to-people communication in different parts of the system.

7.4 Robust infrastructures 2 / 5 (Low)

The elevation differences of Bogor require high water pressures and strong pump performance in different parts of the system which necessitates a comprehensive maintenance regime. Failure rates and non-revenue water due to physical (e.g. leakage) as well as administrative losses (e.g. illegal tapping) are considered high. Moreover, the repurposing of the irrigation system for drainage purposes creates drainage inefficiencies and infrastructure problems.

7.5 Infrastructure and ownership at multiple scales 3 / 5 (Low)

While the reticulated water supply network is owned and operated by centralised supply authorities (PDAM), many individual households as well as large scale water users (e.g. hotels) have their own, on-site supply system (i.e. wells). Similarly, wastewater treatment infrastructure such as on-site or off-site septic tanks are owned and operated by the individual householders. This is also the case for small-scale drainage infrastructure at the household level which is also often constructed and

maintained by private householders or the community. While this points to a high number of decentralised infrastructure solutions, there is little integration between these systems or a planned and deliberate approach to integrate these systems with a centralised network.

7.6 Adequate maintenance 2 / 5 (Low)

Some of Bogor's water system services infrastructure is old and does not receive the maintenance and care it requires. While immediate needs of ageing infrastructure and imminent failures are usually addressed, the maintenance approach can be described as reactive and constrained by a lack of funding. Constructing new infrastructure receives more political attention and capital investment than maintaining existing infrastructure. Maintenance guidelines are not widely available and the repurposing of old irrigation infrastructure for drainage services has led to systemic failures and unclear maintenance responsibilities. At the individual household level, the maintenance of septic tanks is often inadequate and septic tank maintenance is not coordinated or supported by authorities.

Chapter 5

Discussion & Conclusion

DISCUSSION & CONCLUSION

Water Sensitive City Index assessment creates an opportunity to reflect on the strengths and weaknesses of the city's water system to identify opportunities for improvement and areas of common concern with other cities.

The results of WSC Index assessment for Greater Bogor indicate that the averaged performance of goals is relatively even. The average scores of the seven goals were in the range of 2.0 to 2.7 out of 5. *Ensure quality open space,* which scored 2 out of 5, appears to have been a particular concern for benchmarking participants with respect to meeting the criteria of a WSC. However, consistently low scores from WSC Index benchmarking of a number of Australian cities of varying sizes and geographies in *Ensure quality open space* speaks to the difficulty of achieving scores closer to 3 than 2 in the goal's three indicators. Another goal where performance appears to lag is in *Improve ecological health* (2.1 out of 5). A lack of habitat connectivity and insufficient action to address wastewater prior to discharge to the environment appear to be important management issues to be addressed.

WSC Index indicators that have been given moderate to higher scores may still require policy attention. Policy designed to address deficiencies in some Index indicators can lead to beneficial outcomes in other indicators due to interdependencies between them. Indicators in the *Ensure good water sensitive governance* goal are examples where attention to lifting performance can achieve flow-on benefits in other indicators. There are strong links, for example, between governance indicators and the *Increase community capital* and *Ensure quality open space* goals.

Some indicators may have been given low scores because to date there has been negligible consideration of the outcome in formal policy-making. The following indicators are highlighted to draw attention to opportunities for new government action with the potential to improve the WSC Index results in the short-term:

Benefits across other sectors because of water-related services (1 / 5)

Water resourcing and funding to deliver broad societal value (2 / 5)

Water is key element in city planning and design (2 / 5)

As well as informing prioritisation for short to medium-term management actions, the WSC Index results can support long-term transition planning and help measure progress over time. It can act as a framework for incorporating assessment of uncertainty in decision-making and tracking the accumulation of the evidence base for decisions. For Bogor, the confidence level for many of the indicator scores is Low, with a lack of data to support high-confidence indicator assessments. In repeated WSC Index assessments, as more information is used to support indicator scoring, it can be expected that better evidence is available to formulate appropriate policy responses to address systemic challenges.

As the first attempt to apply the WSC Index to an Indonesia city, there are lessons that can be gleaned for similar cities as well as for the WSC Index itself. The revision of indicator 2.5 to focus on "local wisdom" as opposed to "indigenous involvement"

was considered necessary for Bogor given the long history of co-occupation of Java by the Sundanese and Javanese cultures and balanced representation in government. This is not a wholly satisfactory revision as there is potential for overlap by considering local knowledge in 1.1 *Knowledge, skills and organisational capacity* or 2.1 *Water literacy*. It is possible that the original application of indicator 2.5 may be more appropriate on other islands. This requires further testing.

Applying the WSC Index to other cities in Indonesia would also produce useful insights. However, the challenge for those scoring may be in interpreting the seemingly sharp differences in criteria for a score of 1 and a score of 2. The Bogor case suggests that additional time may be needed to build confidence amongst local stakeholders in the WSC Index methodology to develop acceptance of low scores. This is especially the case when several criteria at the lower end of the scale are perceived as not capturing the more nuanced experience of water management in the subject city. However, WSC Index assessment is typically desired in a shorter timeframe than was conducted for the Bogor case.

For stakeholders in Bogor, the application of the WSC Index has been beneficial for applying a system-oriented lens to water management. In a planning environment that has typically emphasised technical approaches, the balanced approach to social and ecological systems has opened up new possibilities for transformation. These are explored in richer detail in other outputs of the Australia Indonesia Centre Urban Water Cluster. In terms of performance benchmarking, it is recommended that this work form the basis for shaping an ongoing approach to system evaluation.

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