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Circular Economy, Reduce, Reuse, Recycle

Theme leader: Global Water Partnership Organization

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Key Messages

Key Message 1: on Water Reuse – Recycling– Reduce

- **Water reuse isn’t the future – it is the present.** Innovative technologies and approaches on water resource management can help to diversify sources of water while at the same time decrease costs, and increase resilience of communities. There are considerable opportunities for making use of different sources of water (storm water, rain water, raw water, grey and black waters) available as potential new resources, that will require technology transfer, social acceptance, adjusted legislation, tariffs and regulation. Water recycling is an opportunity in regions with high water scarcity, this solution becomes essential for social, economic and environmental sustainability because it reduces stress on the water resource. The approach of water conservation, i.e. water demand management, is also important for water-scarce areas when options of developing new water resources are limited and costly. It involves the adoption of policies or investment by a water utility to reduce the waste of water resources and achieve efficient water use by all members.

Key Message 2: on Wastewater

- **Wastewater is not wasted water; it is potentially an important resource.** Sludge was traditionally considered as a waste in the water sector. But now new approaches have turned it into a valuable resource from wastewater that can be used to generate electricity, recover nutrients, and reduce landfill disposal. Benefits such as income generation, employment, poverty alleviation, contribution to food security, improved environmental standards can be gained from well-defined sludge management. Decentralized wastewater treatment systems (DEWATS) and community manageable solutions can respond to local needs and capacity in an efficient and sustainable way.

Key Message 3: on Enabling Environment

- **Making circular economy a reality requires a conducive and enabling environment.** It will require coordination mechanisms at all levels of government and the involvement of all stakeholders, as well as a long term and holistic urbanistic planning processes. New business models and opportunities can be derived from the adoption of a circular economy that will require new finance, regulation, norms, and raising the priority for investment in wastewater and reuse. The adoption of a new Circular Economy approach will also require cultural change and acceptance: sensitization of the populations on all issues relating to wastewater management and water quality and rainwater.

1. Background

Key Challenges

As the main economic engines of growth, Asian cities are increasingly challenged to ensure sustainability of development while reaping the benefits of urbanization. In 2016, 48.2 % of the Asian population was living in urban areas and the urban population is expected to rise to 64% by 2050¹. In the meantime, water bodies are being overexploited, as both sources of water and also as means of wastewater disposal.

According to a study released in March 2016 by Massachusetts Institute of Technology researchers in the journal PLOS², at least 1 billion of the Asia's estimated 4.4 billion people could be facing extreme fresh water shortages in the near future. The researchers go on saying that if current trends in climate change and population growth continue, models show that a big swath of Asia could be facing a "high risk of severe water stress" in as little as 35 years.

Most Asian cities do not have effective wastewater treatment systems. In the Philippines, for example, only 10% of wastewater is treated while in Indonesia the figure is 14%, in Viet Nam, 4%, and in India, 9%³ rivers have been degraded by over-extraction and pollution, and entire ecosystems have been damaged, with negative impacts on biodiversity and the lifestyle of people in the area. In addition, over 1.7 billion people lack access to improved sanitation in Asia and the Pacific and millions defecate in the open. But building new toilets alone is not enough to improve public health, says ADB analyst Jingmin Huang.

Cities in Asia and the Pacific region are increasingly feeling the pressure of population

¹ Reference: UN-Habitat. (2016). Urbanization and Development, Emerging Future. World Cities Report 2016.

² <http://www.businessinsider.com/asia-may-run-out-fresh-water-2050-2016-3?r=US&IR=T&IR=T>.

³ <https://www.adb.org/features/wastewater-management-and-sanitation-numbers>.

growth and urbanization. In South-east Asia, although there are abundant rivers, the overpopulation has led to major pollution and caused the water to be undrinkable. Many people don't have enough clean water to drink. For South Asia⁴, home to nearly 1.6 billion people, it is estimated that 22 of 32 Indian cities face daily water shortages. Besides, South-east Asia and India are currently suffering from one of their worst heat waves in history with temperatures regularly reaching mid-forties⁵ (Celsius). While nearly 20% of the world's population are living in China⁶, the country only contains 7% of the world's fresh water. 11 out of 31 Chinese provinces failed to meet the World Bank's water needs criteria of 1500 m³ per person in 2014. Due to limited water resources, water is often a major cause of border conflicts in Central Asia⁷. And many Pacific islands ⁸are facing the risk that freshwater scarcity may lead to an uninhabitable island, which is mainly caused by climate change.

The Asian Region is also home to devastating floods exacerbated by the change in rain patterns. Just recently, in August 2017, more than 800 people have been killed and 24 million affected following widespread floods across south Asia, affecting mainly Bangladesh, India and Nepal. In 2011, the city of Bangkok has known one of the most destructive floods of its history, affecting all sectors of the economy and livelihoods. Urban planners are wondering how to make better use of rain, storm water and floods.

The above mentioned situations show that Asia cities face major challenges concerning both the quantity and the quality of the water resource. Promising experiences on IUWM and circular economy are gradually being developed in Asia that need to be captured and shared as they can have the tremendous potential to bring about changes in urban health and economy.

Urban strategic frameworks

The Paris Climate Agreement's central aim is to strengthen the global response to the threat of climate change. The Agreement requires all parties to make their best efforts through 'Nationally Determined Contributions (NDC)', which means each country determines, plans and regularly reports its own contribution to mitigate global warming. Since urban areas are responsible for 70% of global carbon dioxide

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<http://asiafoundation.org/2015/03/25/south-asias-water-crisis-a-problem-of-scarcity-amid-abundance/>

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<https://www.weforum.org/agenda/2016/05/southeast-asia-india-suffering-worst-drought-in-20-years/>

⁶ <https://globalriskinsights.com/2017/08/shocks-china-growing-water-crisis/>.

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<https://www.forbes.com/sites/realspin/2017/02/06/will-central-asia-fight-over-water-resources/#413578114c1f>.

⁸ <https://sinkingislands.com/2014/09/20/water-shortage-in-paradise/>.

emissions⁹, cities should take proactive actions to tackle climate change issue, which can ensure the health, wellbeing and economic opportunities for urban residents. The C40 Cities Climate Leadership Group is helping to deliver Paris Agreement and guarantee a sustainable development for both cities and citizens.

The Sustainable Development Goals clearly address these urban wills and challenges by proposing specific targets on water quality, pollution and wastewater treatment (SDG 6.3), integrated water resources management (SDG 6.5) and on waste management (SDG 11.6). As more and more people are migrating to cities, urbanization causes extreme environmental degradation. While at the same time, most global business activities take place in urban areas, cities should take a leading role to find a balance between nature and human so that both of them could develop sustainably.

In Quito (October 2016), world leaders adopted the New Urban Agenda which set global standards of achievement in sustainable urban development, rethinking the way we build, manage, and live in cities through drawing together cooperation with committed partners, relevant stakeholders, and urban actors at all levels of government as well as the civil society and private sectors.

Promising approaches (IUWM and Circular Economy)

Furthermore, the adoption of integrated and innovative approaches is likely to have multiple benefits in terms of improved livelihoods, poverty alleviation, health, employment, income generation, ecosystem sustainability, urban resilience capacity, urban food security and energy security. IUWM is nested within the notion of IWRM. As IWRM provides a framework for interventions over the entire water cycle and a reconsideration of the way water is used and reused, the idea behind IUWM is to consider the entire urban water system in a holistic manner as a part of a coherent framework.

Emerging innovative approaches are increasingly being adopted that include integrated management, considering the whole cycle, from its resource to its use, its waste and reuse, as one system, as well as promoting a multi-sectoral approach where all urban users of water upstream and downstream can communicate and plan.

Unlike the traditional 'take-make-dispose' business model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. The circular model based on three principles: design out waste and pollution; keep products and materials in use; and regenerate natural system. This concept requires that economy needs to work effectively at all scales for both large and small businesses, globally and locally. Through recycling and reusing, circular economy will lead to a closed loop of product lifecycle, which can benefit both environment and economy.

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<https://www.iea.org/newsroom/news/2016/september/cities-are-at-the-frontline-of-the-energy-transition.html>.

The use of recycled water as a potential resource for industrial and agricultural applications, as well as for drinking water offers an alternative that could help to face the challenge of resource availability in water scarce areas. This solution can become essential for social, economic and environmental sustainability because it reduces stress on the water resource. Recycling water promotes productive activities across sectors, and consequently reduces negative economic and environmental impacts and contributes to diminishing potential conflicts. Resource recovery and reuse seeks to shift the focus away from waste that needs disposal, toward creating a valuable resource that can benefit (urban) farmers, create jobs and generate funds to improve sanitation (IWMI).

Combining policy planning for storm water management, rainwater harvesting, and wastewater treatment is a valuable option for developing eco-efficient water infrastructure to tackle such problems as water shortage, floods and public health concerns – in unison (UNESCAP 2011).

Decentralized Wastewater Treatment Systems (DEWATS) are based on the principle of low-maintenance since most important parts of the system work without technical energy inputs and cannot be switched off intentionally (ref BORDA). DEWATS applications provide state-of-the-art-technology at affordable prices because all of the materials used for construction are locally available.

This is just the beginning of a transition towards integrated management of wastewater, storm water, solid waste, energy, and urban agriculture within urban planning and management. It will require to adjust existing norms and regulations around the use of wastes as well a cultural mind shift in the way we perceive and consider the use of wastewater in all its forms.

2. Case studies

2.1 Water Recycling

Case 1: NEWater in Singapore¹⁰

Although Singapore has abundant rainfall, it still is considered as a water-scarce city-state. With growth of industries and population placing increased pressures on water resources in the early years of independence, PUB, Singapore's National Water Agency, was compelled to increase local water catchments, and look for innovative ways to diversify the sources of freshwater.

- **Diversify sources of water:** developing unconventional sources of water ie. using membrane technology to reclaim treated wastewater (to produce high-grade reclaimed water known as NEWater) and desalinate seawater. These sources of water are not dependent on rainfall, and are thus more

¹⁰ *References: Water Recycling in Singapore; Singapore Water Story* [PowerPoint slides].

weather-resilient. Today, NEWater and desalinated water can meet up to 40% and 25% of total water demand respectively.

- **Strong government support:** water issues are at the top of the government agenda since independence.
- **Public acceptance:** sustained public education programme (e.g. establishing the NEWater Visitor Centre for the public to learn about the treatment process and providing NEWater for public sampling purposes) to complement the technical rigor in the development of NEWater.
- **Monitoring and Maintenance:** stringent audit process on NEWater that continues to take place twice a year in Singapore.

Case 2: Rainwater harvesting and storm water management in Bangladesh¹¹

Rapid population growth in Dhaka City puts much pressure on urban water system. Even normal events now can cause drainage congestion and water logging. It can be foreseen the situation will be worse in the future due to climate change.

- **Pilot study on rainwater harvesting:** conducted by BWP and partner organizations. Results turned out to be feasible and promising.
- **Recharge groundwater aquifer:** rainwater is collected from rooftop and part of the storm water is injected.
- **Simulation with a model:** a rainfall-runoff model was constructed to simulate different scenarios to evaluate the performance of rainwater harvesting.
- **Injection rates may vary for different aquifer properties:** this is yet to be ascertained.
- **Rainwater quality:** injected water quality was recorded and no significant threat to contamination of aquifer was observed if rainwater in the first 10 min is flashed outside the recharge pit.

Case 3: Sponge city – Shenzhen¹²

Rapid urbanization brought series water challenges to Shenzhen city, in the form of storm water pollution, reduced environmental capacity and water shortage. The city is now aiming to address these issues and uncertain future, through circular economy and sponge city concepts, as important components for future development.

- **Strong political will and support:** ‘Shenzhen Water Strategy’ flood control program and several regulations were introduced (e.g. Shenzhen Blueline Management Regulations, Shenzhen Water Conservation Regulations).
- **Improved storm water management:** rainwater infiltration, retention and storage and Low Impact Development facilities were developed.
- **Demonstration area project:** Guangming New District was selected to examine low impact development.
- **Sludge reuse for nutrient recovery**
- **Public engagement:** public hearings, knowledge sharing and financing platforms

¹¹ Reference: *Rainwater Harvesting in Urban Areas*.

¹² Reference: <http://www.iwa-network.org/city/shenzhen/>.

have been created.

Key lessons learnt on water recycling: Innovative new technologies can be applied to diversify sources of water (recycled water, storm water, rainwater), which can be helpful to address water issues (e.g. water scarcity; water logging). Developing a new concept will also improve urban water management (e.g. 'Sponge city' concept in storm water management). Monitoring and maintenance on the operation of these technologies should be kept in mind. Sometimes, a demonstration project can be helpful to examine the feasibility of improved management before widespread applications. In addition, achieving public acceptance on such innovative solutions is significant. The media is an essential partner on public education.

2.2 Wastewater Reuse

Case 1: Wastewater to resource recovery in China¹³

Water resource shortage, increasing water use, large wastewater discharge and severe river water quality are the main challenges for China. To strengthen water security, the government is trying to make use of recycled water and consider wastewater as a new water resource.

- **Recycled water treatment plants:** the number and the capacity of the plants are both increasing. Treated wastewater is used to urban river recharge, green space irrigation and road cleaning. Higher standards will be applied in the future.
- **Wastewater treatment plants database:** all operation data of WWTPs are collected over the past 10 years.
- **Sludge management:** sludge is used for biogas production and soil enhancement. In Beijing, bio char produced from sludge is sold to landscape company.
- **A new water tariff system:** with help of World Bank and ADB, a national water tariff system is under development.
- **Public-Private Partnership:** the market is opened to attract more private sectors to promote PPP.

Case 2: Waste to Watts in India¹⁴

More than half of India is facing high water stress, as demand of water-intensive sectors is growing (i.e. agriculture, urban, industry and energy production). The current linear model will fail while a circular economy perspective can make water

¹³ Reference: Presentations from China during SWWW.

https://programme.worldwaterweek.org/Content/ProposalResources/PDF/2017/pdf-2017-6711-1-Fu_20170830_SWWW_All.pdf

¹⁴ Reference:

<http://wri-india.org/blog/waste-watts-how-sewage-could-help-fix-indias-water-energy-and-sanitation-woes>.

management more efficient. Usable water, nutrients and renewable energy can be abstracted from industrial and domestic wastewater.

- **Sludge-to-energy plants:** three useful products are generated (energy, digestate and water). Produced biogas is used for on-site energy, or purified further and sold as natural gas. Solid digestate is used for soil enhancement.
- **Cost-effectiveness:** sludge-to-energy plants can be installed in existing WWTPs, saving time, space and time.
- **Win-win:** current WWTPs lack capacity to fully operate. Non-traditional, smaller sludge-to-energy systems can be helpful to overcome. They can help WWTPs become financially feasible and reduce GHG emissions, which will meet growing water and sanitation needs.

Case 3: Community-managed DEWATS approach in Indonesia¹⁵

In Indonesia, urban sanitation is almost entirely private and on-site, and the institutional capacity is limited to manage sanitation services. Indonesian government then considers DEWATS as the best available option for eradicating open defecation and improving sanitation in urban areas.

- **Pilot site (SANIMAS):** 7 pilot sites were set up between 2003 and 2004, with decentralization of powers and functions to local government to promote co-management.
- **Political will and support:** service sustainability was drawn by revising implementation guidelines. Sanitation development program was included in national development plan.
- **Behavior change:** through campaigns and education at community level.

Key lessons learnt on wastewater reuse: Wastewater is not wasted and waste are valuable. Wastewater reuse can be applied to urban/peri-urban agriculture, which can address food security and reduce energy consumption of treatment plant at the same time. This new idea needs quality control methods to pay attention on public acceptance, since it raises health concern. Decentralized Waste Treatment System can meet local community demands and be sustainable applying RRR approach, which should be analyzed from a multi-disciplinary perspective. More job opportunities are created through public private partnership.

2.3 CE Enabling Environment

Case 1: Legal framework on rainwater harvesting and technical guidelines for solid waste management in Nepal¹⁶

Residents are facing acute water shortage during dry seasons, and land subsidence is

¹⁵ Reference: WSP. (2013). *Review of Community-managed Decentralized Wastewater Treatment Systems in Indonesia*. WSP, Washington, DC.

¹⁶ Reference: *Legal framework on rainwater harvesting and technical guideline for solid waste management: NEPAL*.

becoming a concern due to over pumping groundwater. Worse situations will occur under sustained population growth and climate change. So the government developed legal framework for rainwater to respond to water crisis.

- **Capacity building:** workshop were organized to municipal staff to influence the policy of local municipalities, inviting engineer and planners as well.
- **Public education:** 4 demonstration sites were developed to sensitize local people, with a rainwater harvesting guideline introduced in local language. Education on rainwater harvesting also took place in schools.

Solid waste management is challenging Nepal. Municipalities are limited to sweeping streets and dumping waste in the river or vacant land. Modern waste management techniques haven't been introduced. Government wants to improve solid waste management service and protect ecosystems at the same time.

- **Political support:** acts, guidelines and enforcement mechanisms were developed. Clear responsibilities were identified for stakeholders.

Case 2: Georgia¹⁷

To avoid occurrence of discharges of untreated wastewater that can affect access to drinking water, Georgia introduced several laws, regulations on water protection.

- **Strong political support and continuous leadership:** environmental technical regulations and decree on sewerage system treatment facilities improvement were approved. Legislative acts also defined water use categories and water bodies' classification.
- **Public engagements** are involved in projects related to water protection (e.g. public hearing).
- **Inter-governmental cooperation:** an authority was set up on trans-boundary water resource management between Azerbaijan.

Case 3: Green Policy in Mongolia¹⁸

The capital city, Ulaanbaatar is urbanized rapidly as a result of migration from rural areas. To achieve SDGs and deal with development challenges, the municipality is committed to develop a green city.

- **Strong political support:** Green vision originated from National Green Development Policy 2014, Ulaanbaatar Economic Development Strategy 2015 and Ulaanbaatar 2020 Master Plan and Development Approach for 2030.
- **Key stakeholder engagement:** a consultative process was contained during the development of the Green Development Strategic Action Plan.
- **Main challenge:** poor environment makes Ulaanbaatar not a 'livable' city.

Case 4: Business Models for Resource Recovery in South Asia¹⁹

Four types of business models are recorded by IWMI which make use of wastewater

¹⁷ Reference: Georgia case study.

¹⁸ Reference: Final Report of the Second GWP Pan-Asia Workshop.

¹⁹ Reference: Introduction on RRR, slides from IWMI.

and solid waste in urban/peri-urban agriculture. Challenges include lack of awareness and poor perceptions, as well as logistic capacity.

- **Favorable policy environment and institutional capacity:** need to be improved to ensure the model implementation.
- **Coordinated efforts and engagement of key stakeholders:** to influence policies.
- **Strong public private partnerships** are significant.
- **Public acceptance:** Since these models raise health concerns, actions such as knowledge education should be delivered, as well as focus on technical issues and quality control methods.

Case 5: Market opportunities for DEWATS in South-East Asia²⁰

The low level of sanitation services in some Least Development Countries in SEA makes water use not sustainable. While DEWATS can provide potential investment and market opportunities and thus is promising in SEA.

- **Political support:** to promote DEWATS, government should design adequate and sufficient legislative system.
- **Public awareness and behavior:** should be reformed to better maintain DEWATS, which can be focused on school education on young generation. And demand studies are important before intervention.
- **Develop scalable solutions:** good financing schemes are indispensable.
- **Pro-Poor Public Private Partnership:** since in low-income countries, investment from private sector can be limited due to higher risks, the 5P model can be used to overcome this problem.

Key lessons learnt on CE enabling environment: Before government's intervention, demand study is suggested to be carried out by government to better understand current situation. Coordination mechanisms and institutional capacity should be addressed at all levels of government. New business model (i.e. circular economy) application needs to sensitize the public, which may achieve through public education and stakeholder engagement. As agriculture is one of the pillars of economy in most Asian countries, addressing the connection between food security and water security is necessary. The government should always take care of the main issues (i.e. technical; institutional; regulatory; economic/financial; social) during implementations. But all the stakeholders are responsible and have a stake, which means it is not sole responsibility of government.

²⁰ UNESCAP. (2013). *Market Opportunities for Decentralized Wastewater Treatment Systems in South-East Asia*. UNESCAP Publications, retrieved from <http://admin.indiaenvironmentportal.org.in/files/file/Market%20Opportunities%20for%20DEWATS.pdf>.

3. Actions and Sub-actions, and measures to overcome the problems and achieve the solutions

- **Continuously political leadership and support** are required throughout the intervention. If necessary, existing policies, laws, regulations and guidelines should be revised and new ones should be introduced.
- **Coordination mechanisms** should be developed to improve institutional capacity. Integration of existing institutions needs to be promoted.
- **Economic incentives and financial funding** should be considered. Investments from **private sectors** are an important part, which requires government to draw their interest.
- Under the pressure of water scarcity issue, government should be able to **shift to new concepts** (e.g. sponge city in Shenzhen, green city in Mongolia, wastewater reuse) to diversify water sources.
- **Appropriate innovative technologies** can be applied to diversify water sources, it is not just copy paste from developed countries, sometimes a pilot study could be helpful to examine feasibility of the new approach. Demand study before intervention is suggested to help government better understand current situation.
- **Public acceptance and awareness education** on the new concepts and innovative technologies should be taken into account. For instance, they may be not aware of the whole value chain of solid waste, or it can rise health concerns for wastewater reuse. In addition, water-related behavior change should be promoted. This education on young generations is extremely significant. One key partner in public education is the media, whose influence can be considerable.
- **Monitoring and maintenance** of these technologies and facilities are important, to make sure targeted water can always meet the national standards.
- **Inter-governmental (regional) cooperation** on trans-boundary water issues is useful, viewing problems at catchment scales rather than urban scales.
- **New business models** can be developed in improved wastewater management and solid waste management. Communities should be educated and trained to these models.
- **Promotion of DEWATS** can be promising in some Least Development Countries, where the coverage of sanitation service is low. Co-management on DEWATS is required, which may be done with help of public-private partnership model.
- **Stakeholder engagement** should be carried out from the very beginning and throughout the process. This can be conducted in various forms, e.g. public hearings, online platform etc. Responsibilities should be identified for each stakeholder.