Mark and Focus

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INEQUALITY OF CLIMATE CHANGE

NATURAL WATER POLICY IN NEW ZEALAND

INDUSTRIAL WATERSHED

BUDAPEST WATERWORKS: FUTURE WATER UTILITY

Urban Water Security

Robert C. Brears

Challenges in Water Management

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Mark and Focus

Mark and Focus covers both the risks and opportunities the world's mega-trends provide.

INTRODUCTION

In the 21st Century, the world faces a wide array of mega-trends including climate change and rapid population and economic growth. With resources becoming scarce global economic and social stability is threatened.

Mark and Focus covers both the risks and opportunities these mega-trends provide to business, governance, and society.

CONTACT ME

LINKEDIN : Robert Brears
TWITTER : @Markandfocus
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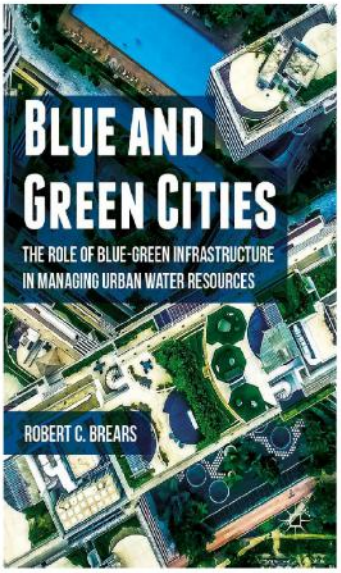

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R. Brears

Blue and Green Cities

The Role of Blue-Green Infrastructure in Managing Urban Water Resources

- Explores the need for alternatives to grey, "build-bigger-pipes" water management strategies
- Considers the role of blue-green infrastructure in managing water resources in an increasingly urbanised world
- Illustrates how different cities have implemented green and blue infrastructure policies

This book offers new research on urban policy innovations that promote the application of blue-green infrastructure in managing water resources sustainably. The author argues that urban water managers have traditionally relied on grey infrastructural solutions to mitigate risks with numerous economic and environmental consequences. Brears explores the role urban water managers have in implementing blue-green infrastructure to reduce ecological damage and mitigate risk. The case studies in this book illustrate how cities, of differing climates, lifestyles and income-levels, have implemented policy innovations that promote the application of blue-green infrastructure in managing water, wastewater and stormwater sustainably to reduce environmental degradation and enhance resilience to climate change. This new research on urban policy innovations that promote the application of blue-green infrastructure in managing water resources sustainably will be of interest to those working on water conservation and policy. Robert C. Brears is the founder of Mitidaption, Mark and Focus, and is Director on the International Board of the Indo Global Chamber of Commerce, Industries and Agriculture. He is the author of *Urban Water Security* (2016).

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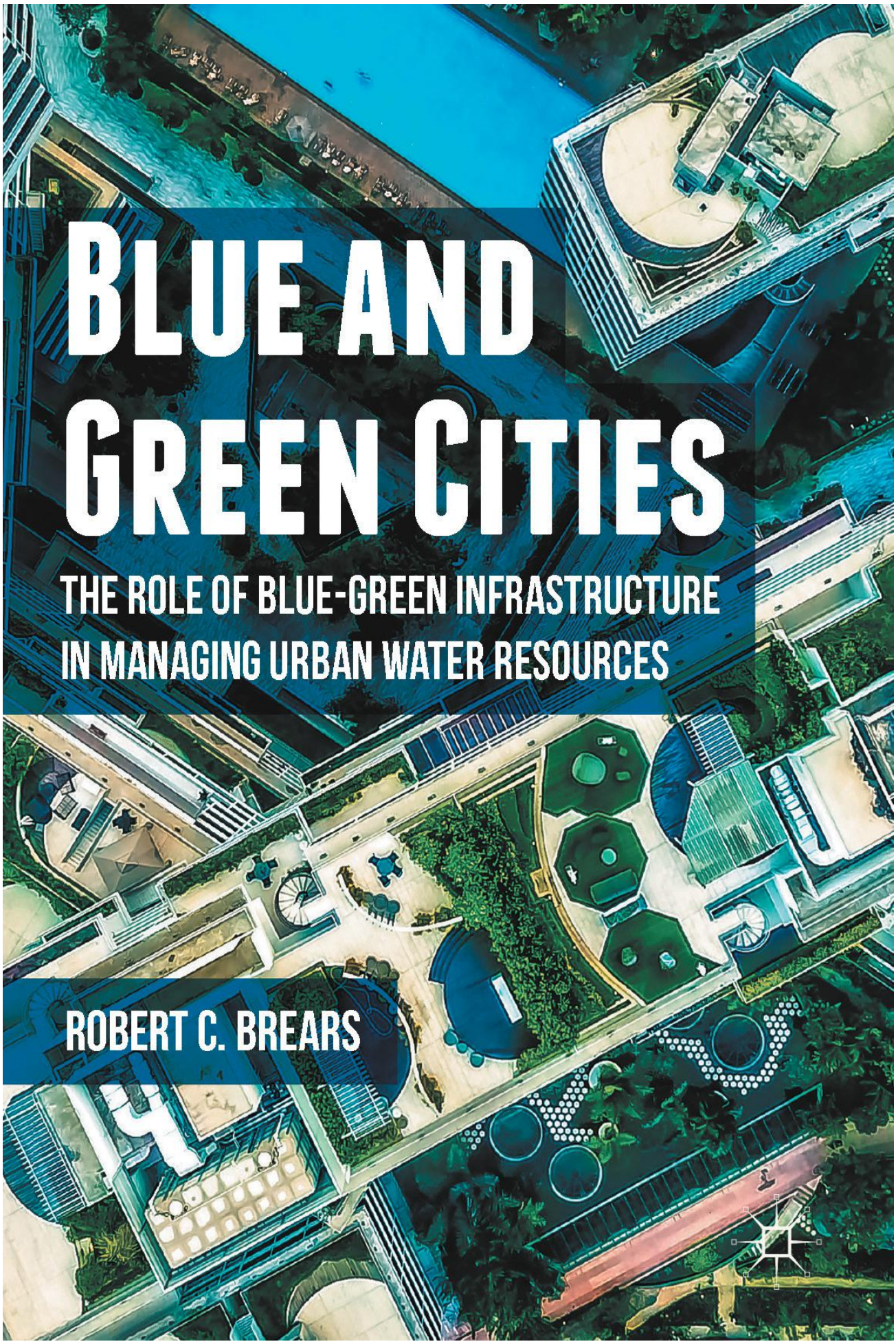
BLUE AND
GREEN CITIES
THE ROLE OF BLUE-GREEN INFRASTRUCTURE
IN MANAGING URBAN WATER RESOURCES
ROBERT C. BREARS

INEQUALITY OF CLIMATE CHANGE

By Tara Rava Zolnikov, Ph.D., MS, MS

Climate change is the result of greenhouse gases. Greenhouse gases are a mixture of water vapor, carbon dioxide, methane, nitrous oxide, fluorinated gases, and ozone. These emissions—and climate change, in general—are primarily the result of human activity and thus, becomes exacerbated by economic and population growth (IPCC, 2014).

There are many consequences resulting from greenhouse gases, aptly known as climate change. The most significant effects from climate change to human populations is the increase of natural disasters, specifically hurricane, cycles, droughts, and floods. Stronger hurricanes and severe heat waves are not only destructive to the ecosystem (e.g. life cycle changes due to disrupted conditions) but are life-threatening to everything in the path of these disasters (Environmental Protection Agency [EPA], 2016; Zolnikov, 2018b). Through these drastic weather patterns that upend normal life, humans and animals become affected because they rely on this biodiversity to exist (e.g. food, shelter, etc.) (Zolnikov, 2018b).

Natural disasters are not the only negative outcomes related to climate change. Other effects include increased adverse health outcomes, affected crop or agriculture output, marine life, and coral reef destruction, affected jobs and industry, decreased resource availability, and more. While many people will be affected, the focus of this article is to highlight the inequality of climate change and how the effects will overwhelm certain populations more than others. While many people have and will continue to suffer from the effects of climate change—especially those living in coastal regions, highlands, or drought-stricken areas - there is a subset of eople within this affected population that will be suffer even greater consequences.

Populations in low- and middle-income countries will experience disproportionate outcomes due to climate change. Effects will be magnified and affect urbanization, land use (e.g. habitable, farming, etc.), freshwater resources, access to healthcare, and more (Haines, 2006).

INEQUALITY OF CLIMATE CHANGE

Some reasons populations living in low- and middle-income countries have worse outcomes are due to:

- Poor access to weather prediction technology and information
- The inability to move away from harm to safer areas (e.g. suggested evacuation procedures and routes)
- Inadequate access to resources (e.g. governmental support)
- Low humanitarian aid and relief (e.g. quality water, shelter, food)
- Poor knowledge on how to reduce risks and increase opportunities
- Inability to pay for adaptation strategies (e.g. air conditioning)
- Lack of supportive policy or involvement of sectors to decrease public health effects

Change is needed and warranted in situations like this, but unfortunately, are not always obtainable. The capacity to adapt and change is linked to both social and economic development (e.g. natural and man-made economic drivers, social networks, human capital, governance, national income, health, technological abilities, etc.), wherein impoverished countries may not be sufficiently equipped and thus, may not be able to mitigate or adapt to changes (IPCC, 2007). This is in opposition to wealthier countries that are better governed or able to create policies—or a subset of legal standards, rules, or regulations—specific to climate change to encourage people to adapt to climate change. The lack of government support through policy or resources proposes an uneven distribution of adaption measures to climate change across the world (IPCC, 2007).

This can result in greater negative effects experienced by these vulnerable populations. Solutions must surface in order to relieve these up-and-coming damaging outcomes that will affect millions of people. Ideas should revolve around the need for climate change-focused policy and institutional framework, infrastructure investment and improvement, increased mitigation and adaptation strategies, diversification of industry, technology innovation (United Nations [UN], 2017). Long-term solutions, however, need to be created and implemented on a worldwide platform; these techniques can include an overall decrease of greenhouse gases through efforts such as clean cookstoves, renewable energy, electric cars, and more. Together, these strategies can provide relief and even encourage productivity in populations that are and will continue to be exposed to outcomes related to climate change.

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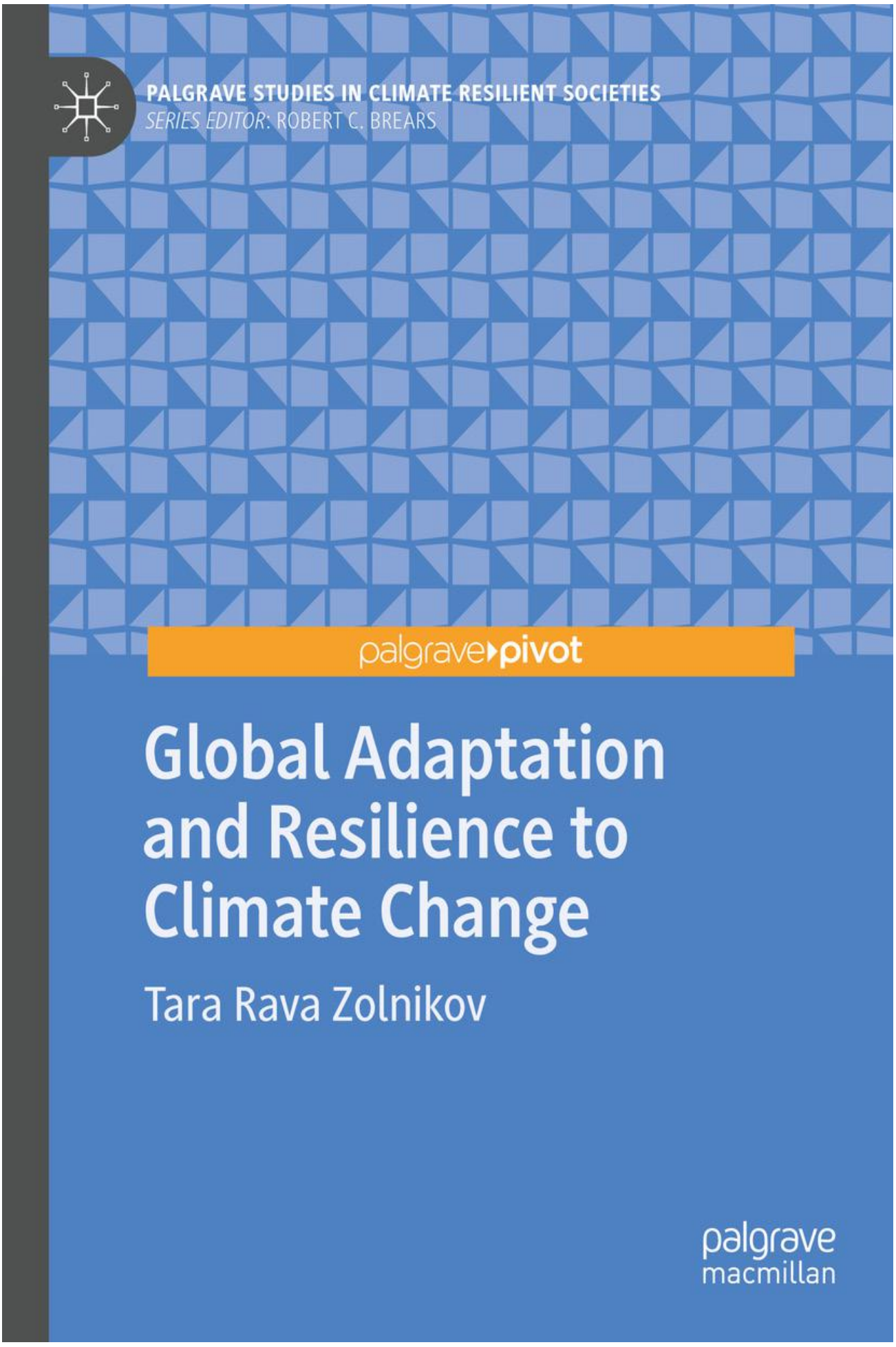
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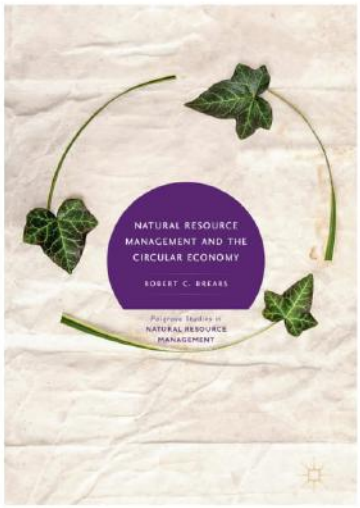

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Robert C. Brears

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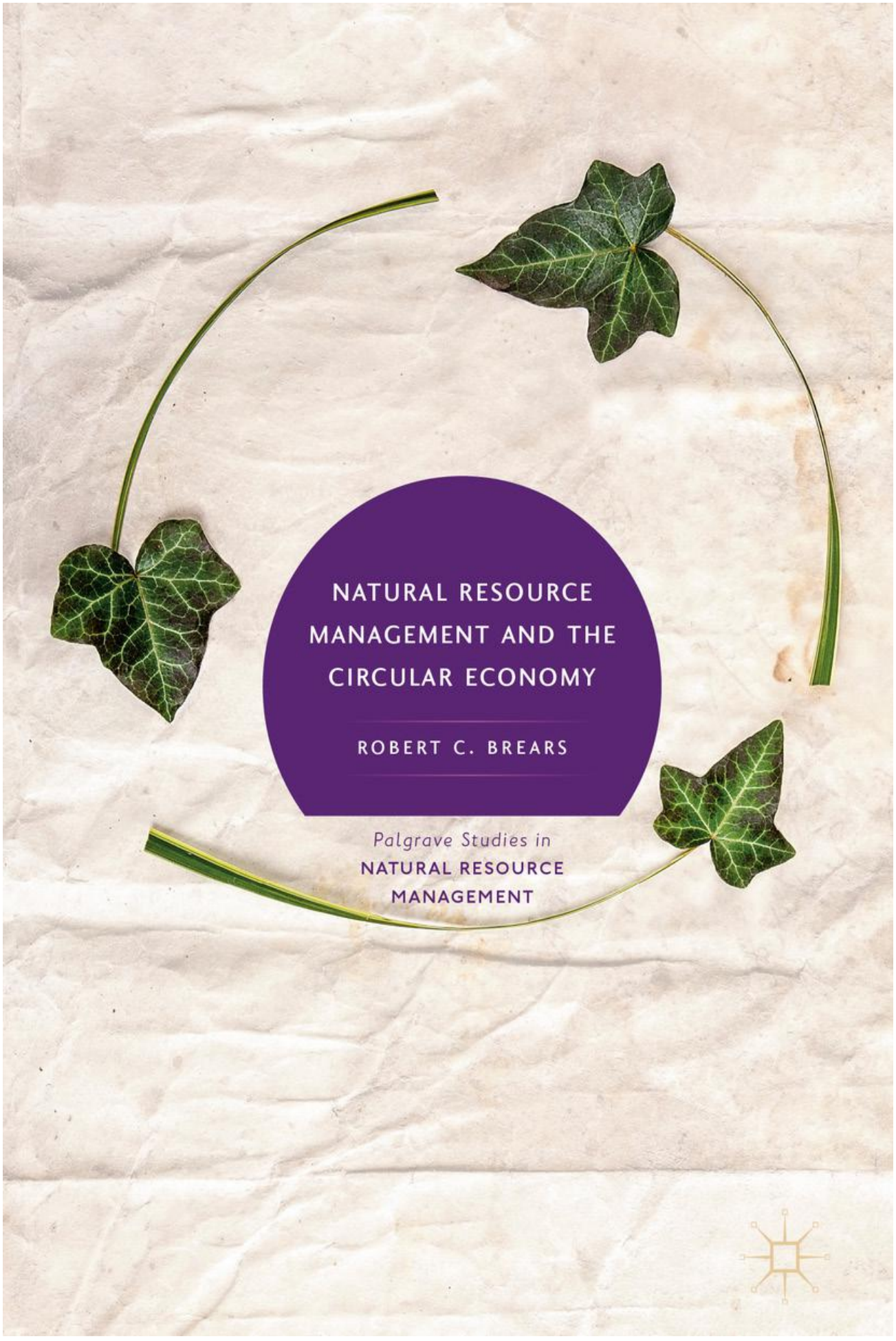
NATURAL RESOURCE MANAGEMENT AND THE CIRCULAR ECONOMY
ROBERT C. BREARS
Palgrave Studies in
NATURAL RESOURCE MANAGEMENT

NATURAL WATER POLICY IN NEW ZEALAND

Dr. Alexander Kouzminov

"Water is a God-given gift", - Winston Peters, New Zealand Acting Prime Minister.

Should we accept that our blue gold is underestimated? Do we really need a policy for our natural mineral waters? Can their benefit for state economy be more substantial?

Our Blue Gold Resource

Most of the natural mineral waters in New Zealand originate in magma chambers, which exist miles under the Earth's surface and were formed by geological processes hundreds of millions of years ago, during the pre-Ice era. Some of these waters are up to 50,000 years old. They have been recognized for the healing properties by Maori and the first European settlers in this country many years ago. There are about 180 hot-baths and health resorts that have been developed around naturally occurring mineral springs in New Zealand – springs which are commercially and non-commercially operated. These range from luxury mineral spas, bubbling mud and soda pools, to natural lakeside pools and historic bathhouses. Many minor springs are located across the country. Of these 180 thermal spas in New Zealand, about 50 are of national importance.

The national groundwater resource is valued at NZ$8 billion and provides 35% of the nation's consumptive water use.[1]

Most of them are unique, naturally-occurring thermal resorts with their own mineral water resources and their waters contain varied and unique concentrations of minerals and trace elements of therapeutic value that cannot be artificially replicated by conventional methods. These resources have the potential for greater development, so as to attract local, interstate, and overseas visitors.

Natural Mineral Springs as One of the Major Contributors to State Economy

New Zealand is the best holiday spot in the world, according to Britain's Daily Telegraph newspaper.[2] The tourism industry is believed to be on track to continue its position as one of

NATURAL WATER POLICY IN NEW ZEALAND

New Zealand's biggest export sectors, according to the Tourism Industry Association.[3]

Mineral water obtained from natural springs has long been an important commercial proposition.

Our clean and healthy waterbodies are vital to the growth and sustainability of New Zealand's $36 billion tourism industry, which is projected to increase annual turnover to $41 billion by 2025.[4], [5]

Tourism is now New Zealand's largest export industry in terms of foreign exchange earnings. International arrivals to New Zealand normally double approximately every 10 years to reach about 5 million by 2024 as forecasted.[6]

Between the top 30 nature-based activities undertaken by international tourists, mineral water hot-pool attractions are the sixth most popular activity among other top-attractions with about 380,000 (or 17% participation) visitors annually after 'beaches' (860,000 visitors, or 39%), 'scenic boat cruise' (555,000, 25%), 'geothermal attractions' 500,000, 23%), 'lakes' (460,000, 21%), and 'scenic drive' (445,000, 20%) primary attractions for international tourists.

Where water impounds as hot pools, it too becomes a source of domestic tourism activity ranked the third with about 980,000 visitors (or 2.3% participation) behind 'beaches' (3.3 million, 7.5%) and 'fishing' (1.5 million, 3.5%) primary activities, making them one of the major contributions to ecosystem functions of domestic visitors attraction.[7]

Water Policy

The bath-health capital of our natural waters has not yet been properly recognized. A strong evidence of this is that among today's research studies on health effects of these springs there is not even one substantial scientific investigation, which would investigate therapeutic effects of our blue gold.

Without this scientifically-evidence based analysis New Zealand businesses cannot promote their unique brands (e.g. water services, water products, hot-bath health services, etc.) legitimately with no violation of some laws such as e.g. the Consumer Guarantees Act 1993, Fair Trading Act 1986, and other related Acts.

This country does not have a bath culture like Japan, Europe, or even like our neighbor Australia, where hot spring therapy is part of routine medical and therapeutic care and is also a serious business. These gaps preclude further development of a national hot-bath thermal health industry, mineral drinking bottled-water industry, and consequently related economic investment in New Zealand as an international destination for top-quality geothermal health services.

New Zealand water has been indicated in international publications e.g. The Economist, The Wall Street Journal, Al Jazeera, and The Guardian as degrading which contradict with New Zealand's overseas green and clean image.[8] This international coverage may severely lessen/put down/undermine New Zealand reputation internationally.

Currently, aquifers – underground water sources – are not adequately recognized or protected by national water policy documents (e.g. Resource Management Act 1991). The current national water policy does not properly include (or do not include at all) a greater focus on natural mineral waters, mineral drinking bottled-water, hot-bath health services, balneotherapy[9], etc. Moreover, there is no policy (e.g. standards, guidelines, regulations) to use natural mineral water for human consumption in New Zealand.

Balneology which is the scientific study of the therapeutic benefits of naturally occurring mineral waters has lost value in the eyes of the country's national tourism and health programmes.

It fell out of the attention of state organizations regulating the use of natural resources to improve the country's economic development and create health programs for the public. Investments in this sector are minimal.

None of the existing New Zealand water policies for groundwater e.g. the 'National protocol for state of the environment groundwater sampling in New Zealand' (Ministry for the Environment, 2006) and 'Guidelines for Drinking-water Quality Management for New Zealand' (Ministry of Health, 2013), include policy (e.g. standards, guidelines, strategy and regulatory settings) for natural mineral waters and geothermally influenced springs and their health impacts, their use for human consumption, mineral water treatment, hydro-thermotherapy etc.

Recently (2017), the New Zealand Green Party has proposed the Resource Management (Clean Groundwater) Amendment Bill[10] as section 6 of the Resource Management Act 1991 to make the protection of water quality and quantity in aquifers and groundwater systems a matter of 'national importance'.

The Bill specifies that "protecting groundwater quality […] in our aquifers is important […] for public health", and also indicates that "the Resource Management Act 1991 omits any specific reference to aquifers or groundwater".

The Bill also proposes other amendments to protect aquifers and groundwater systems. This is a good start for further developing of national policy for natural mineral waters. This is a strong perception of geothermal water potential and its management in New Zealand, with the recent national healthy groundwater resource strategy highlighting the natural environment and aspects of sustainability.

We also do not have our own regulations for bottled water. We do have a microbiological quality compliance criterion for bottled water sold in retail stores, the Ministry of Health's Microbiological Reference Criteria for Food (the water is also defined as 'food') which came into being in 1995, and the Australia-New Zealand Food Standards Code 2002 for bottled water manufacturers.

In New Zealand, we have adopted international quality standards for bottled water, such as the World Health Organisation/ Food and Agriculture Organization CODEX Alimentarius regulations for natural mineral waters, and the standards for bottled/ packaged drinking water jointly developed by WHO and UN's Food and Agriculture Organisation.

Standards for municipal tap water do exist in New Zealand but using them for bottled water products is not a correct procedure.[11]

Summary and Conclusions

The therapeutic value of natural mineral source waters has not yet received serious attention from the authorities which regulate natural resources in the country.

This sector – hot-bath spa culture has a good capacity to grow with no ecological limits, and mineral springs' health tourism can become a serious business in New Zealand. We need to use the natural mineral water resources effectively to explore their value in a full capacity.

There should be quite thorough research into the therapeutic effects of New Zealand's natural water springs, so the water-processing and tourism industries could have the solid scientific grounding to enhance New Zealand as an international destination for top-quality bottled-water brands and hot-bath health services and economic investment.

The control – namely a full-utilization of natural mineral waters potential capacity – requires input from a wide range of organizations: central, regional and local government; water, health and tourism industries; and the research community.

The country needs its own policy (e.g. standards, guidelines, strategy, and regulatory settings) for drinking bottled-water products, natural mineral water for human consumption, and related services because current water regulations do not work properly. Healthy natural mineral waters may become one of the state economy's major resource inputs in New Zealand.

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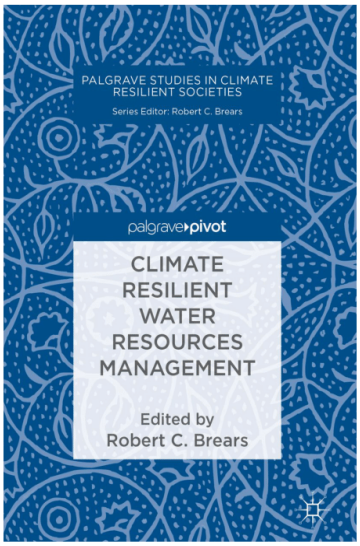

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Robert C. Brears (Ed.)

Climate Resilient Water Resources Management

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- **Discusses how governments can implement climate resilience strategies whilst protecting the natural system**
- **Argues for adaptable climate resilient water resources management**
- **Lays out the effects climate change has had on water quantity and quality**

The effects of climate change are beginning to impact water quantity and water quality across the globe. However, there is no single action or strategy that any government can implement to ensure a community is resilient to climate change-related extreme weather events while also protecting the natural system. Instead, Robert Brears argues, climate resilient water resources management requires integrated, forward-thinking policies that are not only adaptable to changing climatic conditions but also seek to maximise economic and social welfare in an equitable manner while ensuring the continued health of their ecosystems. This book addresses how several levels of government in different geographical locations, with varying climates, incomes, and lifestyles, have implemented a variety of policies and technologies to ensure communities are resilient to climatic risks, and how these policies preserve and enhance the natural system and its associated ecosystem's health.

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BUDAPEST WATERWORKS: FUTURE WATER UTILITY

By Attila Csirkes (Operations Center), Andrea Oláh ((Solar panels and Heat pump innovation expert), Csaba Burány (Information &Technology Department), Viktor Görög (Security Department), László Szabó (Industrial Security Department), Bernadett Lemaire (Operational Engineer at Budapest Central WWTP), László Váci (Wastewater Technology expert), Evelin Madzin (Network engineer, NRW expert), Patrik Balla (Water metering expert), Tamás Nika (water metering expert), Pál Bartók (Operations engineer), David Válko (Water Sales Department), Bernadette Kellermayer (Customer Service and Metering Management), and Tamás Bencze (International Business Development Directorate).

With Budapest Waterworks being recognized as one of the world's leading water utilities, Robert Brears asked the utility a series of questions on how it is transforming itself into a Future Water Utility. The following article was provided.

Background

In terms of size and level of services, the Budapest Waterworks is one of the leading water utility providers in the Central European region. Over the past centuries, the Company has paid attention to using the latest technologies and equipment during its activities. The first waterworks of Pest was already in operation in the year of the Company's foundation in 1868 and a few decades later, in 1904 Budapest Waterworks commissioned the most modern pump house of contemporary Europe. In 1980 Hungary's biggest water reservoir of 80,000 cubic meters was built in the belly of Gellért Hill towering over the River Danube which divides the city; while eighteen years later, the world's sole asymmetrical water tower opened. In addition to potable water supply, Budapest Waterworks also operates the Central Sewage Treatment Plant in Budapest with a daily capacity of 350,000 cubic meters, which is one of the most modern sewage treatment facilities of Central Europe.

Global outlook

The Company has made use of its almost 150-years-experience and expertise in over a dozen countries in the past decades. In the recent weeks, one of its major projects in Sri Lanka has reached a new milestone: The Company successfully completed the reconstruction - together with one year technical assistance - of two water treatment plants that partly provides drinking water supply for Colombo, the biggest city of Sri Lanka. In addition to upgrading the facilities, they also increased the daily capacity of the Kalatuwawa Water Treatment Plant from 71,000 cubic meters/per day to 90,000 cubic meters/per day and the capacity of the Labugama Water Treatment Plant from 40,000 cubic meters/per day to 60,000 cubic meters/per day.

But Sri Lanka is not the only Asian country where the Waterworks of Budapest has taken an important role in water supply: they are building 34 small water treatment plants in Indonesia in a total value of USD$36 million, they carried out an efficiency-improving audit for the Shanghai Waterworks Fengxian Water Company in China as well. One of the subsidiaries of the company is working on the design of a waste water treatment plant in the Far East. They have also entered into water cooperation agreements with several European and Asian countries, including Turkey, Azerbaijan, and Serbia.

Gold Standard water utility

Although in terms of size Budapest Waterworks may appear a small company by world standards, it is an internationally recognized firm. In April 2017, the Global Water Summit in Madrid honored the Company with a Gold Standard for Utility Performance Prize and conferred on it the Member of the Leading Utilities of the World Network title. With this distinction, the Company has gained access to the league of barely a dozen prominent and internationally recognized water utilities including Washington D.C.'s District of Columbia Water and Sewer Authority (DC Water), Amsterdam's Waternet, Public Utilities Board Singapore, K-Water Korea, Western Australia's Water Corporation, Waterworks Bureau of the City of Kitakyushu in Japan, Los Angeles County Waterworks Districts, VCS Denmark, Atlanta Watershed, and South East Water in Australia.

What priority areas is Budapest Waterworks emphasizing when 'exporting' its knowledge to other operators globally?

Budapest Waterworks handles a more than 5,000-kilometer-long potable water network, with two potable water treatment plants and seven different wastewater treatment plants supported by world-class technologies. The design and construction knowledge resting on operation experiences, and the extensive practice gained in this field, are indispensable for the company to develop and operate the sizeable water utility assets they manage, that is the water supply system itself, in the long-term satisfying the highest expectations, and to reconstruct them to meet the expected level of efficiency.

Tailored-made solutions

Our Company not only designs and partly implements its own projects with its own capacities and with the involvement of subcontractors but also accepts more and more external project orders in this line all over the world. The basis of our philosophy is that "tailor-made" solutions, adjusted to the given locations, considering the local conditions, can be optimal. We are not obligated (and committed) to any technology suppliers, so we can provide, without hidden constraints, services of a good price and value ratio to our Partners. Our goal is to improve our partners' operational-supply security, economic efficiency and thus their revenues and the number of satisfied customers by recommending and handing over the most state-of-the-art technology and company management solutions. The key competencies of our company on offer to our clients are: Planning, Design and Construction; Operations and Maintenance Services; Business Consulting Services; and Engineering Services.

With a low non-revenue water rate of 14%, how is Budapest Waterworks is lowering it further?

Managing water loss in water supply system of Budapest is a complex and determinative task for several departments of the company. The problem of losses deserves attention and appropriate actions to have reduce avoidable stress on our valuable water resources. We have applied well known and less known solutions and instruments, and we have developed and implemented several new solutions (technical, economic, service and administrative), to manage losses. Our strategies have resulted in achieved optimum efficiency, decreased source extraction, and optimized system operation and energy usage.

Loss management at Budapest Waterworks – physical losses

There are many ways to decrease non revenue water (NRW). In order to reduce the physical losses – such as hidden losses – our active leakage activity began in 1986. The number of staff supporting this activity and the tools used have been constantly increasing.

Figure 1. shows the leak detection methods and instruments for leak detection (Active Leakage Control (ALC) activity) of Budapest Waterworks. During leak detection, the first step is monitoring the network with minimum night-flow measuring and/or with district metered areas (DMA). Thus, the place of the leakage can be determined in advance. The second step is to prelocate with leak noise loggers and/or contact microphones. Thus, the faulty line section will be highlighted. And finally the third and the last step is to pinpoint the location of the fault.

This could happen with the use of correlation and/or ground microphone.

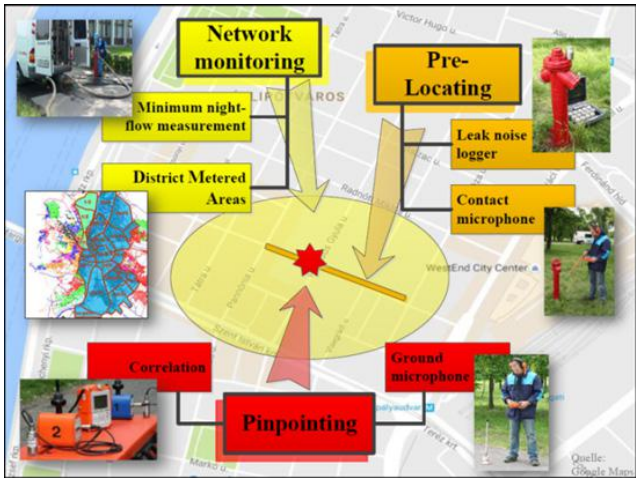


Figure 1. Leak detection methods and instruments

Now our Company is focusing on an integrated – pressure management and DMA – system. In this case, these two methods will be used simultaneously. During the Network Management project, we are installing measuring tools that can be used to measure the water and pressure conditions of a given area, from which it is possible to reduce the amount of hidden losses (Figure 2). With the help of targeted ALC activity, more punctual measurements and manageable water distribution can be achieved, making our DMA system simultaneously cutting edge and cost-effective.

The operation of the DMA system requires strong, safe, and robust IT background and connections. The structure of the water distribution is based on a SCADA system and DMA network; therefore, Budapest Waterworks can manage the supervision of about 120 separated zones. Several special reports and dashboards support the control of consumption trends of each area. These reports can help the ALC activity.

Figure 2. Measuring the water and pressure conditions of a given area

Loss management at Budapest Waterworks – Commercial losses

To reduce the value of NRW, we also deal with commercial losses parallel with the physical losses. From a commercial point of view, significant errors are caused by unbilled metered and unmetered consumptions, unauthorized consumptions, customer meter inaccuracies, and data handling errors. To decrease the unbilled authorized consumption, the accurate and up-to-date database of customers and the use of water meters are a basic requirement. In 2005 a customer inventory was performed.

From the commercial point of view, there are various significant impacts of unauthorized consumptions. Illegal use of public utilities is the unmeasured taking of water from the service connection or the distribution mains, for example, the formulation, by-pass of the water meter, intentional damage, manipulation of the water meter, and illegal water supply on fire hydrants. Our company has set up a separate group to establish processes that can represent the interests of our company in litigation

procedures. This acts in the favor of eliminating irregularity, minimizing commercial losses, and recovering the costs of the procedure. The launching of the detection is based on customer inventory application, user reporting, and information flow within the company.

The use of fire hydrants in our service areas is limited by the application of an established concept. Knowing the purpose, possibilities, and the exact conditions of water use, we can determine the best technical option which can provide the optimum solution that brings to the fore the economic efficiency, water consumption measurement, and controllability. The loss due to the measurement error of the water meters on the network is significant in terms of commercial loss. The problem stems from the wear and tear of water meters, the higher rate of measurement error, the worse and continuously deteriorating starting sensitivity, or the flat billing. To ensure reliable measurement of the amount of water consumed on our network, the accuracy of our delivered and dismounted water meters is continuously monitored.

Our company has developed a water measurement strategy which determines where and when is it necessary to change the water meter based on consumption and economic aspects (taking into account the existing regulations). Depending on the nature of the use of water, it is necessary to define the technical parameters of the water meter that are justified for accurate water consumption measurement.

Budapest Waterworks has collected long-term experience concerning reduction of water losses. It means, that it is a not a plug&play method that can be applied to all kinds of circumstances. Thorough engineering, preparation, planning, and realization are needed to reach the most economical solution that can be executed in the given conditions.

What efficiency improvements are being made in the providing of water and wastewater services?
Several energy efficiency-improving projects have been implemented in Budapest Waterworks' life. Beside assuring high-quality service we take seriously focusing on the use of renewable energies thus reducing impacts on the environment. We're going to introduce shortly the innovations already implemented or under implementation which serve this purpose: Micro hydroelectric station at the Central Wastewater Treatment Plant (CWWTP); Exploitation of solar energy; Heat pump with uniquely designed heat exchanger; and Energy saving possibilities in operations.

Micro hydroelectric station installed in the CWWTP of Budapest Waterworks
The micro hydroelectric station placed in the effluent channel of the CWWTP is an investment realized within the frames of the so-called 'green program'; as the majority of the operating costs come from the energy used from the electricity network. The average quantity of the incoming wastewater is 250,000 m3/day (10-12,000 m3/h), which enters after treatment the Danube directly. In case of medium Danube level and average daily wastewater flow the effluent channel assures enough fall and flow rate to utilize the effluent for energy production.

Preliminary Study And Planning
The feasibility study was entirely based on the in situ survey and the flow metering data of the effluent. Essential points were assuring operation during flood periods, the ratio of energy recovery, feasibility, supply security (e.g. handling power failures), and maintenance needs. 10-12,000 m3/h treated wastewater makes a water level of 0.8-1.2 m in the effluent channel, and water arrives in the sewage disposal shaft with an important head (over 3 m). It depends on the downstream repercussion which is determined by the Danube level. Based on the given head, the channel sizes, and the flow the installation of an Archimedean screw turbine it was feasible to exploit water energy. To assure best use of the fall height right before the effluent shaft, during the planning phase the turbine was placed in the channel section before the shaft with a ~22° decline. Practically the slant axle turbine was installed in the flow-metering Parshall channel.

It was required by planning that the treated wastewater must have an important head reaching the effluent shaft, as the turbine works under these hydraulic conditions. In this case, loss is minimal, the system is able to handle the resistance of the turbine. In case of higher floods or peak loads the turbine stops, swells the incoming channel, one part of the water is led

through at a higher level, the other part tumbling over the spillover flows in a temporary channel and gets to the effluent shaft in this provisional way.

Possible Alternatives Of Implementation

The preliminary study analyzed in details the possibilities of temporary channel installations, and set three options:

- Version A: the temporary channel runs parallelly to the existing channel next to the turbine
- Version B: the temporary channel and the storm spillover (by-pass) runs in a common section
- Version C: newly built double reinforced concrete channel (temporary and by-pass channel)

Among these options, the version containing the temporary and the by-pass channel in common section proved to be the best from technical and implementation point of view. Continuous and calculable energy production was strongly underlined in the planning phase, so a micro-hydroelectric plant was installed which is slow-paced, quiet due to the 3-speed helical gear transmission, and its expected yearly energy production is E365= 488.000 kWh.

Implementation

After obtaining the construction permit the building was started on 31 October 2014. The works needed due foresight and continuous cooperation between the contractor and the operator to assure the successful and trouble-free implementation. In several phases of the construction a watertight work area had to be set up, therefore the wastewater inlet had to be stopped in these periods. To install the turbine the bed-plate and the external side walls of the Parshall channel had to be demolished and a new reinforced concrete channel section built with slant bed-plate and semicircular section; which needed special civil and hydraulic engineering skills.

Micro hydroelectric plant

At the shaft receiving the effluent coming from the building, a connection with shuttle was built to a new shaft which is placed in the storm spillover (by-pass) pipe section. The depth of the new reinforced concrete shaft is 5.6 m according to 'Version B', its size is 2.80 x 2.90 m, wall thickness is 30 cm. The two DN1800 Hobas pipes are concreted in the shaft from two sides. To divert water, two shuttles (closing fittings) are installed which close out the turbine automatically and immediately in case of electric power failures. They also assure flow rate control of the water diverted to the turbine and close out the turbine during maintenance works. After successful operating tests and test runs the micro-hydroelectric plant started its daily operation on 28 may 2015.

Utilization of solar panels (PV)

The small solar (PV) power plants which are already implemented in Budapest Waterworks pumping stations or that are in planning phase join directly the inner electric grid of waterworks, and they operate in synchronized mode parallel to the external (public) grid. The electric energy produced by the small power plant supplies exclusively waterwork appliances, reducing electric consumption from the external network. Storage or sale of produced energy is not realized. Electric input to the public electric grid is not permitted for such systems at medium voltage connections (10 kV, 20 kV). Declared by the Electric Energy Law systems without grid connection they do not need a building permit. The upper-performance maximum is 0.5 MVA. Grid connection is possible through low voltage (0.4 kV) connection via a 'buy-sell' meter (with annual accounts), but the main target is to consume internally 100% of the produced electric energy. Therefore, the nominal performance of the PV systems, defined in a way that power the needs of the pumping station in normal daytime operating conditions, is always higher than the performance of the small power plant.

The operation of the PV system is fully automatic: staff are not needed and it has its own supervisory system. The solar panel may produce an electric performance depending on the intensity of the incident light. However solar insolation depends on several environmental parameters (clouds, diffuse light), which modify light intensity and produced performance. The operating hours of a PV systems is equal to the number of sunny hours, that is 6-12 hours daily. The inverter connects to the grid automatically when solar panels are active, and detaches when light energy is insufficient.

BUDAPEST WATERWORKS: FUTURE WATER UTILITY

If grid synchronicity breaks off, the inverter is immediately disconnected, it doesn't feed short-circuits and has an anti-islanding option. Galvanic disconnection is assured by interrupters and so the produced energy surplus is not fed to the public network. To avoid supply to the public grid the (AC) connection point of the small power plant is mounted with a 'Anti-Watt' security switch. In case of breakdowns (like disrupt of the inlet voltage), the PV system control disconnects instantly the inverters from the network. Restart is only possible manually with preliminary permit of the electric grid operator. One purpose of the Waterworks is to expand the use of such systems depending on economic possibilities in every suitable areas. The ratio of in-house renewable energy production within electricity consumption will increase in the long-term period, which will reduce the quantity of electricity bought from public grid at a varying market price.The system presented above has been operating since spring 2018 in Ferihegyi road pumping station.

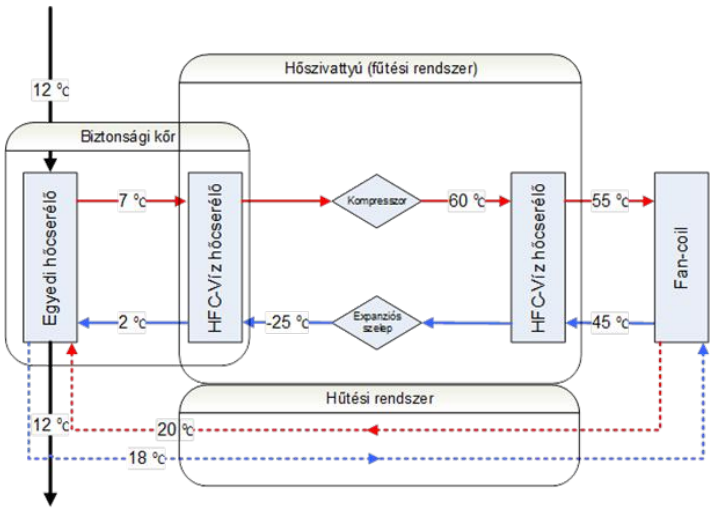
Heat pump innovation in Budapest Waterworks

The first time Budapest Wateworks explored the idea of using a heat pump system for exploiting energy of the water within the pipes was in 1982. In 1985, an experimental device was installed at the Szigetújfalu site, where the oil-based heating system of the Security guard building was changed to the new system. The heat source was the water flowing in the ROCLA pipe with a 7-13 °C temperature, which was directly let in the heat exchanger. Heat transfer was realized by an R22 working fluid, then drinking water was diverted back to the ROCLA pipe.

Several studies have been elaborated in the last few years about exploiting drinking water heat capacity surplus in heat pump systems. All studies cited the question of heat exchanger as the main issue, as no heat exchanger existed in the market which was designed exclusively for use in drinking water networks. Heat exchanger mean water quality risk in drinking water, as the working fluid (HFC) and drinking water might mix, stagnant areas may develop within the small tubes of the exchanger, and in cooling mode, the temperature of the drinking water may get too high.

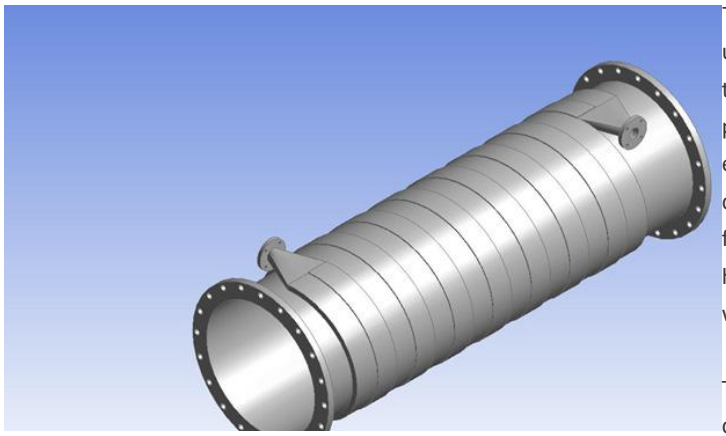
Therefore, the need for a special heat exchanger evolved which is designed to comply with all requirements given in the studies and can be adapted to drinking water networks without any troubles. An important point is that the heat exchanger cannot mean any quality risk, drinking water is not allowed to be taken out of the pipe and later let back. The installation should not increase pressure loss, as savings in heating energy would be lost by compensating the additional pressure loss.

The image here below presents the layout of the unique heat pump system designed by Budapest Waterworks professionals.



An additional security ring is planned within distilled water flows around the drinking water pipe. The system can be used for air conditioning in summer beside the heating of the pumping station and the neighboring offices and other buildings. In this case, the distilled water circulats directly between the fan-coils and the unique heat exchangers.

The unique heat exchanger



The new heat pump's main innovation is its concept by using the drinking water pipe as heat exchanger. Furthermore, its parameters were exclusively set to the pressure side of the pumping station. The pipe is covered by a casing where circulation of the secondary fluid doesn't create any additional pressure lost while the free heat capacity of the drinking water is exploited. The helical external casing can maximize the residence time without stagnant areas.

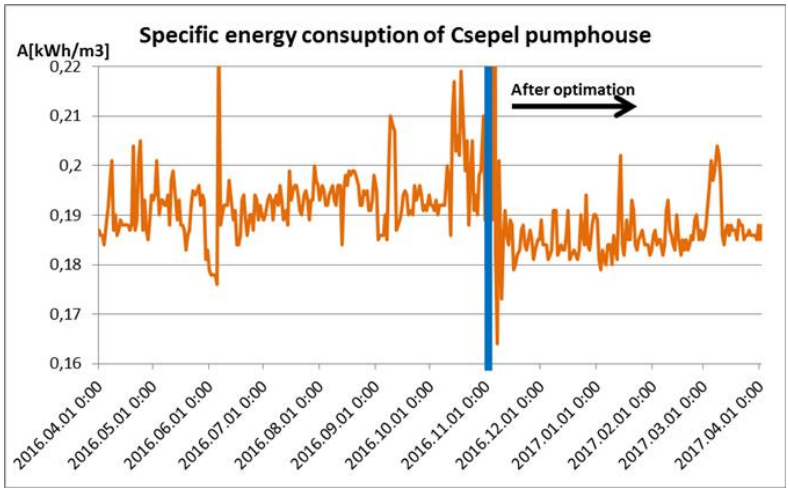
The feasibility plans were finished by autumn 2017, then construction works begun in Budafok pumping station. The operating tests are running currently, and based on the experiences by now, it is considered to be a successful project. Besides the heat pump system presented, several traditional heat pumps are under implementation within Budapest Waterworks, and we work on providing our services in more and more sustainable ways.

Energy efficiency improvement possibilities in operation

One of the main challenges of drinking water supply is to efficiently operate a system planned and built by preliminary defined parameters and to fulfill constantly changing consumer needs at the same time. Needs change within day (peak and low periods), by season (cold-warm, wet-dry periods) and by long-term trends (changes in number of customers, in consumption habits, in industrial water use etc.). Based on its 150 years of experience Budapest Waterworks regularly supervises its operating methods regarding energy efficiency aspects as well. Key indicators (eg. flow rate, pressure, energy consumption, etc.) are available in sufficient data density, so the most cost-efficient way to optimize operation is the regular analysis and, if needed, change in operating mode.

*Network- and Pressure management: energy savings by reducing pressure and high efficacy pump operation:*The most important electric energy consumers within Budapest Waterworks are 756 drinking water producing wells and 104 pumping stations. Based on historical and actual data the professionals of Budapest Waterworks constantly seek the most efficient pumping regime at the actual water demand.

Figure 3. Specific energy consumption of Csepel pumphouse

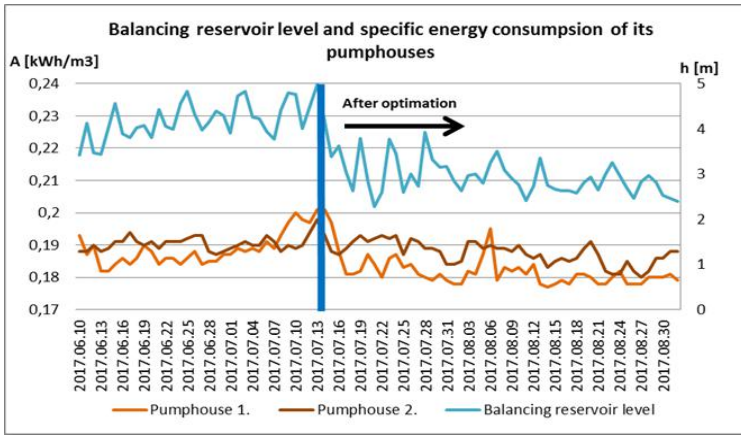


In one pumping station test pumping at a permanent rate was replaced by a method with periodically higher (morning/evening) and lower inlet (day/night), taking into account the best efficiency water transfer point of the pumps. Its energetic effects

are represented by Figure 3. above.

Operation of pressure zones with reservoir and decrease of daily average water level in reservoirs taking into account safety reserves: The more inlet follows consumer demand the less water has to be stored in the reservoirs situated at the highest point of a pressure zone. Therefore, the average operating water level in the reservoir and the average zone pressure can be decreased. In Figure 4., the reduced average reservoir water level (blue line) results in lower energy consumption of the pumping station (orange and brown ones) if the efficiency of the pumps are unchanged.

Figure 4. Balancing reservoir level and specific energy consumption in pumphouses



Adapting the operation of pressure zones to consumer habits (e.g. setting day/night pressure): At all periods the lowest pressure level has to be defined which is still sufficient to supply the given zone. Pressure reduction may also cut back NRW, which is an additional advantage.

Figure 5. Optimized pumping station with lower winter pressure

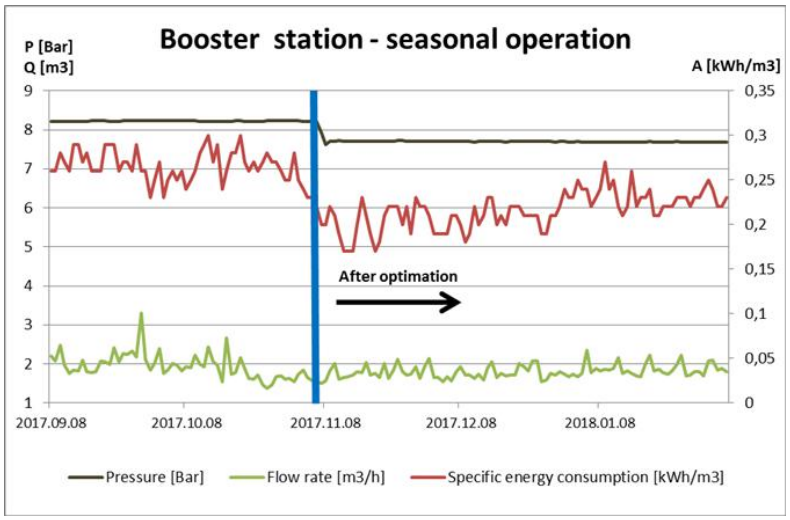


Figure 5. shows a pumping station with a lower winter pressure. Water supply is still sufficient (green line), while the brown line presents the lower energy consumption reached by pressure reduction.

What social engagement programmes are underway with regards to encouraging customers/future customers (young) to use water wisely?

The aim is digital and smart water supply/operation. Naturally, the Company has to offer outstanding performance day after

day in its primary service area, the capital of Hungary and its conurbation. Since it has over two million customers, it must handle several hundred personal requests, thousands of telephone calls and e-mails daily, not to mention such channels of minor traffic as postal mail.

While a couple of decades – or even a couple of years – ago a company's customer services department aimed to address the requests and queries of their customers personally in possibly more walk-in customer service offices, today, thanks to the steady and fast development of the IT world, the companies are striving for the opposite. The expectations of the customers have changed as most of them prefer to do business with their service provider from home, sitting before their computer instead of filling in paper-based forms. Not only the utilities of mega-cities have to prepare for this trend, but also much smaller companies including the water utility provider of the Hungarian capital, Budapest Waterworks.

Reducing the workload of the customer service personnel is an ongoing objective of the Company. Our colleagues read the meters equipped with PDA sets and smartphones and do the administration of meter installation and replacement on tablets, without using paper. Besides the employees of the Company, its customers can also enjoy the benefits of the digital world: they can not only do business with the Company through the online customer service but also download an application on their smartphone for this purpose.

With the help of the Otthon+ (Home+) free application customers can submit their consumption data simply, quickly and even without a landline phone or a desktop computer. When reading their meters, consumers can also take a photo and submit it to the provider, and the application will even notify them about the approach of the reading date.

The national portfolio of Budapest Waterworks includes not only water supply and related technical and laboratory services. Stepping beyond the borders of a water utility service provider, Budapest Waterworks has entered the market with extra products like "Vízálló védelem" (Watertight Protection) a leakage prevention and bill protection insurance and "VízPlusz" (WaterPlus) discount card which grants preferential rates on hundreds of products and services across the country. Other examples of existing or planned solutions that enhance customer satisfaction and facilitate operation are as follows:

Online development efforts

To gain prestigious recognition, a work of outstanding quality must be performed that even exceeds the requirements of the age in every field of the Company's activity, including customer service. Therefore, the Company is making efforts to encourage online customer service instead of walk-in offices. The facilities providing online customer service are currently undergoing major development to enable customers to do a few businesses with the Company from their home. All the functions of the new online customer service will also be available from devices providing internet access that is from smartphones, tablets, laptops, and PCs as well. However, this is only the starting point of the medium and long-term plans which aim to ensure the administration of every business on these facilities within a few years.

Services beyond the provision of potable water

Technical surveys, laboratory tests: Technical and laboratory services are most popular with the business customers. They include water leakage detection, track and ground radar tests as well as drinking water and bathing water quality tests for wellness hotels, swimming pools, and restaurants.

The Company also sells some of these services to residential target group, as for example, testing water quality of drilled wells and finding leakage in the ground are services frequently ordered by residential customers.

Point collection card: Over the past years, Budapest Waterworks has developed and marketed several extra services, too. The VízPlusz discount card introduced a few years ago is highly popular not only in Budapest but in the entire country and competes favorably with the point collection cards that the big multinational companies have been offering for decades. This is to be thanked, among others, to the fact the VízPlusz card is free and grants immediate discount on the purchase of many

internationally recognized and demanded brands of products and services.

Quick Repair: Development of the different services provided based on the customers' needs and ensuring their satisfaction continue to represent high priority for Budapest Waterworks. The customer service often receives questions whether our Company also handles repairs of pipe bursts and other water supply defects. With maximum consideration of the needs of our customers, our Company focuses on the provision of such Quick Repair service which, in addition to the emergency repair of the most frequent water and sewerage related problems, can also address other repairs on a case-by-case basis, be it a dripping tap or the installation of a washing machine.
When developing them we lay special emphasis on making available the services as simply and efficiently as possible; our goal is to offer such online facilities which everyone can use easily and comfortably regardless of age and, even more importantly, they can get the requested repair service indeed fast.

Comfort services
Remote reading: In the spirit of innovation, our Company is also developing remote reading systems. Several thousand signal transmitting meters have already been integrated in our billing system, which offer the following benefits: synchronous water meter reading, accurate, provide authentic water consumption data free of an eventual human error, and comfortable for our consumers as they need not care for submitting the readings on time. It helps learn and analyze customer habits and the meters can be read without limitation in time, in the absence of the consumer. The continuous data communication enables fast detection of eventual network errors. It is expressly recommended for apartment complexes, industrial facilities, and department stores.

Digital operation
Electronic reading system: The entire reading process is implemented on electronic devices, with the help of industrial PDA. It includes recording the meter reading, taking a photo of the meter and the addition of comments by the reader. The meter reader can also make electronic minutes on the spot which the customer can sign in acceptance. The precise position of the meters is displayed on a map. The activity of the reader can be monitored real-time through the data and time stamp, the GPS coordinates and the photos made. The system also operates as a mobile computer for the colleagues.

Electronic worksheet: The entire paper-based work recording is replaced in the investigation process; local data recording and photo making are all done on an electronic device. The work tool is an industrial tablet which withstands the conditions of physical fieldwork. The device is in continuous online connection with our internal network and our databases so that the colleagues working in the field have up-to-date information always. It provides interactive access to our GPS system. The client software connects to a work organization and control system which enables the flat distribution of the necessary investigation tasks among the colleagues. It is also suitable for the real-time monitoring, reporting, and control of the completion of the investigation tasks.

During its history of 150 years, the Budapest Waterworks has never been satisfied with simply supplying clean and healthy drinking water to its consumers. Our customer service is also making constant efforts to develop its services, even ahead of the other utility providers and meeting halfway the expectations of the consumers. This also means that they make serious efforts to ensure that within a few years' time neither paper-based forms nor walk-in customer service offices are needed.

With customers demanding ever more services, what digitalized customer services will Budapest Waterworks offer in the future?

Digital Strategy of Budapest Waterworks
Since 2014, Budapest Waterworks has a digital strategy that includes a proposal on how to support business strategy focusing on Information Communication Technologies (ICT) and digitalization. The most important goal is the automation of business processes using the Internet and industrial sensors (IoT - Internet of Things) and robotization. The Digital Strategy also includes

specific development projects: SCADA systems, intelligent metering and smart city, mobility and access to partners and consumers, and mobile workforce management.

SCADA over IP: The SCADA system is a water production management system, one of the key pillars of the company's core business, water production, and IT systems supporting the delivery of produced water to consumers. At the beginning of 2000, Budapest Waterworks has shifted to fully automated centralized operation management. Operations Center staff prepares control programs for remote locations with programmable logic controllers (PLCs) and manages the technical equipment that is part of the entire drinking water generation and distribution infrastructure from water supply to basins to powerhouse pumps. Over the past 3-4 years, the entire communication infrastructure has been renewed, the communication IT network has been replaced with optical cable and remotely managed PLCs.

Lora, NBIoT for IOT and smart metering: Several pilots have been launched in the field of smart metering in recent years, with two main technology directions determining the scope for the Budapest Waterworks LoRa and NBIoT. Pilot projects have provided insight into technology comparison. However, a definitive solution has not been implemented, given the shortcomings of current technologies in data communication. The new generation NBIoT is now a promising solution for improving low signal strength (shaded, undercover) measuring points into a smart metering solution. At the same time, the widespread solution, LoRa, seems to be promising to implement Internet-based automatic metering data collection, which can be taken in the next one or two years and implementing the digital strategy.

RPA technologies (robotic process automation): RPA stands for Robotic Process Automation. It is a virtual workforce that can automate a workflow if it has only a few human decision points. Since it uses the user interface of existing IT systems, it does not require development but only customizing. According to McKinsey & Company, the replacement of 110-140 million FTEs (Full Time Equivalent) by 2020 is possible with automation and software tools. This type of robotization serves to replace recurring, screen-based tasks that require data manipulation and can be trained, based on changes on the screen, to handle data streams forming a process and based on information on which IT system is affected and can permanently execute it if input is received. Its advantage is that the robot can be trained, missed, and radically reduces the lead time in administration.

Robotization will become increasingly important in the automation of the monotonous tasks of office work in the next few years at Budapest Waterworks, which will result in the release of significant human resources and the company can focus on expensive human knowledge more creatively and can perform more useful tasks than ever. Such a software licensing saves the daily work of 5-6 office workers, which can redirect their performance into more useful activities.

App role out for subcontractors (OME+): There is also considerable potential for saving human resources in outsourcing tasks. Advances given by technology and digitalization open new doors, as the use of the Internet for industrial use and the spread of mobile devices will enable the partners to be involved in the company's business processes. The point is that a secure data connection should make it possible for partners to access corporate resources, databases and data manipulation should be entrusted to them. Practically they perform the same administration tasks as before on paper, now rather by using digital devices, and the data need not be registered from paper into IT systems again. This seems to be a good solution for common use of the Internet and VPN.

The concrete application for which we are talking about in Budapest Waterworks is developed in 2018 for the business partners. With this application, data capture has been transferred to business partners without using internal human operators.

Workforce Management: This is the most matured area of IT and business processes where Budapest Waterworks has the greatest experience. Workforce Management was first developed in 2004 for pipe network repair jobs. The maintenance of the facility was introduced in 2008 with slightly different business requirements and has been continuously extended to wastewater facilities and the non-water technology facilities. Fieldwork is administered through mobile devices that connect to a central IT system through an IBM MQ Series communication server. The principle of the workforce management system is that

in case of leakage management from the customer call until the last step of administration is performed along a closed process. In the case of facility maintenance work, the rows of the annual maintenance plan are allocated by an automatic scheduler. Accounts are made online or offline in real time, time stamps and photos are taken for jobs are attached to the electronic worksheet and are archived. The time and place of arrival and departure to the site and the materials used are recorded in the SAP system, data is transferred from the mobile device via IBM MQ and the central WFM database. The range of field devices ranges from industrial tablet to smartphones. The tablets support network investigators as they require larger screen for map usage. They can also use a function to exclude pipe sections by electronically searching valves on screen. Site crews and contracted partners are provided with all IT support to keep an accurate administration.

The mobile treatment plants are very interesting! Do expand!

Containerised Mobile Water Purification Systems

In 1986 the management of Budapest Waterworks decided to establish a civil protection capacity for unforeseen water shortages. For today, after several decades of development, the Unit became an international water purification module with mission experience, registered in the European Union Civil Protection Mechanism.

By recognizing the human right to safe drinking water, we are committed to provide healthy potable water to as many people as possible. For decades Budapest Waterworks has been an active participant to supply water in disaster situations, and from 2005 it also participates in international missions as a humanitarian aid organization. Budapest Waterworks has its own-developed containers and emergency water supply team consisting of volunteer colleagues, which is also an officially registered unit of the European Union Civil Protection Mecha¬nism.

The Hungarian Water Aid Unit (HWAU) has proven its suitability at several domestic and international locations. Since 2005 Budapest Waterworks has participated with its own mobile purification systems in several missions and volunteering in international humanitarian aid projects around the world, among others in countries such as Sri Lanka, the Philippines, Serbia, Bosnia and Herzegovina and in Albania.

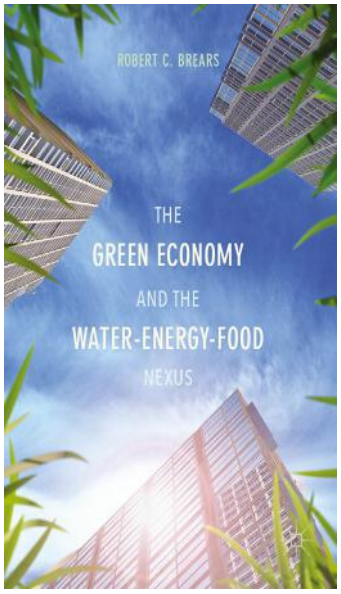
In addition to these projects, Budapest Waterworks also participated in several international projects including the MODEX organized by the Civil Protection Mechanism of the European Union, or the INSARAG qualifying practices (United Nations).

Along with our humanitarian engagement, in 2015 our Company developed a special mobile drinking water purification container optimized for refugee camp conditions which was named CEWPU (Containerized Emergency Water Purification Unit), type WW-RO. Being operated by the Turkish Disaster Management Agency (AFAD) the WW-RO provided the entire water supply of a refugee camp at the Turkish-Syrian border by using natural surface water resources.

Based on the operation of the WW-RO in the refugee camp and on the previous mission experience of the HWAU team, Budapest Waterworks created its WW-UF unit. In terms of technology, this container is simpler since special purification is not needed in all cases.

Budapest Waterworks offers the WW-RO / WW-UF models as standard units, but it also designs and manufactures water purification systems meeting individual demands. Both systems can produce drinking water meeting the WHO standards. WW-UF is suitable for treating lightly or moderately contaminated water, while WW-RO can be used for treatment of highly contaminated water. The operational background is fully provided by Budapest Waterworks. All the team members are employees of the company and participate in the work of the module on voluntary basis.

Photo credit: https://pixabay.com/en/budapest-bridge-water-architecture-536289/



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The Green Economy and the Water-Energy-Food Nexus

- **-Presents a series of case studies that illustrate how cities, states, nations and regions of differing climates, lifestyles and income-levels have implemented policies to reduce water-energy-food nexus pressures-Discusses the components of the food-water-energy nexus and the pressures it faces from rapid economic growth and climate change-Provides a review of the various fiscal and non-fiscal tools available for reducing the global demand on the water, energy and food sectors**

This book argues that a variety of policies will be required to create synergies between the water-energy-food nexus sectors while reducing trade-offs in the development of a green economy. Despite rising demand for water, energy and food globally, the governance of water-energy-food sectors has generally remained separate with limited attention placed on the interactions that exist between them.

Brears provides readers with a series of in-depth case studies of leading cities, states, nations and regions of differing climates, lifestyles and income-levels from around the world that have implemented a variety of policy innovations to reduce water-energy-food nexus pressures and achieve green growth.

The Green Economy and the Water-Energy-Food Nexus will be of interest to town and regional planners, resource conservation managers, policymakers, international companies and organisations interested in reducing water-energy-food nexus pressures, environmental NGOs, researchers, graduate and undergraduate students.

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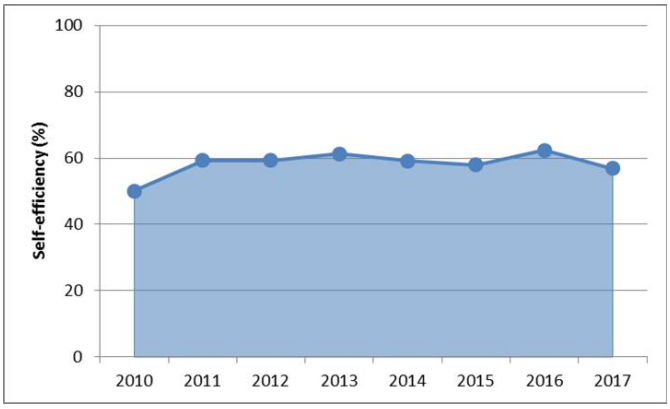
EFFICIENCY IMPROVEMENTS AND TECHNOLOGICAL DEVELOPMENTS BY BUDAPEST WATERWORKS LTD. ON BUDAPEST CENTRAL WASTEWATER TREATMENT PLANT

By Bernadett Lemaire & László Váci

Budapest Central Wastewater Treatment Plant (BCWWTP), the largest sewage treatment plant in Hungary designed for 1.6 million PE(BOD5) is in operation since 2009. The construction of this plant was financed by the European Union, the Hungarian State and the Municipality of Budapest aiming to ameliorate the water quality of the Danube River. The applied technology of BCWWTP is a conventional activated sludge (CAS) treatment, where all technological structures are covered, ventilated and the foul air is entirely treated. By creating green rooftops on the technological buildings 70% of green surface was achieved on the Plant to fit in the urban environment. It also permits to reduce energy costs by natural insulation and it absorbs stormwater, which was lessening the need for complex drainage systems. To promote the sustainability of the BCWWTP, biogas is produced by anaerobic digestion which is used to produce electricity and heat; thus the energy self-efficiency of the establishment is around 60 % in a yearly average.

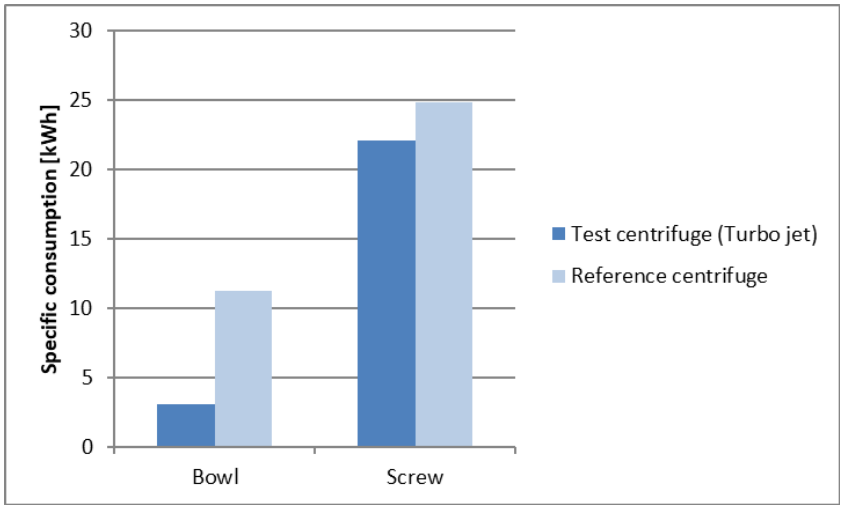
Since the operation has been taken over by Budapest Waterworks in 2013 the operation and the maintenance emphasize on efficiency improvements and technological developments. Continuous effort has been made to optimize the overall technology and the different units, which resulted in continuous increase of the energy self-efficiency (see Figure 1).

Figure 1. Energy self-efficiency on BCWWTP



This positive tendency is a result of multiple actions. Along with the adjustment of the maintenance service-plan to the prevailing status of the devices, several minor modifications have been carried out to gain energy efficiency of the different equipment. Such as installing Turbo Jet weir plates in the dewatering centrifuges, which are amongst the biggest energy consumers on the BCWWTP. These weir plates guide the centrate discharge from the centrifuge in the opposite direction to the bowl rotation, which creates a reaction force and recovers the kinetic energy from the centrate. This extra force supports the bowl rotation and thereby reduces main drive power consumption. The energy efficiency results of this installation compared to the previously existing installation were clearly convincing (see Figure 2.), the implementation of these minor elements permitted an economy of approx. 7.000€/year.

Figure 2. Comparison of the specific energy consumption of the existing and the upgraded centrifuges



The centrate water produced by the dewatering process of the anaerobically digested sludge represents 15-20 % of the nitrogen load on BCWWTP. Compared to the main stream's conventional nitrification/denitrification method, the side stream deammonification process has approximately 63% lower O2 need. Thus, to reduce the energy consumption and to improve the sustainability, a single step, one reactor (SBR) nitritation- anammox system had been installed at the BCWWTP.

Two anammox reactors have been constructed with 2000 m3 effective volume each, seeded by 25 m3 of anammox sludge, with the purpose of treating 2100 kg/day ammonium-nitrogen load with a minimum 85% efficiency, thereby reducing the internal ammonium-nitrogen load by 10-15%. This installation is rather unique since at present not many anammox processes were reported following thermophilic anaerobic digestion units.

After more than four years of experience, it can be outlined, that the sensibility of the technology makes the process operation quite challenging. Still, even at high-load periods, 80% of ammonium- nitrogen removal efficiency could be reached; which resulted in 40,000 €/year saving for the Company by reducing the electricity consumption by 600 MWh in a yearly basis (see Table 1.). Further optimization to decrease the suspended solids load of the centrate water as well as to increase the capacity of the deammonification unit is pending.

Lately, a cooperative project was debuted with Budapest University of Technology and Economics, Department of Hydraulic and Water Resources Engineering aiming to enhance the energy efficiency of the BCWWTP. Investigating the mass balances of the Plant it was pointed out that the biological treatment unit (that represents 56% of the overall energy consumption) could possibly be optimized by fine-tuning.

As a result of on-site measurements and hydrodynamic simulations on the biological treatment, it was concluded that during the non-aerated phases the thrust of the stirrers can be reduced. Furthermore, more efficient oxygen balance might be achieved in the basins by the fine-tuning of the aeration and by synchronizing its regulation with the stirrers.
Within some time the full-scale trial of this optimization prospect will take place to elaborate the details of the future operation. In case the results of the test operation will verify the preliminary estimations 10-20% reduction of energy can achieved on a yearly basis. Moreover, an average 3-5% reduction of aeration need could be attained by the fine tuning while preserving the same cleaning efficiency.

Table 1. Comparison of conventional nitrification/denitrification and the deammonification processes

	DO	Aeration time	Volume	Ammonia load	Specific load	Energy need
	[mg/l]	[min/d]	[m^3]	[kg/nap]	[kg/ m^3]	[kWh/ NH4Nkg]
Nitrification/ Denitrification (main stream)	1.8	980	8600	650	0.08	3.75
DEMON (side stream)	0.4	720	4000	880	0.22	2.39

INDUSTRIAL WATERSHED

By Jim Lauria

Over the past five decades, the ecology mega-trend has led us to recognize the many complex relationships in the watersheds that surround us—and positioned industry as the enemy of those same watersheds. Now, progressive business leaders see that they are the heart of not just the natural watershed in which they operate, but of industrial watersheds where their decisions have implications on the source, use and re-use of valuable water resources within their businesses.

The glory of industrial watersheds is much like the wonder of natural ones—the elegant interconnectedness among water supplies, the economy of use and reuse, the continuum from source to sink and back again. Comprehending industrial watersheds is leading businesspeople to better appreciate, and better manage their water supplies.

Of course, the first lesson from watersheds is the fact that every drop of water is constantly being reused. Just as the name implies, the hydrological cycle isn't a pipe, it's a circle, with water transforming from precipitation to surface water to groundwater, bubbling back to the surface, then evaporating, then condensing to form precipitation again. When power plant operators began reusing cooling water, the environmental impact was dramatic. According to a 2008 report by the Union of Concerned Scientists, freshwater withdrawal intensity among power plants in Virginia, North Carolina, Michigan, and Missouri—where once-through cooling systems are the norm—were 41 to 55 times greater than in Utah, Nevada, and California, which boast more recirculating systems.

Careful accounting

Just as in studying a natural ecosystem, every drop of water that gets pumped into the industrial watershed, falls from the sky, or released must be accounted for. It must be analyzed, treated, wisely utilized, appraised, and then have its future uses assessed on that appraised value and the efficiency of various treatment options.

INDUSTRIAL WATERSHED

The overlaps among ingredient water, service water and process water in an industrial watershed can allow for highly effective re-use either with or without treatment, which in turn improves both energy efficiency and water efficiency. That's where analysis is especially important. Analyzing the contents and condition of water throughout its cycle through an industrial facility can help pinpoint how much treatment is necessary before it is piped to its next task or to discharge into the environment. After all, cooling water for a boiler does not need to be purified nearly as much as would a supply of ingredient water that will be packaged with the food inside. Later in the cycle, water being prepared for discharge must be brought to a high standard, and investments and efforts have to be scaled accordingly.

The importance of the dissolved oxygen (DO) content of water also rises in an industrial watershed model. Managing DO—in the sense of increasing it—is vital in water that will be discharged to the environment. But DO management—in the sense of lowering it—is also important in many industrial applications, because dissolved oxygen can accelerate the corrosion of equipment in facilities like power plants. Fortunately, re-aerating deoxygenated water can be a simple task. It just requires some planning and the commitment to understanding the contents of water, how it will be used, and how we can manage it.

Stormwater is the wild card in an industrial watershed. It can be a plus when rain delivers new supplies of vital water, but can also pose a threat of flushing contaminants off-site. Stormwater can force the issue for water managers, connecting the natural and industrial watersheds in ways that are not always desired...or controlled.

Business sense

An industrial watershed mindset dovetails with efforts to maintain resiliency. On a business level, we're learning from Mother Nature how to flow with disruptions and weather unexpected events without crippling the business model. On an ecological level, we're finding how challenges to the system can be absorbed or diverted through its interconnected water channels.

As a result, thinking in terms of industrial watersheds isn't some sort of hippie consciousness raising. It's good business. In fact, it's critical to survival in today's business climate.

Increasingly, watershed thinking is growing more vital every day. Increasingly, industries operate at the pleasure of the communities that surround them—and there have been cases around the world in which companies have struggled to establish facilities in the face of opposition to their possible impacts on water quality or scarce water supplies. In a 2013 poll of industry leaders, the Pacific Institute and VOX Global found that 80 percent of the respondents expected water supply to impact where they will locate a facility in the following five years. Fifty-seven percent said water issues affected their bottom line, and an equal number predicted water issues would affect their growth. In addition, 79 percent of the company leaders reported facing current water challenges and 86 percent expected to face them within five years—which is now.

Today, society evaluates businesses not just on their revenues and returns, but on their environmental footprint. Reducing water consumption, energy use and carbon emissions have become new indicators of a company's values and its business approach. As a result, the efficiencies of a watershed mindset can flow straight to the bottom line and to the corporate social responsibility report.

Powerful tools

Aiding the industrial watershed perspective is a host of new tools that help managers understand, evaluate and treat water throughout its circulation in the system. In many ways, these high-tech tools mirror an ancient way of thinking about watersheds. Five centuries ago, Leonardo da Vinci envisioned water flowing through arteries in cities that breathed and excreted—descriptions of urban watersheds that drawn in terms of pure, elegant anatomy. Today, we can build on that model with sensor eyes and ears, wire (or wireless) neural networks, SCADA brains, and state-of-the-art filtration and treatment systems that act as kidneys and livers. Our technology hasn't quite evolved to the magnificence of the human body yet, but it provides remarkable flexibility and fluidity in managing water with a systems approach and a constant loop that provides feedback and adjustment.

When we combine an industrial water management approach with the vision of two of life's most impressive systems—the human body and the hydrological cycle—we can begin to see how water can play a wide range of functions, be treated to more than one degree or level, and vary in its value and function. We can look beyond the concept of water as a monolithic commodity and consider how to optimize the use of potable water, brackish water, process water, gray water, and wastewater. Then we can use those many waters again, and ultimately cycle, recycle and efficiently manage the resources that buoy our industries.

Overall, understanding industrial water within a watershed model helps managers steward water more effectively and manage it with greater cost- and energy-efficiency.

*Jim Lauria is Vice President of Sales & Marketing for Mazzei Injector Company, LLC, a fluid design company that manufactures mixing and contacting systems. He has over twenty years of global water treatment experience in the agricultural, municipal, industrial and commercial markets. Since graduating with a Bachelor of Chemical Engineering degree from Manhattan College, he has traveled the world benchmarking the best water management practices. Jim can be contacted at jlauria@mazzei.net

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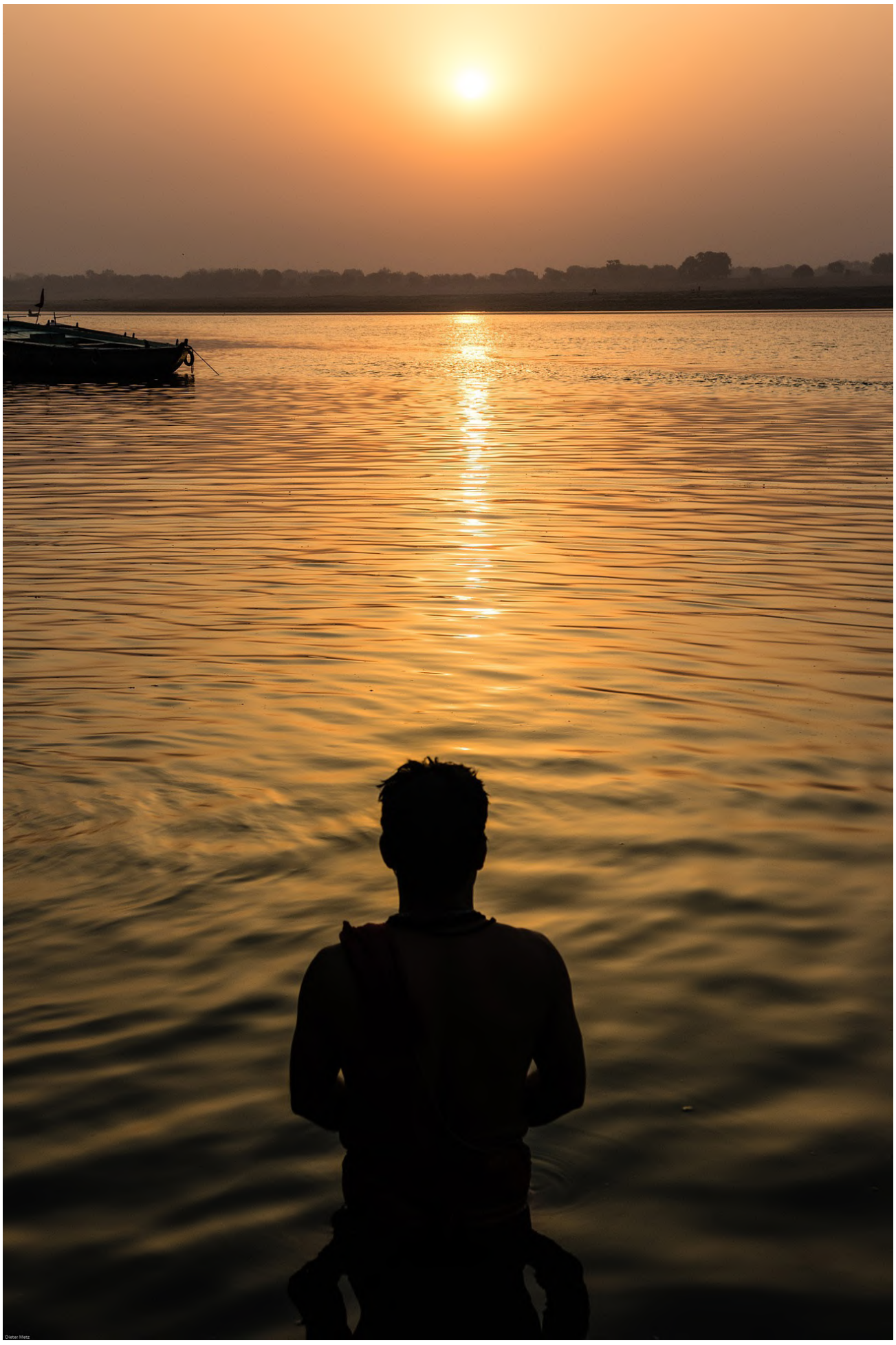
Dieter Metz

RESCUING THE SAVIOR

By Dr. Arvind Kumar, President, India Water Foundation

Water, the elixir of life, the key to sustainable development and main bulwark against the vagaries of climate change, is in itself confronted with 'existential' threat in terms of water insecurity, water-stress and water scarcity in the wake of increasing depletion of aquifers due to over-exploitation, retreating glaciers, and mounting menace of pollution of surface and groundwater resources.

Until the initial phase of the onset of the 21st Century, there was concern about water, yet the emphasis on according priority to water in national policies was lukewarm in many countries. With the process of globalization gathering momentum, emphasis on industrialization, urbanization and food production to feed the burgeoning population also started receiving priority resulting in augmentation in demand for water that is already a finite source.

Growing demand for water and the resultant water-stress and water-scarcity coupled with the increasing problem of water pollution in recent times have culminated in according priority to water governance. In the wake of increasing adverse impact of the vagaries of the ongoing process of climate change, gradual efforts for according due recognition to water being at the core of Climate Change being made since the onset of the 21st Century; nevertheless, got impetus in the aftermath of the Paris Agreement on Climate Change (PACC) and the post-PACC period has transitioned towards viewing water as critical to both climate mitigation and climate adaptation.

India Water Foundation (IWF), a non-profit civil society founded in 2008 with its Headquarters in New Delhi, India, has a Special Consultative Status with the UN Economic and Social Council (UN-ECOSOC) and is accredited Observer Status Governing Body of United Nations Environment Assembly (UNEA). It has been engaged in assimilation and dissemination of traditional wisdom, best practices and innovative techniques in water and environment sectors. IWF visualizes the Asia-Pacific region as a water-surplus region sans environmental hazards by 2050 by integrating Integrated Water Resource Management (IWRM), water-energy-food nexus

and ecosystem-based adaptation (EbA) approaches as key components of sustainable development goals into national policy at local, provincial, national and regional levels by harnessing water-energy-climate-food nexus approach, assimilation and dissemination of wit and wisdom from local to global level and vice versa.

The IWF works amongst the people at the grassroots level, especially amongst the marginalized and weaker sections, women, tribal people and the poorest communities in India and the Asia-Pacific region, in cooperation with local, state and national governments, and with other like-minded civil society organizations (CSOs), to help them develop water, sanitation, hygiene and climate change adaptation services that are not temporary but lasting forever. The IWF identifies the roadblocks to sustainable development and help overcome them. It helps the people to make the change from short-term gains to long-lasting services that could transform their lives and their futures.

Plethora of knowledge and experience about best practices and innovative techniques garnered by IWF through its exposure and participation in leading national and international deliberations and ground level work in Meghalaya (located in Northeast India) and many other states of India in water, energy and environment sectors has enabled IWF in pioneering on-engineering and non-technical solutions which are of equal significance in tackling water and environment related problems by encompassing PPT (People – Process – Technology). This has given the IWF advantage of thought leadership in many areas like policy formulation, facilitating conferences, seminars, symposia, workshops etc., capacity-building and sustenance, eco-sustainability, facilitating technology intervention, nexus approach, assimilation & dissemination of Water, Environment and Sanitation related knowledge, inter-sectoral convergence, equal emphasis on soft approach along with hard approach, collective approach on water and its dependent sectors etc.

Major activities undertaken by IWF during the period spanning over a decade primarily have veered around major themes of water and climate change, which inter alia, include: advocacy, competence and capacity building of all stakeholders, exchange and sharing of views about innovative and best practices on salvaging major rivers, especially River Ganga and Yamuna River, judicious management of natural resources, especially water, enhancing resilience to the vagaries of climate change and improving livelihoods of the people, especially of poor and downtrodden segments of the society, enhancing awareness of the stakeholders via capacity building in water conservation, rainwater harvesting, and recycling wastewater for reuse, conducting training programme for application of hydro-geo-morphological mapping for groundwater prospection in 20 states of the Indian Union, launching of awareness enhancing campaigns and use of environment-friendly technologies and frequent launching of awareness generation programmes among school children about water and climate change.

Being a knowledge partner of the Meghalaya Basin Development Authority (MBDA), Government of Meghalaya, India, in managing water resources in the state of Meghalaya for about a decade now, IWF has played its humble role in the management and governance of water and environment sectors. Management and governance of water, energy, food, and environment-related issues are facilitated through Integrated Basin Development and Livelihood Programme (IBDLP), a flagship programme of the Government of Meghalaya, which is being implemented through more than 20 missions and sub-missions. Competence and capacity building programmes of the stakeholders launched from time to time by IWF in harnessing IWRM and water-energy-food nexus approaches have proved instrumental in integrating these approaches into the official policies of the state and yielded salutary results in terms ensuring security in water, energy and food sectors, enhanced resilience to climate change as well as improvement in livelihood of the people culminating in poverty reduction and increased economic growth.

IWF has made its humble contribution in making Meghalaya as an exemplary model of successful implementation of IWRM and Nexus approaches and it is gradually inching towards harnessing an EbA approach in tackling vagaries of climate change. IWF has presented Meghalaya Model in its presentations in national and international seminars, symposia and workshops, including at the Stockholm World Water Week 2015. IWF has played the role of a catalyst in impacting directly/indirectly formulation of water-related policies. IWF's emphasis on inter-sectoral convergence, integrating IWRM and Nexus approaches is gaining increasing recognition.

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STRENGTHENING THE RESILIENCE OF THE CANADIAN WATER SECTOR

By Adrian Toth, Canadian Water and Wastewater Association (cwwa)

In 2009, Public Safety Canada (PSC) announced the National Strategy for Critical Infrastructure which aims to make Canada's critical infrastructure more resilient. The Strategy is supported by the Action Plan for Critical Infrastructure which addresses the strategic objectives outlined in the Strategy namely: build partnerships; share and protect information; and implement an all-hazards risk approach.

PSC has defined 10 Critical Infrastructure sectors for Canada, one of which is water. Water and wastewater systems are critical to the protection of our environment and health, and to the economic capacity of our nation. To become more secure and resilient the water sector needed a unified and collaborative tool such as a National Risk Profile and an assessment of emerging trends and theories which could move the sector as a whole forward. No such study has been conducted before to assess the resilience in the water sector nationwide.

In partnership with the Canadian Water and Wastewater Association (CWWA) and PSC, the Dalhousie University had conducted a research study to assess the state of preparedness of the water sector, identify strengths and weaknesses in the sector, make recommendations for concrete measures that water utilities can take to enhance resilience. The project was funded by Defence Research and Development Canada (DRDC) through the Canadian Safety and Security Program (CSSP).

The project goal was to develop and conduct a National Survey of the Water Sector in order to create a National Risk Profile that can be used collaboratively by CWWA and PSC. The project addresses the following:

- Determine what policies and practices water utilities are expected to have in place to mitigate and prevent risks and enhance resilience according to policies and legislation in Canada
- Identify emerging threats and risks, and emerging trends, practices, and theories in advanced water utility risk management
- Determine what risk management practices water utilities

in Canada currently employ to mitigate and prevent risks and enhance resilience, how effective those practices are and what obstacles prevent them from doing more

• Identify gaps, misalignments, and areas of compatibility in water utility risk management

• Identify additional tools and strategies the water utilities, and the sector as a whole can employ to further mitigate or prevent risks.

The study, which included online responses and phone interviews with regulators and operators, requested respondents to identify and rate a variety of risks. Questions encouraged respondents to discuss where they gained information about risks, how they managed risks, and which risks they perceived to be most pressing for their organization. Aging infrastructure was the most frequent risk highlighted and rated the highest in terms of likelihood. By contrast, cybersecurity was a polarizing risk both in terms of its likelihood and appropriate responses to it.

The data collected from the National Survey constitutes a repository of information on the water sector in Canada unlike any of its kind. It provides a baseline comparison for assessing risk levels at specific sites. This baseline allows the sector to evaluate problem areas, areas of strength and facilitates prioritization of resilience-enhancing measures. It provides an assessment of the current state of resilience and physical security of the water sector as a whole. This will allow the water sector to establish realistic goals and timelines for improving site-specific risk management efforts.

The final document is accessible at http://cwwa.ca/pdf_files/Water_sector_vulnerability_REPORT.pdf

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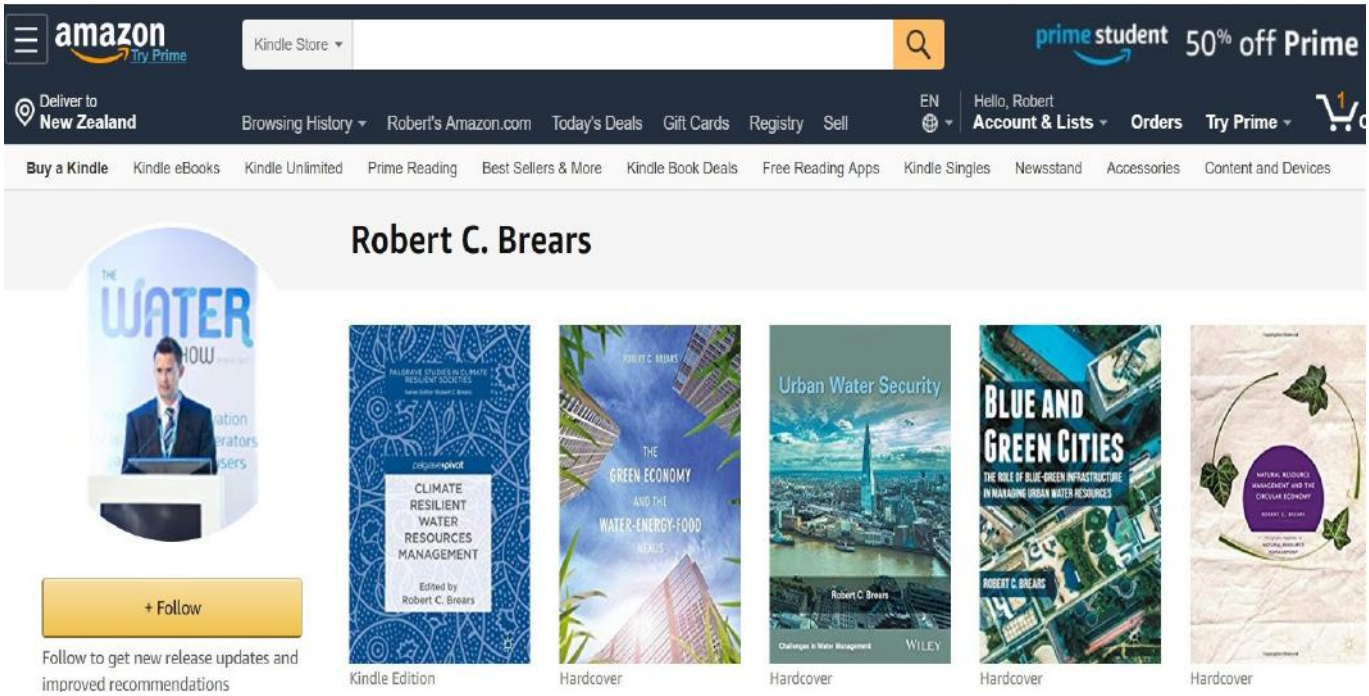

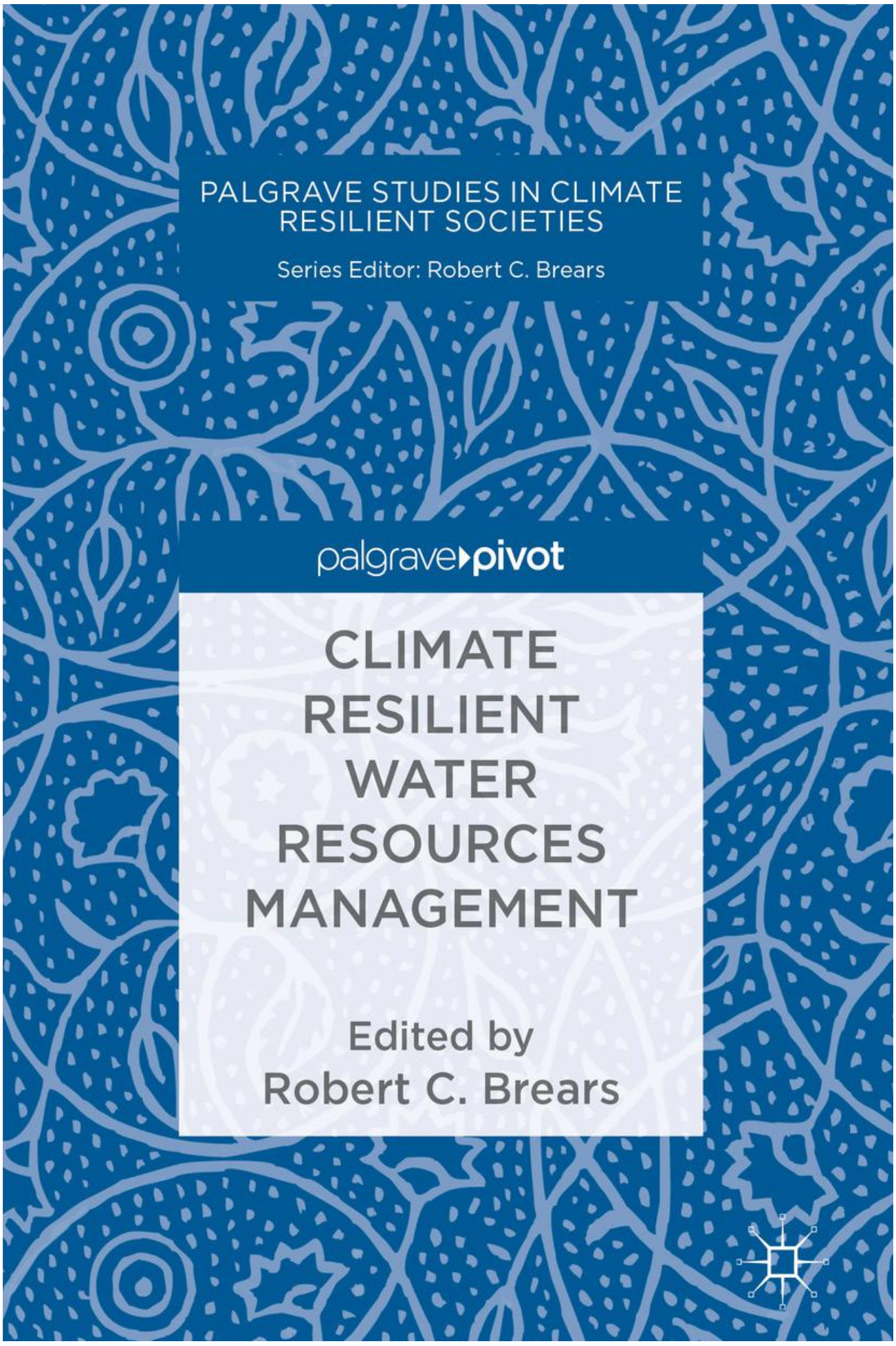
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CLEANING UP MANILA: ONE WATER UTILITY'S STORY OF INNOVATION AND ADAPTATION

By Simone Ballard, International Water Association

Urban Water Utilities in Developing Nations can skip the awkward phase and jumpstart Innovation and Climate Adaptation by addressing real problems in their communities using a Low-Carbon Mindset.

Maynilad Water Services, Inc., in response to a lack of wastewater coverage, sought out innovative measures to increase their wastewater coverage. Implementing a decentralized approach, they were able to create sub-catchments on the San Juan River Basin using compact technologies. Simultaneously, they have increased their energy efficiency through process optimization of all turned-over facilities, saving power along the way. The projects have contributed to odor control and the overall well-being of the community while offsetting greenhouse gas emissions from untreated wastewater.

Manila is the bustling coastal capital of the Philippines, a nation made up of over 7,000 islands and endless tropical beaches. The natural beauty and rich history of the nation, with origins and influences from Asia, Oceania, Europe, and North America, make the Philippines a unique global gem.

Manila's current population stands at 1.78 million (2015 estimate) – with the metropolitan population at a whopping 12.3 million, swelling up to 15 million during the daytime. The city is the most densely populated in the world, with an average 42,857 people per square kilometer.

The lifestyle in Manila, like many cities in the Asian region, is being challenged by recent global trends such as rapid urbanization, population growth, and natural disaster events. The safety of the population and future success of this city depends on adapting to these challenges, as well as preparing for the uncertainty of climate change.

Climate change will most likely exacerbate current challenges such as water scarcity and quality through increased drought and flooding events. Urban water utilities are at the front lines of these issues, with both a stake in addressing the global climate crisis to avoid further risks and an opportunity

to help mitigate climate change through greenhouse gas emissions reductions.

Besides adapting for the future, Manila has real water problems which need to be solved today. Issues, such as lack of waste-water coverage, contribute to ongoing health and safety concerns. However, with a little creativity, today's problems can be addressed while preparing for the challenges of tomorrow.

Thanks to the actions of Maynilad Water Services, Inc. – who took a proactive step towards securing a better future for their community – water management in the Manila region is now improving. Having the self-awareness to know that water management solutions are not 'one size fits all', and that one solution may work in other regions but not theirs, the Maynilad team embarked on carving out their own unique path.

The main target area was to address the lack of wastewater coverage in the San Juan River Basin. Waste being dumped directly into the river was causing an overwhelming odor and degrading local water quality. Knowing this was an immediate need and knowing that the solution couldn't take too long or be too costly, Maynilad Water Services, Inc. sought out alternatives.

Solution: Decentralized Wastewater Treatment through compact sub-catchment technology
Implementation of 15 decentralized sewage treatment plants (STPs) along the river basin not only greatly improved the odor issue, but by increasing wastewater treatment, the utility has also been able to avoid greenhouse gas emissions that would have been released through the untreated wastewater. The decentralized STPs used compact technology and a combined sewer system to reach a total combined capacity of 72 million liters per day (MLD) serving 132,500 households daily. During the process, Maynilad saved 47% in lot area, a huge gain in the most densely populated city in the world. It's simple and innovative solutions like these which are being further explored and promoted by the WaCCliM project worldwide: looking for practical, creative, and low-carbon pathways for water utilities in developing nations.

Overseeing STPs at Maynilad Water Services, Inc.

Solution: Process Optimization of all turned-over facilities, higher energy efficiency
Taking their journey to better service performance and climate mitigation one step further, Maynilad Water Services, Inc. optimized their internal processes on all facilities that were turned-over; thereby reducing their energy, carbon, and water footprints in one swift move (see more on water-energy nexus and water utilities here).

How can more facilities achieve these results too?
Maynilad was successful in their implementation of these upgrades due to several enabling factors. National regulations and policies motivated the utility to meet and surpass the mandatory standards, such as the Supreme Court Mandamus "to clean up, rehabilitate and restore Manila Bay".

Also, engagement with key stakeholders in the region was critical to the appropriate and timely implementation of their wastewater expansion projects.

Of course, there were some obstacles in the process, such as right-of-way issues, tedious permit acquisition, informal settlements on easements, and unavailability of power supply for the new facilities. These are common challenges in the developing world and require patience, determination, resources, and long-term vision to overcome.

The Tandang Sora STP, which uses an STM-Aerator combining activated sludge and fixed film technology in a compact biological treatment system.

In the future, Maynilad plans to achieve 100% sewerage coverage in the West Zone of Manila by 2037. In the process, they also hope to incorporate nutrient removal, utilize energy efficient pumps, improve water reuse, and start converting waste to energy. To meet these ambitious goals, they recommend five steps going forward, which other utilities can follow in their strategic planning:

1. Start by identifying the gaps and opportunities for improving services
2. Benchmark with other industry leaders to find out how best to improve services. Adopting existing technologies is one way, but it may also mean developing a whole new solution
3. Involve all stakeholders in the project conceptualization and implementation process
4. Improve community awareness and participation in environmental projects
5. Conduct information-education campaigns to ensure that all stakeholders understand the need for the project

The Road Less Travelled

Given the unique situation in Manila, conventional approaches such as centralized wastewater treatment were impossible to consider for companies like Maynilad. However, they didn't accept defeat, instead, they carved their own path to better service and higher capacity for the community. The successful operation of the 15 STPs marked a major breakthrough towards better sanitation and public health in the country. This approach is gaining momentum in the developing world, such as a similar case study in New Delhi.

Tying together practical measures water utilities need now, and gains in climate mitigation, is the aim of the WaCCliM project, and more on this case study and useful resources can be explored on the project's knowledge platform ClimateSmartWater.org. Share with us your inspiring water utility story today!

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ISLANDS AS LIVING LABS FOR CIRCULAR ECONOMICS

By Nadine Galle, Metabolic Foundation

Islands have fascinated scientists for centuries as key hotspots of change. Now, economists are taking a keen interest in their role towards accelerating the circular economy. This summer, Metabolic will collect data, visualize, map, and analyze all resource flows on the Dutch Wadden Island of Vlieland. With this comprehensive overview, key stakeholders and local residents will work to further close the loops and achieve their self-sufficiency goals. Here I examine how islands are natural living labs and why starting small, on an island scale, could bring about the insights necessary to develop the most promising circular interventions.

When I was in school for earth sciences, one class stood out: island biogeography. The field originated in Darwin's time to explain how species diversify as they disperse across islands. I was drawn in by the story of Darwin's finches, perhaps the most famous example of species diversification, where finches on different islands had evolved different beaks to account for differing food availability. To me, it represents in a very clear visual way the uniqueness of island geographies and their ability to catalyze profound changes.

And just as islands are a living laboratory of evolution, they also provide a natural playground for another shift. Islands attract millions of tourists every year, mainly driven by their special location and rich natural and cultural heritage. Yet, despite their attractive qualities, islands face distinct challenges and vulnerabilities through such issues as resource pressure, limited economic diversity, and vulnerability to climate change. It is these issues that demonstrate the urgency of the circular economy and it is the clearly defined boundaries of islands that make islands perfect isolated laboratories to test out how to make it a reality.

Closing the loops on Vlieland

Vlieland is the smallest inhabited island of the Dutch Wadden Islands, in the North of the Netherlands and lies farthest from the mainland. Despite only having one town, the island has several highlights and attracted over 200,000 visitors last year. Currently, virtually all Vlieland's products are imported

from the mainland. After use, their waste is also transported back to the mainland to be processed. The transport consists primarily of diesel-powered ferries and ships, which carry goods and people back-and-forth from the island.

For all its challenges, Vlieland holds great potential for energy savings and more renewables, likely in the form of increased wind turbines and photovoltaic panels. Waste flows also hold great potential. In the short term, waste can be significantly reduced with measures on smart, recyclable or perhaps reusable packaging, and later, examining flows for potential upcycling on the island. Manure and food wastes, for example, could be used locally instead of being shipped back to the mainland.

Since 2007, Vlieland has made strides to realize its ambition to become fully sustainable with a focus on becoming energy self-sufficient by 2020. However, in 2014, Lab Vlieland, which supports sustainable initiatives on the island, voiced concerns about the progress towards energy self-sufficiency so far. Pilot projects had struggled to scale up and there was objection to exclusively focusing on energy self-sufficiency.

In partnership with Lab Vlieland and the local municipality, this summer Metabolic will take it a step further by collecting data, visualizing, mapping, and analyzing all the energy, water, and material flows on the island. Thus, this comprehensive 'material flow analysis' will also holistically address issues of waste management, imported goods, logistics, transport, mobility, and sustainable tourism.

Working on such impactful circular economy initiatives that can so demonstrably scale-up is a driving motivation for Metabolic, but sometimes the passion is even closer to home. My co-project manager, Gerard Roemers originally comes from the neighboring Dutch Wadden Island of Ameland and is excited by the ways our lessons in Vlieland could be applied elsewhere, including his home island. Summarising the opportunity at Vlieland he said, "By outlining an integrated overview of all these streams, prominent stakeholders, the municipal government, and local residents can intervene at evidence-based priority areas to close the loops on the island and realize a sustainable and circular economy".

Success stories of circular islands

Success stories are already coming out of islands that have implemented renewable energy and circular thinking. In 2009, the island of Samsø in Denmark reached its renewable energy goal with resident-owned wind turbines. Samsø residents now have a carbon footprint of negative 12 tonnes per person per year, compared to the Danish average of 6.2 tonnes and the Australian 17 tonnes. The wind turbines are owned by a combination of private owners, investor groups, municipal government, and local cooperatives. Problems related to the 'NIMBY'-factor (not-in-my-backyard) were combatted by allowing anyone who could see the turbine from their home to sign on as a co-investor. This bottom-up approach and community buy-in were crucial to the success of the zero-carbon master plan. In October 2015, Samsø launched the even more ambitious 'Full Circle Island' project which aims at making the island the first fully circular place in the world. Again, the natural laboratory setting of an island makes Samsø an ideal playground for testing new ways of working to close the flows of goods, energy, water, food, and capital.

Indeed, establishing a circular economy on islands has a multitude of benefits. Socially, successful circular economic applications on islands have the potential to scale to the mainland. These should be supported by a global network of circular islands in which best practices, awareness, and education of a circular economy can be spread amongst peers. There is also a range of business benefits, such as significant cost savings from the reuse of materials and the reduction of waste for waste processing. Lowered emissions result from fewer waste disposal transits and material goods imports (often by diesel-powered ship). Perhaps most significant is the environmental benefit of reusing what we have instead of disposing of it. Reuse preserves the natural and cultural heritage which could otherwise be threatened by rampant waste disposal.

Our work with Living Labs

Islands are ideal living labs due to their geographical insularity, however experimentation and innovation can occur on a number of scales. Communities are often bonded over shared environments and strong social ties, which can promote collaboration and more rapid buy-in to new ideas and technology. So, it is important to empower them to act on this potential.

The Metabolic Foundation was established to do just this – it has set up a Community FabLab to provide resources, services and programs that make tools, knowledge, and clean technology accessible to the community. A FabLab (short for fabrication laboratory) typically partners with local organizations and community spaces to provide local residents with the basic resources to develop and express themselves and their community. This is important as communities, like islands, are uniquely positioned accelerate the transition to a circular economy by allowing room for experimentation and a playground for new innovation.

Metabolic Foundation's Community FabLab is called Brenchie's Lab and is located in Aruba, an island in the Caribbean. Brenchie's Lab leads the "Plastic Beach Party", a recycling collective aiming to create a future with no more plastic on its beaches. The goal is to create a movement where plastic dependence is reduced in part by creating a financially sustainable model to recycle plastic into locally relevant and reusable products, while also leading beach cleans. This approach works both to clean the existing environment, reduce reliance on the mainland, and involve local residents to make a difference in their own community. The work in Aruba could become a model for how other islands, and then larger communities, can also tackle plastic waste.

Ideas that can take off

As the world begins to grasp circular economics, they will also need to grow and protect island economies. So far, circular economy development has primarily focused on centralised and urban supply chains. Starting small, on an island scale, could bring about the insights needed to further research, experiment, and improve the most promising of circular interventions. Islands are unique. According to the theory of island biogeography, their isolation allows evolutionary processes to occur at different rates. Just like finches tried and tested their many beaks, we can try and test many circular interventions to find what works. Then we can help these ideas and interventions to take off and really fly.

Photo credit

https://www.pexels.com/photo/person-s-left-hand-holding-green-leaf-plant-886521/

BUILDING BLUE-GREEN CITIES

By Robert Brears, Founder of Mark and Focus and Our Future Water

Faced with climate change and environmental degradation many cities are turning to Blue-Green Infrastructure (BGI) solutions to enhance climate resilience as well as restore the health of ecosystems.

BGI is a strategically planned network of natural and semi-natural areas, ranging in size from rain gardens right up to green streets, that are designed and managed to deliver a wide range of environmental, economic, and social benefits including improved water quality (BGI captures and cleans stormwater, ensuring waterways are healthier), reduced potential for flooding (BGI slows down and holds stormwater allowing it to soak into the ground), enhanced resilience to climate change (BGI can use water as a resource for communities and natural habitats), reduced infrastructure costs (BGI reduces the volume of water entering the sewer system, increasing the lifespan of the sewers and reducing infrastructure maintenance costs), and increased space for communities and wildlife (BGI provides multiple mental and physical health benefits to communities as well as a sanctuary for urban wildlife and pollinators).

Los Angeles' Blue-Green Infrastructure Key to Water Security

Across Los Angeles, more than 27,000 acre-feet, or 8.8 billion gallons, of stormwater is captured each year at centralized spreading grounds where it recharges groundwater in the San Fernando Groundwater Basin. Stormwater that cannot be captured is discharged to the Pacific Ocean via the city's rivers and stormwater drains.

The Los Angeles Department of Water and Power (LADWP) is in the development phase of a stormwater incentive program for the infiltration and on-site use of stormwater from industrial facilities. This program aligns with the Sustainable City pLAn's goals of reducing the purchase of imported water by 50% by 2025 and producing 50% of LA's water locally by 2035. Under the proposed program, all industrial facilities regulated by the Industry General Permit and within LADWP's service area/areas of interest will be eligible to participate in the program. The total rebate amounts will be based on yield

for each respective facility, with the rebate amount of $1,100/acre foot (AF) for infiltration and $1,550/AF for onsite reuse. Requirements for the program may include:

- Program participation agreement
- Possible flow meter installation, subject to inspection and verification
- Access to the stormwater infrastructure for testing, inspection, and observation regarding maintenance, operation, repair, and replacement of the stormwater infrastructure

With success of the program dependent on stakeholder feedback, LADWP hosted a meeting to communicate the program's development and engage with attendees, including facility managers, industry representatives, and environmental and community-based organizations, on how best the proposed program can be implemented. Feedback on the proposed program is also being gathered from industrial facility managers, trade groups, state and regional water quality and environmental stakeholders. From this, all comments will be reviewed, and the program modified, if necessary, before implementation.

Building a Climate-Resilient, Blue-Green Oslo

Oslo's high population growth and rapid urban development means climate resilience is becoming increasingly important. By 2030, it is projected that the population of Oslo will be around 30% higher than today, making it the fastest-growing major city in all of Europe. The combination of urbanization impacts from a rising population and more extreme precipitation events from climate change will reduce natural drainage and make the population more vulnerable. In response, the city is implementing a range of Blue-Green Infrastructure strategies to enhance the city's resilience to climate change-related extreme weather events while restoring nature.

Reopening waterways

Oslo has 10 main waterways that run through its urban areas. Up until recently, the city's waterways were considered problematic for sewage and an obstacle to the development of land. As such, large sections of waterways flow through pipes and culverts. However, these have predefined capacities and with more frequent and heavier rainfall from climate change, urban flooding will become an increasing challenge. Oslo has decided to restore these waterways by reopening closed rivers and streams where possible to handle stormwater more efficiently, as well as create recreational spaces for people and facilitate increased habitat for biodiversity.

Over the past decade, a total of 2,810 meters of waterways have been reopened. The reopened parts have rapids, deep pools, and recreational areas as well as a purification system to manage runoff from roads. One example is the Teglverksdammen Project which is a reopening of around 650 meters of the stream Hovinbekke. The project has been planned and designed as a natural cleaning system with several sedimentation basins, a stream with water rapids, a small lake, and shallow waters with dense vegetation. Stormwater from a nearby school is also safely led into the newly reopened stream.

3D simulation of flooding

Oslo has created a 3D-model of the entire city that enables surface runoff simulations to be conducted to pinpoint floodways. The model provides theoretical drainage lines that have been analyzed according to slope and catchment area to give the probability for flooding and/or erosion. The model has surface runoff and inundation depths for a storm event with a 200-year return period, enabling the city to target and prioritize mitigation and better determine the retention and floodway system.

The Blue-Green Factor

Oslo will use the Blue-Green Factor (BGF) to ensure there are 'blue-green' qualities in construction and renovation projects, with the BGF tool being designed to give a higher priority to green areas and outdoor spaces in planning processes, and to ensure predictability for developers in terms of requirements for outdoor spaces in the context of water management, vegetation, and biodiversity. Specifically, the BGF scores the 'importance' of each structure based on performance criteria mainly in relation to water infiltration and storage capacity. Scores are given for different kinds of blue-green surfaces in relation to their hydrological regulating effect. Additional points are also given for water and vegetation features that enhance runoff control in

conjunction with aesthetic qualities and biodiversity habitat. To make the BGF scoring more accessible to the wider public, researchers from NINA in cooperation with city officials under the OSLOpenNESS project have developed an Android application version — BGF calculator — for Smartphones. The BGF calculator utilizes both the calculator and satellite images from Google Maps to automatically calculate total property BGF.

NYC's Green Infrastructure Expansion

Green infrastructure is playing a key role in New York City's stormwater solution with the New York City Department of Environmental Protection (DEP) managing 586 million gallons of stormwater per year and 467 equivalent greened acres through green infrastructure projects, the majority of which are on right of ways and public property. Moving forward, the city is expanding its Green Infrastructure Program to private property owners.

New York City's green infrastructure aims to reduce combined sewer overflows (CSO) into New York Harbor, in addition to providing multiple community and environmental benefits to the city's neighborhoods and residents in a cost-effective way. These secondary benefits include increased urban greening, urban heat island reduction, and more habitat for birds and pollinators. By incentivizing retrofits on private property, in addition to retrofitting the city's streets, sidewalks, and public property, New York City is well on track to meet its 2030 CSO reduction goal of 1.67 billion gallons of stormwater a year.

Private Incentive Retrofit Program

DEP will be releasing a Request for Proposals to procure a Program Administrator to launch and administer a new green infrastructure Private Incentive Retrofit Program. The five-year contract will have a value of $43-$58 million with a goal of retrofitting 200 greened acres. The Private Incentive Program will be limited to specific tiers of private properties in the combined sewer areas of the City to maximize the potential of green acres managed:

• Tier 1: Privately-owned properties in the combined sewer areas of the city that are greater than 100,000 square feet (SF), with 915 sites identified covering 6,170 gross acres

• Tier 2: Privately-owned properties in the combined sewer areas of the City that are between 50,000–99,999 SF, with 1,511 sites identified covering 2,366 gross acres

Fast-tracking green roofs

DEP has released a streamlined fast-track review process for private green roof projects funded through its Green Infrastructure Grant Program. The funding schedule sets reimbursement rates for green roof projects based on growing media depth and planted area with reimbursement rates for green roofs between 3,500–20,000 SF set as follows:

• Projects with soil depths of 1.5–1.99 inches will receive $10/SF
• Projects with soil depths of 2.0–2.99 inches will receive $15/SF
• Projects with soil depths of 3.0–3.99 inches will receive $25/SF
• Projects with soil depths of 4.0+ inches will receive $30/SF

These upfront reimbursement rates eliminate uncertainty over how much funding is available for potential projects and by giving this information to applicants in advance it means DEP can fast-track green roof grant applications, with anticipated design approval within 90 days from the submittal date.

Conclusions

From the case studies, three main pointers can be deduced: stormwater is a precious resource to be utilized in the pursuit of water security, BGI can manage localized flooding while restoring natural habitats and protecting infrastructure from climatic extremes, and cities can incentivize the private sector to implement green infrastructure solutions that have multiple public benefits.

Photo credit

https://pixabay.com/en/architecture-building-environment-21702/

SUSTAINABLE SANITATION ALLIANCE (SuSanA) MENA CHAPTER

By Lara Nassar SuSanA MENA Chapter

On the 27th September 2015, a high-level plenary meeting of the General Assembly adopted 17 Sustainable Development Goals (SDGs) officially known as Transforming Our World: the 2030 Agenda for Sustainable Development — the culmination of a three-year process aimed at synthesizing the environmental, social, and economic dimensions of development. The SDGs have built on the eight Millennium Development Goals (MDGs) set in 2000. While much has been achieved through the MDGs, countries region-wide did not make sufficient progress on environmental sustainability and the SDGs are therefore set to ensure just that.

"Whilst globally significant achievements were made for many of the MDGs, progress was uneven between the MDGs, as well as across regions and countries. The MDG target for sanitation was missed by a wide margin, and this highlights the urgency for increased action in the sanitation sector. The lack of knowledge and of capacity at all levels is one of the many reasons for this failure, with its concomitant huge health and economic consequences."[1]

Key Challenges

Even though water extraction increased by almost twice the rate of global population growth in the 20th century,[2] UN-Water[3] highlighted that billions of people around the world still lack safe water, sanitation, and handwashing facilities. An estimated 63 percent of the West Asia and North Africa (WANA) region still lack safely managed sanitation facilities[4], which include the unsafe disposal of human feces in open fields, bodies of water or with solid waste. With much of the wastewater left untreated, water pollution, hygiene, health, and more importantly water availability region-wide is under threat.

"Over 2.3 billion people lack basic sanitation services, 892 million still practice open defecation and 4.5 billion people lack safely managed sanitation services. These will not be eradicated by 2030 with current trends."[5]

Policy research has demonstrated that due to poor water decision making and infrastructure, water insecurity has in-

creased, and unsustainable sanitation conditions have worsened which impact food security, livelihoods, and educational opportunities.[6] This is further exasperated by approximately 22.5 million refugees that have been globally forced to migrate and live in refugee camps or in host countries. In Jordan for example, United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) and United Nations High Commissioner for Refugees (UNHCR) has registered 2.8 million refugees and have estimated that 622 USD is needed for water costs per refugee per year.[7] These costs account for water supply, sanitation, and indirect opportunity costs per cubic meter.

Significance of Implementing SDG 6

It is clear, there is a global and regional need to address these urgent challenges. SDG 6 on Water and Sanitation focuses on addressing key components on water availability, sanitation, improved water quality, increased water efficiency, ecosystem protection, and finally water diplomacy.[8] More importantly, SDG 6 and its targets address sanitation beyond toilets which include aspects of excreta management and reuse. However, it is also important to note that sanitation, hygiene, and wastewater management – key elements in SDG 6 – are key fundamental aspects needed to achieve not only SDG 6 but many of the other SDGs.

In that regard, SuSanA (Sustainable Sanitation Alliance) an informal network of people and organizations who share a common vision on sustainable sanitation and want to contribute to achieving the SDGs, in particular, SDG 6, showcased how Sustainable Sanitation[9] can be the core aspect needed to implement all the other SDGs (Figure 1). Launching the SuSanA Middle East and North Africa (MENA) chapter in late 2017 has encouraged the work on achieving SDGs in the region for countless benefits that include; water security, ending the cycle of disease and escaping the poverty gap.[10]

“The overall goal of SuSanA is to contribute to the achievement of the SDGs by promoting sanitation systems based on principles of sustainability. The Sustainable Sanitation Alliance welcomes and greatly appreciates the SDGs as they highlight the important role sanitation has in sustainable development and help push sanitation further up the political agenda. The focus of the work of the Sustainable Sanitation Alliance in the context of the 2030 Agenda will be to facilitate the implementation of sustainable sanitation systems in water and sanitation at all levels considering the three dimensions of sustainability: social, environmental and economic”.[11]

Regionalising key recommendations

Operationalizing the SDGs has proven to be harder than originally thought. It presents challenges for different sectors, and acknowledging these challenges offers possible opportunities for enhanced implementation. Much research has been done on providing key global science and policy recommendations to better implementation.

The guide to SDG interactions[13] has identified the great need for mobilizing expertise that helps in strengthening science-based decision-making and thus creating a science-policy-society interface. Other research has identified strengthening data systems and creating regional partnerships to enhance multi-stakeholder engagement processes and develop capacities.[14]

The SuSanA MENA Chapter, therefore, aims to regionalize these key recommendations and address today’s complex economic, societal, environmental, and cultural challenges which require a platform where knowledge is co-created through science-policy-society interfaces. This Chapter aims to create platforms that allow rich exchange between the three.

Only through strong linkages between science, policy, and society can knowledge be created and used to make strong evidence-based decisions that help empower the civil society in developing countries.

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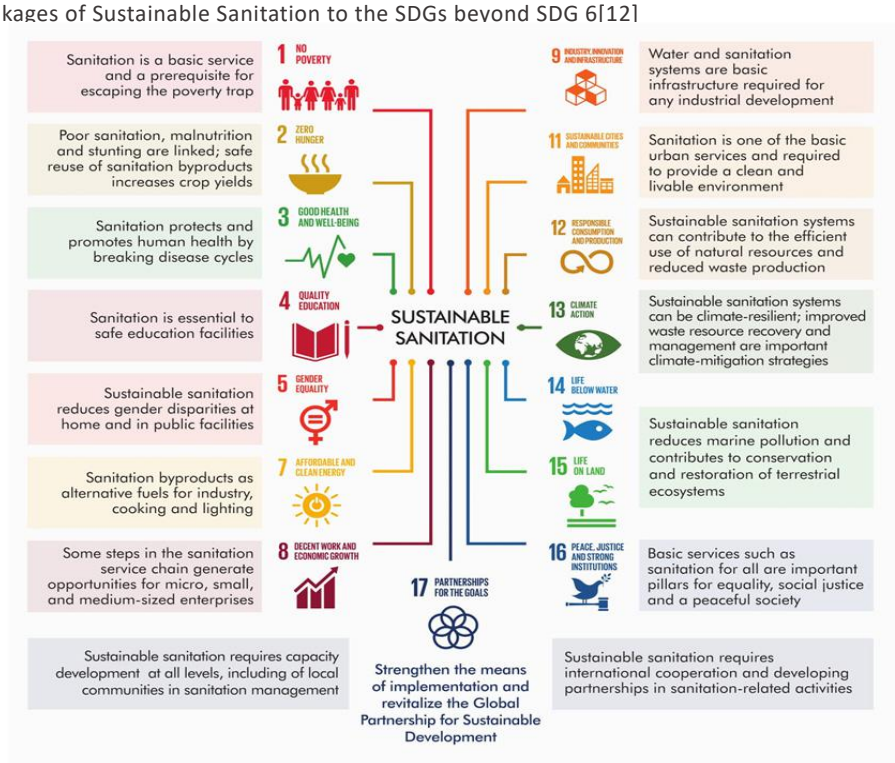
[1] SuSanA (2017). Contribution of sustainable sanitation to the Agenda 2030 for sustainable development - SuSanA Vision Document 2017. SuSanA, Eschborn, Germany

[2] Nassar, Lara (2017): A Guidance note for SDG Implementation in Jordan: Water, Energy and Climate Change, WANA Institute; http://wanainstitute.org/en/all-publications?f1=197&f1=197

[3] UN Water (2017) “SDG 6 Synthesis Report 2018 on Water and Sanitation”; http://www.unwater.org/publication_categories/sdg-6-synthesis-report-2018-on-water-and-sanitation/
[4] Safely managed sanitation facilities indicate the use of improved facilities that are not shared with other households and were excreta are safely disposed of in situ or transported and treated offsite. This data is derived from the UN-Water SDG 6 synthesis report 2018.
[5] UN Water (2017) “SDG 6 Synthesis Report 2018 on Water and Sanitation”; http://www.unwater.org/publication_categories/sdg-6-synthesis-report-2018-on-water-and-sanitation/
[6] Nassar, Lara (2017): A Guidance note for SDG Implementation in Jordan: Water, Energy and Climate Change, WANA Institute; http://wanainstitute.org/en/all-publications?f1=197&f1=197
[7] ibid
[8] ibid
[9] There is no exact definition of sanitation in the 2030 agenda, but there are two targets 6.2 and 6.3 that speak directly about wastewater and sanitation management. The SuSanA alliance has defined Sustainable Sanitation within the 2030 Agenda to be: a system which not only protects and promotes human health by providing clean environment and breaking the cycle of disease, but also to be economically viable, socially applicable, and technically and institutionally appropriate which protecting the environment and its natural resources.
[10] SuSanA (2017): Sustainable Sanitation and the SDGs: Interlinkages and opportunities. SuSanA interlinkage document. https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/2859
[11] SuSanA (2017). Contribution of sustainable sanitation to the Agenda 2030 for sustainable development - SuSanA Vision Document 2017. SuSanA, Eschborn, Germany
[12] SuSanA (2017): Sustainable Sanitation and the SDGs: Interlinkages and opportunities. SuSanA interlinkage document. https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/2859
[13] International Council for Science ICSU (2017). A Guide to SDG Interactions: from Science to Implementation; https://www.icsu.org/cms/2017/05/SDGs-Guide-to-Interactions.pdf
[14] UN Water (2018): Highlights from the Sustainable Development Goal 6 synthesis report 2018 on Water and Sanitation.

Figure 1. The Interlinkages of Sustainable Sanitation to the SDGs beyond SDG 6[12]



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RESILIENT CITIES

Leading cities are implementing resilience-building strategies

WATER-FOOD NEXUS

More water will be required for food production. At the same time water quality is impacted.

SMART H20 CITIES

Water utilities are using smart technology to manage scarce resources efficiently.