From household-based sanitation facilities to urban-scale infrastructure

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Abstract. Around the world, urban sanitation continues to pose a significant challenge to achieve Sustainable Development Goals number 6. In a particular comparison with neighboring countries, Indonesia is known to lag behind in coverage and quality of urban sanitation infrastructures. Based on our experiences, we take closer look what type of technical solution, implementation, and approaches have been applied and their evaluation over time. For the future, we are looking for new, more flexible and comprehensive approaches to address significant development gaps after implementation our historical sanitation technologies approaches as: (1) Low cost urban sanitation facilities of Water and Sanitation Decade, 1980-1990; (2) Decentralization of urban sanitation infrastructures of Millennium Development Goals, 1990-2015; (3) The development of citywide versus medium sized communal sanitation infrastructures, 2015-today. By taking a longer historical view as we have done from 1980 until now, we identify that City Wide Inclusive Sanitation (CWIS) approach will be the one of the development approaches of urban sanitation infrastructures and facilities that can accelerate development of safely-managed urban sanitation in Indonesia. CWIS is a comprehensive planning and implementation approach for improving and developing the whole urban sanitation development including its service chain.

1. Introduction
Cities are a reflection of society, telling us a unique story about the way we plan, design, build, operate, maintain, and develop human settlements. Across Indonesia's urban areas, development is a reflection of the driving force behind economic growth, rather than being shaped by the quality of environmental health. One of the fundamental indicators of this relates to the attention given to sanitation facilities and infrastructure. Sanitation facilities in Indonesia are largely defined by the development of individual household, not as a municipal service to meet the broader quality of life in a city. As long as density remains low among human settlements, status quo may be appropriate; but as the scale of a city gets larger and denser, management and maintenance services need to be met with government interventions or municipal organizations that can respond to the needs of, and protect, citizens.

Over the years, we have become aware that most of our urban areas in Indonesia do not provide adequate urban sanitation infrastructure and services, except when people take action on their own. This usually means building pit latrines or septic tanks for household sanitation. As a result of the lack of enforcement of regulatory standards, all cities in Indonesia experience significant water contamination. Rivers and ground water pollution act not only as vectors for disease but also influence the overall livability and quality of life. Indeed, tackling the growing burden of disease and compromised

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environmental health of Indonesian cities can be done through shifting the current approach of urban sanitation to a more integrated approach at urban and city planning, design, construction and operation.

2. A review of sanitation infrastructure development approaches in Indonesia

2.1. Development history

With over 250 million people, Indonesia is a large country, with more than 500 Local Governments. Approaches to improving municipal wastewater and sanitation infrastructure conditions began long ago through the promotion of Off Site and On Site Sanitation Disposal Systems. During the Water and Sanitation Decade (1980-1990) this was done through the Integrated Urban Infrastructures Development Program, which piloted projects and practical implementation initiatives such as Samijaga (Sarana Air Minum dan Jamban Keluarga/Low Cost Household Shallow Well and Toilet Facilities), MCK (Mandi, Cuci, Kakus/Low Cost Public Bath, Washing, and Toilet), and sewerage projects (Jakarta/JSSP, Bandung/BUDP, Medan/MUDP). In 1990, the Millennium Development Goals (MDGs) set out targets to achieve the elimination of 50% 1990 Open Defecation levels by 2015, and the result was that the target was nearly achieved [9]. The total achievement of sanitation access coverage in the year 2014 reached 62.14% of 62.40% set forth in the MDG targets from beginning at sanitation access coverage of 30% in the year of 1990 [9]. During this decade the focus was to achieve the goal of Open Defecation Free. However, Off Site Sanitation Disposal Systems were still developed as Citywide or Communal Facilities Scale. The 2016 Asian Water Development Outlook (AWDO) noted that Indonesia’s Improved Sanitation of Household coverage is at 61%, but that Collected Urban Wastewater System coverage was only 1% [1]. The 2020-2024 Indonesia’s development plan noted that progress of basic and improved sanitation facilities coverage at the end of the year 2018 was 76%, and safe sanitation facilities coverage 7% [4]. The 6th goal of the more recently established Sustainable Development Goals (SDGs) for the period 2015-2030 aims to achieve 100% coverage of improved sanitation facilities, and even further sets out a target to achieve safe sanitation facilities, followed by Indonesian National Development Planning Agency (Bappenas) setting target 100% coverage of improved sanitation facilities and 20% coverage of safe sanitation facilities at the end of 2024.

Around the world, urban sanitation continues to pose a significant challenge in achieving the Sustainable Development Goals in public health and the environment. Indonesia in particular, is often compared with neighboring countries and is considered to lag behind in coverage and quality of the achievement of urban sanitation infrastructure development. Indonesia is a large fragmented archipelago with complex management challenges across diverse regions, cultures, ecologies, and islands, and furthermore, is experiencing rapidly growing urban that creates particular barriers to providing adequate and safely managed urban sanitation. Based on our experiences, in this paper, we take a closer look at what type of technical solution have been implemented over time, and consider what type of approaches might be applied as solutions going forward.
**Figure 1.** Global sanitation improvement decades from 1980 to 2030.

**Figure 2.** Indonesia’s sanitation facilities access achievement and future prediction.
2.2. **Future development approach.**

Following global best practices for scaling up sanitation services, our proposed method is looking for a citywide integrated system which fulfills the goal of implementing safe and appropriate urban sanitation facilities and infrastructures that underpin a more flexible and comprehensive approach to address the significant development gaps. The rationale for selecting this overall approach builds on the experience of implementing historical sanitation technologies approaches as follows:

- Low cost on site and off site sanitation disposal systems that took place during 1980-1990;
- Decentralization of urban sanitation infrastructure development to achieve the Millennium Development Goals, which took place during the period of 1990-2015;
- Citywide sewerage, small and medium sized communal sanitation infrastructure systems, which are developed from the year of 2015 until now to find appropriate and affordable technology for urban sanitation in Indonesia.

By taking a longer historical view dating back to 1980, we identify that an integrated system can support urban sanitation infrastructure development and its development acceleration to break through problem of slow urban sanitation services development in Indonesia. This system is a comprehensive planning and implementation approach for improving and developing the entire of urban sanitation infrastructures and facilities and its service chain, with diverse adaptive and appropriate technical solutions, that are mixed with a variety of solutions, incrementally developed, which integrate both on site sanitation disposal techniques and off site sanitation disposal, at once incorporating centralized and/or decentralized systems, and providing affordable yet comprehensive operation and maintenance arrangements. For the future, this system can provide one of the fundamental approaches for urban sanitation infrastructures and facilities technology selection in Indonesia, which should be supported by non-technical factors such as increasing the political, will of Central, and Local Governments, adequate financial mobilization, community empowerment, law enforcement, management improvement, and public private partnership promotion.

2.3. **Government’s political will**

The overall perception both among the government and citizens consider that households are responsible for their own sanitation facilities and Local Governments are responsible for their services of sludge collection and treatment. This paradigm is appropriate if there are no land problems in laying proper septic tanks and soak away in the housing lot. Unfortunately, alongside the rapid expansion of urbanization, increased building and housing density result in many housing lots getting smaller and smaller, without enough land for laying their soak away or providing the adequate infiltration well. In this increasingly common scenario across urban Indonesia, government intervention is required to protect overall health of the population and manage the surrounding environment from water-related diseases, protecting them from contamination and water/soil pollution. These aspects on environmental health are also determined through nationally mandated policies, which would require identifying sanitation technologies across the service chain, such as the sitting and location for a wastewater treatment plant in the city area.

In 2003 The National Drinking Water and Environmental Sanitation Working Group (*Kelompok Kerja Air Minum dan Penyehatan Lingkungan*/*AMPL*) was established by the Central Government. It is chaired by Bappenas and supported by other related institutions and aims to accelerate development and improvement of sanitation infrastructures and facilities, and be followed by Provincial and Municipal (Kabupaten/Kota) Governments. Every 2 years, The National Water and Sanitation Conference (KSAN) are convened by the Central Government, and every year The Sanitation Summit is organized by the Association of Local Governments for Sanitation Awareness (AKKOPSI). This are carried out by the Local Governments themselves, and is a reflection of the political will among Local Governments from year to year. Given decentralization policy in Indonesia, these actions are important because by law, Local Government responsible to handle municipal wastewater management.
2.4. Community Participation.
Since last fifteen years, many municipal communal wastewater initiatives have been developed, establishing local leadership and interest in communities for demanding and increasing the quality of wastewater services. Indeed, municipal wastewater management motivation and participation of the community are continuing to grow. Association for communal sanitation organization have been developed, such as the Association for Indonesia Community-Based Sanitation Organizations (Asosiasi Kelompok Sanitasi Seluruh Indonesia, AKSANSI), and the Community-Based Sanitation Management Association (Komunitas Pengelola Sanitasi, KPP), as well as others whereby people are sharing knowledge and experience with each other on a regular basis. To accelerate this broader interest, the government has introduced various trainings and education to produce more municipal wastewater handling facilitators and also developing guidelines accordingly. In 2007, the environmental sanitation motivation activities were launched through annual Sanitation Jamboree activities, which educate, train, and motivate school children and also competitions for health and hygiene, among others. More recently, 24 Local Governments have introduced Municipal Wastewater Communication Forum (Forum Komunikasi Air Limbah Permukiman, FORKALIM) to conduct improvements on how to handle municipal wastewater management and to share knowledge and experiences to each other.

Municipal wastewater management challenges in urban areas are relatively more complex when compared with the same issues in rural areas. Accurate data collection and regular analysis is very important, as well as roadmap development and urgency task is required to mobilize stakeholder at Central and Local Governments such as NGO, private, and communities. New research and action is required to discover and establish a new paradigm for a new urban municipal wastewater approach that involves the appropriate technology and management considerations in order to provide input to the central government, local governments and the community, as well as others who are involved in municipal wastewater handling due to urban areas that are continuing to grow for the foreseeable future.

3. Household sanitation facilities and housing development
Due to urbanization and increasing density, housing development and characteristics are also undergoing changes, which create a significant new management challenge for sanitation facilities. The trend is that housing lot is getting smaller and more compact. This condition is especially challenging in locations with human settlement areas that are not covered by a piped water supply system. In these situations, people are forced to secure water through the use of shallow wells to meet their demand for water consumption. To provide adequate protection from contaminated groundwater sources, required enough distance between the soak away or leaching pit of the septic tank to the shallow well that are used for water access, which also depend on soil permeability conditions. Where these issues of proximity and contamination are not addressed, urban areas can be transformed in terms of the quality of their environmental health.

In order to provide adequate arrangement of sanitation facilities for housing lot, namely to treat and leach household wastewater, require certain land and good soil permeability conditions. For example, with a population density less than 300 persons per hectare, on-site sanitation disposal system may be adequate, whereby each house is equipped each by a septic tank and its soak away or leaching pit, requiring about 25 m² of land [6]. These on site sanitation disposal system require septic tank maintenance services and city sludge treatment plant. The land requirement of the city sludge treatment is based on number of people are served. For example for 100.000 people are served require about 1.000 m² of land. When the population density is less than 100 persons per hectare, options may include simple on-site sanitation disposal system such as double pit latrines and gray water leaching pit, where each house requires about 10 m² of land [6]. When population density is more than 300 people per hectare, options may include city wide sewerage and community-based sanitation systems [6].

4. Urban sanitation infrastructure
Urban planning is a critical enabler for community and environment health improvement in Indonesian cities and its surrounding areas. Community health is influenced by many factors beyond the health
sector, and planning allows for multiple sectors to work together as a part of a broader system. Urban planning therefore plays a central role in the prevention of diseases from vectors of water contamination by means of providing adequate urban water supply and wastewater facilities and infrastructure that provide regular and reliable service. Over the year, we have learned many valuable lessons about urban planning relative to wastewater and the environmental health of a city, which has hence developed into a multisector discipline. Nevertheless, most cities in Indonesia place a very low priority on the municipal handling of domestic wastewater, relegating it to a household problem only; as a result, most cities are not provided with sewerage and or the sludge handling services. To date there are only 13 sewerage systems across Indonesia, most established as pilot projects or partial systems, amidst thousands of small scale community based sanitation systems developed in Indonesia. These systems serve no more than 7 % of Indonesia’s population, and the remainder are still dependent on individual septic tanks or pit latrines, often without adequate maintenance services, and about 20 % of the population still has no access to proper sanitation facilities [4]. To accelerate the improvement of urban health conditions, it is commonplace to first consider environment health infrastructure and facilities as a priority, and approach this goal to serve as the key determinant when planning cities. Indonesia’s challenge is to integrate planning processes at a broader scale in order to accommodate key dimensions such as land requirements for sanitation infrastructure and facilities. Rising urbanization and urban density causes even greater complexity and risk for community and environmental health, where by expanding vectors of waterborne diseases and contaminants in water and soil over time. Waiting could also create increasing pressure to the household, wastewater pose an even greater challenge, necessary land and capacity to address the issue, making interventions more expensive in the future. Waterborne diseases and pollution can be prevented by close attention to design, sitting, and regular interventions that provide continued maintenance over time. In this paper, we promote a solution that is applicable in urban areas across Indonesia. The new integrated approach is required, where it is developed from various components that are already implemented in Indonesia urban areas. Indeed the proposed approach sets out to integrate existing facilities and scale them up into a holistic and integrated system, whereby planning and design solution can be accessed by all people in an urban area so that nobody is left behind, while also providing the necessary framework for addressing environmental health more broadly.

5. Conclusion
Currently in Indonesia, as mentioned above there exist many variants of sanitation models that are developed both in terms of onsite sanitation disposal system and off site sanitation disposal system [6]. When the MDGs began in 1990, access to sanitation facilities for Indonesians was only 30% (9). By 2018, 76 % of Indonesians both in urban and rural areas have some form of access to adequate improved sanitation facilities, while 16% of the Indonesian population has access to improper sanitation facilities, and 6% still have no access to sanitation facilities [4]. The national sanitation target in 2024 is 90% of the population to have adequate improved sanitation facilities, and 10% of Indonesians with access to simple sanitation facilities and no open defecation [4]. The condition of municipal sanitation in Indonesia means that 69% of the population has access to on-site sanitation disposal facilities such as double pit latrines in rural areas, and septic tanks or other package wastewater treatment units in urban areas. This is the common and longstanding practice of sanitation facilities at the household level in Indonesia since many years ago. This system may be appropriate for those that can afford natural self-purification processes and have enough land for a house lot that manages the proper septic tank and its soak away or leaching well with additional leaching well for handling household gray water. Nevertheless, this is rarely the case and urbanization is intensifying pressures on the overall water system. Septic tanks only treat black water, which also requires services provided by mobile equipment to transport to a city sludge treatment plant. When household lots are too small, it is also often difficult to access on-site sanitation disposal units, and this situation is compounded if an area does not have adequate access to water supply services. Over time, the density of urban housing is increasing, houses and sanitation facilities of on-site sanitation disposal systems creates additional pressure and will continue to further degrade soil and water condition. To solve these challenges in urban areas,
government are beginning to approach urban sanitation by serving wastewater and sludge collection services directly from the location of the household by providing piped systems or by transport equipment, but these interventions requires land for the urban sanitation infrastructure. Therefore, for dense urban areas, citywide sewerage systems remains the ideal sanitation facility, but financial constraints on the affordability of such systems and its maintenance for local governments or other managing entities remain a significant barrier to overcome.

Based on the Ministerial Regulation number 4/2017 by the Ministry of Public Works and Public Housing (PUPR), both on-site and off-site sanitation disposal systems can be applied, depending on the condition of the location, or the area where the sanitation infrastructure and facility will be implemented and developed [6].

Lessons from past development of sanitation systems where many models are already implemented in many cities, the author promotes that now we require a process of rearranging and consolidating the existing facilities and their management structures so that the existing facilities can be applied across an urban area to ensure that nobody is left behind in terms of accessing sanitation facilities and infrastructures, including its services. We are now beginning to look at the City Wide Inclusive Sanitation (CWIS) approach as an overarching strategy to be fulfilled under MPWPH guidance number 4/2017, supported by the SDGs and New Urban Agenda (NUA) action plan. CWIS is a comprehensive planning and implementation approach for improving and developing urban sanitation infrastructures and facilities in its entirety, developing the service chain and expanding its quality and accessibility, with diverse, adaptive and appropriate technical solutions, that provide a variety of solutions, incrementally developed, which integrate both on-site sanitation disposal technique and off-site sanitation disposal technique, incorporating centralized and or decentralized system, and comprehensive operation and maintenance arrangement. CWIS approach is already implemented in many countries. The author hopes with some modification based on local condition and regulations, this approach will
accelerate urban sanitation infrastructure development program in Indonesia to achieve the SDGs number 6.

**Figure 4.** Typical sanitation technology options in Indonesia and CWIS.

### References:

[1] Asian Development Bank 2016 Asian Water Development Outlook 2016, Strengthening Water Security in Asia and Pacific *Manila ADB* **115**

[2] Kalbermatten J M, Julius D S and Gunnerson C G 1980 Appropriate Technology for Water Supply and Sanitation, A Sanitation Field Manual *World Bank Publications on Water Supply and Sanitation* **1** (Washington DC: The World Bank)

[3] -- 2015 Report on the achievement of Millennium Development Goals in Indonesia **1** (Jakarta: Bappenas) p 142

[4] -- 2020 *RPJMN 2020-2024 Preparation* **1** (Jakarta: Bappenas) hand out presentation

[5] -- 2017 *Panduan Praktis Implementasi Agenda Baru Perkotaan (New Urban Agenda)* **4** (Jakarta: Ministry of Public Works and Public Housing of Indonesia) p 376

[6] -- 2019 Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Republik Indonesia, Nomor 04/PRT/M/2017, tentang Penyelenggaraan Sistem Pengelolaan Air Limbah Domestik, **1** (Jakarta: Ministry of Public Works and Public Housing of Indonesia) p 518

[7] UN-ESCAP and UN-Habitat 2019 *The Future of Asian & Pacific Cities* **1** (UN Publication) p 185

[8] UN-Habitat and World Health Organization 2020 *Integrating health in urban and territorial planning* **1** (UN Habitat and WHO) p 108

[9] Unicef and World Health Organization 2018 *Millenium Development Goals* **1** (Unicef and WHO)

[10] Sarosa W 2020 *Kota untuk semua* **1** (Jakarta: Mizan Expose) p 455

[11] World Health Organization 2018 *Guidelines on Sanitation and Health* **1** (WHO) p 82