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Resource Efficiency for Green and Resilient Urban Development in the Asia-Pacific Region – The case of water –

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Table of Contents

Executive Summary

The study assesses the opportunities and challenges in achieving resource efficiency for green and resilient urban development in Asia and the Pacific with special reference to water. As an analytical framework, the research employs eco-efficiency and resource efficiency approaches coupled with discussions of green and resilient urban development in achieving sustainable water resources management in Asian cities. Attention is paid to suggestion of appropriate policy measures on how to achieve resource efficiency and green and resilient urban development in the region based on good practices from the Republic of Korea, Japan, and Nepal.

Asia and the Pacific embrace the majority of the world's mega cities and are characterized by high growth rates of small- and medium-sized cities. The region shows a unique pattern of urbanization and accounts for about 65% of the demographic expansion of all urban areas in the world since the onset of the 21st century (UN-Habitat, 2013). Such rapid pace of urbanization in the region has caused numerous problems, and may bring about many uncertainties. Amongst them, water is one of the most challenging issues for sustainable development.

There is an ensemble of challenges in terms of urban water management in Asia and the Pacific. First, water resource endowment per capita in the region is much lower than global averages. Second, water quality has rapidly deteriorated in urban streams, lakes, and wetlands as well as major rivers in the region due to numerous polluting industries around urban areas. Third, conventional water management systems in urban areas of the region have proved to be inefficient. Fourth, more demands of water in developing urban centres pose a threat to sustainability of water resources and have implications for the nexus between water and energy. Fifth, middle-class urbanites have increased demand for various goods that use more water resources in the industrial process. Sixth, the ecological efficiency of water use is not adequately managed. Finally, natural disasters, i.e. floods, are expected to be detrimental to the security and sustainability of urban areas in the region, especially coastal cities.

In order to overcome such problematic issues, innovative strategies are required for resource efficiency and green resilience in urban development. Eco-efficiency indicates more efficient resource use with less environmental impacts. Three principles relevant to eco-efficiency are: 1) internalization of externalities; 2) adequate pricing of resources and pollution; and 3) removal of perverse subsidies and incentives for compliance.

Together with eco-efficiency, the study pays attention to resource efficiency with reference to water resources. Resource efficiency is defined as the rationing of resource inputs on one hand to economic outputs, and social benefits on the other, and encapsulates the perspectives of a life cycle and value chain. This approach is useful in making water supply and consumption more effective. The quantity of water used in production and relevant resources have various implications with regard to water resource efficiency: 1) distribution and consumption; 2) pollution load generation and emission intensification; and 3) urban water and sanitation services operation with high energy efficiency (the nexus between water and energy).

Adverse impacts of urbanization on ecosystems can be ameliorated through the adoption of green and resilient urban development paradigms, such as eco-city, smart growth, urban resiliency and green buildings. Eco-city is referred to as human settlements in a sound

relationship with ecosystems without giving pressure on their carrying capacity. Eco-cities consume fewer resources and reduce amount of wastes and are associated with the idea of compact cities that advocate reduction of commuting distance and decrease of energy use in multiple-home buildings. This leads to easier maintenance of water infrastructure and conservation of ecosystems (wetlands, small streams and biodiversity).

Smart growth embraces a series of green ideas, including more compact growth, use of existing infrastructure, and investment in system maintenance, and these elements can help decrease costs, conserve and protect water resources in the long run. In a similar context, urban resiliency can strengthen the capacity of cities to implement diverse, multi-faceted, inclusive, and well-conceived ways in order to adapt to global environmental changes. One of the best ways to increase urban resiliency is to adopt green buildings. This type of building uses fewer resources such as water and energy whereas providing positive impacts on the health of those who live and work in them.

Water resource efficiency is instrumental in increasing efficiency in water management for green and resilient urban development. In coping with challenges in urbanization, infrastructure is one of the key areas that Asian cities should focus on. The idea of eco-efficient water infrastructure for green and resilient urban development is useful. The combination of physical (dams, embankments, piped water supply facilities, and wastewater treatment facilities) and non-physical infrastructure (laws, regulations, regulatory programs, government bureaus and civil society groups) is necessary for achieving an optimal level of water utilization and less burden to limited water resources, especially for urban areas in the region.

As good practices, the study highlights the experiences of three countries - the Republic of Korea, Japan and Nepal. The Korean government has embarked on the Smart Water Grid (SWG) Research Project since 2012 in order to manage the limited water resources efficiently. SWG is considered as an innovative solution to achieve efficiency of water resources management through the application of information and communication Technologies (ICTs), such as advanced metering infrastructure (AMI), smart sensors, and smart servers, etc. in water and wastewater treatment, distribution and supply systems. Japan's 3Rs (Reduce, Reuse and Recycle) approach is something to do with the idea of 'Sound Material-Cycle Society' which was initiated in 2012. This society works towards conservation or minimization of the natural resources consumption and reduction of environmental loads, as much as possible. Related policies are prevention or reduction of wastes, encouragement of cyclical methods of products, i.e., reuse, recycle, and heat recovery and recyclables (3Rs). In this scheme, environmentally friendly alternatives are taken into account in order to move towards a zero waste society.

The decentralized wastewater treatment system and the rainwater harvesting system installed at a School in Tokha, Kathmandu show the efforts to improve sanitation services and augment water supply together with consideration of sustainability in the rapidly expanding urban areas. The decentralized wastewater treatment system helps to enhance sanitation, adequate water supply in community or household level, to reduce the load of wastewater, and to decrease negative environmental impacts caused by wastewater. Rainwater harvesting plays a key role not only in providing additional water resources but also reducing flood (i.e. flashflood), soil erosion and contamination of surface water with pesticides and fertilizers from rainwater run-off.

The policy framework of this study encompasses five policy measures. First, **the integrated approach** is suggested. This approach necessitates the shift from piecemeal to

integrated and from centralized single-purpose to decentralized and multipurpose policies. Such policies and management systems require an integration of water supply, rainwater harvesting, wastewater treatment, solid waste (sludge) management, recycling and disaster prevention measures. More specifically, cities need to consider linking urban water issues with other non-water issues in an integrated fashion, i.e. transport and housing within the framework of green and resilient urban plans, the nexus between water and energy, and land use planning.

The second policy measure is **the increase of economic efficiency**. Economic efficiency for urban water management can be increased through various ways. As non-structural methods, municipal governments can consider the adoption of sound water tariff systems and the water budget approach. For instance, cities are recommended to employ the system of increasing block tariffs, which are also called, 'conservation pricing'. The examples of structural measures are the reduction of water losses through leakage and the prioritization of retrofitting existing infrastructure rather than constructing new infrastructure. Distribution losses are much larger than production losses, and therefore, primary attention should be paid to the distribution losses. Public utility authorities in urban areas should consider a pursuit of 'fix-it-first' policy, which can improve of finances, conserve water resources, and lower costs for their customers.

The conservation of ecological efficiency is the third policy measure in order to revitalize natural environments in urban areas and provide practical benefits such as the improvement of air and water quality, living conditions, water-related disaster prevention, and biodiversity. A fast track to increase ecological efficiency is to value ecosystem services in an adequate manner, which requires a prerequisite, the establishment of proper institutional settings, such as the Payments for Environmental Services (PES) system that values environmental services for conservation. The adoption of sustainable landscaping implanted with local plants can save large amounts of water and guarantee sustainability in urban areas in which landscaping in residential and commercial buildings is increasing in Asia and the Pacific.

As the fourth policy measure, **the enhancement of quality of life** is recommended. Universal access to clean drinking water and adequate sanitation services needs to be guaranteed in cities in the region, and human health, livelihoods, gender quality and economic development should be considered in a comprehensive way. Also, priority should be given to policies on how to empower the public, in order to increase resource efficiency and achieve green and resilient urban development. Small-scale solutions for water supply, such as rainwater harvesting, rooftop gardening and water reuse and recycling should be emphasized. Together with central or federal governments, municipal governments should advocate policies and plans for enhancing the capacity of urban dwellers to prepare for floods and respond to disaster and recovery.

Enabling environments are the fifth policy measure and the solid platform in achieving sustainable water management in urban areas. A good set of clear legal frameworks for the water sector should be introduced together with consideration of urban water issues. In addition, municipal governments in the region should mobilize funds to ensure financial sustainability through adequate levels of water tariffs or taxes and promotion of consumption pattern changes by education and demand management. Private sector participation should be considered for introducing cutting-edge technologies, management know-how, and additional funding from the private sector. Stakeholder participation is imperative in identifying opportunities to decrease water demand or make existent systems more efficient.

1. Introduction

The magnitude of urbanization at the global level is associated with not only the concentration of resources, people, capital, and technologies but also patterns of resource consumption and its pressure on the environment. Cities require approximately 80% of the world's energy and claim the same share of CO_2 emission. Additional pressures from urban development have been put on water supplies, waste collection and treatment systems, biodiversity and other crucial resources (Engelke, 2012).

Urbanization is rapidly taking place in Asia and the Pacific. In 2014, approximately 48% of the region's population (or more than 2 billion people) lived in urban areas. The share of urban dwellers in the region has been rising over the last 25 years as a result of natural population growth, rural to urban migration and the reclassification of rural areas into urban areas. An estimated 120,000 people are migrating to cities on a daily basis (UNESCAP, 2014a). By 2018 more than half of the regional population will live in urban agglomerations. In just over 30 years from this milestone, no less than two-thirds of the region will be urban, or around 3.2 billion people.

Whilst a complexity of challenges remains in cities in terms of resource efficiency and sustainability, cities provide new opportunities to enhance global sustainability by promoting low-carbon and resource efficient urban development. This window of opportunity leads to improvement of well-being, sustainable life styles and conservation of natural resources for future generation in urban development.

This study appraises the opportunities and challenges in achieving resource efficiency for green and resilient urban development in Asia and the Pacific with special reference to water. As an analytical framework, the research employs eco-efficiency and resource efficiency approaches coupled with discussions of green and resilient urban development in achieving sustainable water management in Asian cities. The case studies are drawn from the experiences of the Republic of Korea, Japan and Nepal which reflect the extent to which cities can contribute to enhancement of urban development through adoption of green and resilient and resource efficiency approaches for water management. As policy framework, the report suggests five policy measures. The first and overall principle is an integrated approach for resilient urban development, and the second measure is to increase economic efficiency. The conservation for ecological efficiency is also necessary as the third measure, and the enhancement of quality of life is emphasized as the fourth measure. Last, the study recommends an establishment of enabling environments.

The first part of the report pays attention to various issues and challenging factors of resources for urban development in Asia and the Pacific. A review and discussion on resource efficiency, and green and resilient urban development are followed with a special focus on eco-efficiency and its relevance to urban water management. Fourth, the research refers to good practices from the Republic of Korea, Japan, and Nepal as benchmarking cases. These cases illustrate sustainable ways of urban water management highlighting the significance of structural and non-structural measures. The five policy suggestions are discussed in the final chapter.

2. Issues and Challenges of Water Resources for Urban Development in Asia and the Pacific

2.1 Urbanization and Water Resources

Sustainable urban development is becoming one of the imperative issues. Over half of the world's population (54 %) live in cities in 2014, and the urban population grows by 2 people every second (UN-Water, 2013). Asia and the Pacific embrace the majority of the world's megacities and are characterized by high growth rates within small-and medium-sized cities. The region shows a unique pattern of urbanization after the turn of the new millennium and accounts for approximately 65% of the demographic expansion of all urban areas in the world since the onset of the 21st century (UN-Habitat, 2013). The new century can be dubbed as the 'Asian Urban Century.' In 2014, about 48% of the total regional population, which is more than 2 billion people, lived in urban areas. The region still has large number of population living in informal settlements/slums. For example in 2009, more than half a billion people in the region continued to live in slums, equal to 30% of the urban population (a decrease from 50% in 1990).The urban population is projected to reach 3.3 billion, which accounts for 63% of the total population in the region by 2050 (UNESCAP, 2014a; UN-Habitat, 2013)

Such a rapid pace of urbanization in the region will cause many possible challenges. National governments will need to mobilize a massive amount of resources for housing, water and energy infrastructure, and other physical elements of the built environment together with meeting tremendous resource and waste implications. Without urgent actions, cities in the region will be confronted with bitter realities of their sustainable development being undermined due to formidable challenges, particularly related to resource consumption patterns (Engelke, 2012; UN-Water, 2015).

Water is one of the most challenging issues for sustainable development. Water consumption per capita has increased in accordance with fast urbanization in developing countries because of two reasons. First, urbanization entails an increase of energy and goods production, which requires more freshwater consumption. For instance, coal-based power plants and nuclear power plants use a vast amount of freshwater. Thermal power is expected to be responsible for a third of China's industrial water withdrawals in 2030 (Engelke, 2012; UN-Habitat, 2011a).

Second, people in urban areas tend to consume more water when their income level increases. Piped water supply systems encourage rich urbanites to consume more water through personal use (showers, toilets), household appliances (dishwashers), and other direct forms of use (watering gardens and lawns or washing cars). Indirect water use by urbanites impacts on water availability, such as urban energy, increased goods items and even more food consumption (virtual water) (Engelke, 2012).

In addition to these, more challenges remain with regard to urban water management in Asia and the Pacific. Water quality control is a lingering problem in many cities, and the situation is increasingly more acute than before, which jeopardizes the amount of drinking water available. A lack of adequate sewage treatment facilities and well-connected sewers exacerbates the level of water pollution in numerous urban streams in the region.

Water-related disasters should draw more attention. The region is one of the most disaster-prone regions in the world, and in 2013, water-related disasters claimed over 17,000

lives, which were estimated at 90% of all water-related disaster deaths at the global level. Over US$ 51.5 billion were recorded as economic losses. One of the side-effects of urbanization is that more highly valuable economic assets and people are situated in disaster-prone areas such as floodplains, especially in large cities in the region (UN-Water, 2015).

2.2 Key challenges

There is an ensemble of challenges in terms of urban water management in Asia and the Pacific.

First, water resource endowment per capita in the region is much lower than global average. Population density of the region is 1.5 times higher than the global average with the lowest fresh water availability per capita of all global regions. Poor management of water resources decreases per capita availability. The availability per capita in the region is second lowest in the world because of population size and misuse and overuse of the supply (UNESCAP and KOICA, 2012).

Second, water quality has rapidly deteriorated in urban streams, lakes, and wetlands as well as major rivers due to the establishment of polluting industries in the outskirts of main cities or suburban areas in the region. The grave situation of water pollution worsens the availability of clean water for drinking, manufacturing and energy generation purposes in cities. Poor water supply and sanitation services can spawn detrimental impacts on the economy because of increased risk of disease and premature deaths. An aggregated US$ 2 billion per annum in financial costs and US$ 9 billion per annum in economic losses due to poor sanitation services are estimated in the countries like Cambodia, Indonesia, the Philippines, and Viet Nam (UNESCAP and KOICA, 2012).

Third, conventional water resource management systems in urban areas of the region have proved to be inefficient, which consist of a centralized piped water supply system, single water uses and large-scale and centralized wastewater treatment systems. For example, water losses in the course of delivery are defined as ‘non-revenue water’ that should adequately be addressed when considering an upgrade, retrofitting or construction of water management facilities. The total cost for non-revenue water can reach around US$ 14 billion per annum at the global level, of which over one third takes place in developing countries (UNESCAP and KOICA, 2012).

Fourth, demands of water in rapidly developing urban centres pose a threat to sustainability of water resources in the region, and negative impacts are often extended to surrounding environments thanks to urban sprawl. This phenomenon has implications for the nexus between water and energy, since more electricity is required in the course of water