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# Urban water security for developing countries

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**Abstract**

Populations in urban centers of developing countries have increased very significantly during the post-1960 period, primarily due to urbanization. Rates of population growth during this period simply overwhelmed their financial, institutional, and technical capacities to manage all types of basic services, including the provision of clean water and proper wastewater management. Surprisingly, issues of access to clean water and sanitation at major international forums of very senior policymakers were first raised during the United Nations Conference, in Vancouver, in 1976. It recommended that everyone should have access to clean water by 1990. Subsequently, Millennium Development Goals set the target that, by 2015, the number of people not having access to clean water should be reduced by half, compared to 1990. The United Nations claimed that this target was met in 2010. However, this is not true. Thereafter, the Sustainable Development Goals stipulated that everyone should have access to clean water by 2030. Current developments indicate that this goal is highly unlikely to be reached. This paper objectively reviews the progress of urban water security in developing countries from the post-1960 period, analyses why international targets were missed in the past, and what can be done to ensure urban water security in developing countries in the future.

**KEYWORDS**

access to clean water and wastewater management, Millennium Development Goals, realistic future prospects for urban water security, Singapore's urban water and wastewater management, Sustainable Development Goals, urban water security

## 1 | INTRODUCTION

More than 200 years ago, Adam Smith, a Scottish Philosopher, often considered to be the "father" of economics, wrote:

> Nothing is more useful than water: but it will purchase scarcely anything: scarce anything can be had in exchange for it.

Smith's observation, even after two centuries, is still valid today. This anomaly is in spite of the fact that human beings cannot survive and thrive without a reliable supply of water, it is the only natural resource that has no economic price. In addition, water is absolutely essential for producing food, generating electricity, and survival of all ecosystems. No economic or commercial activity is possible without water. Yet, it continues to be the only natural resource in which there is no global trade, except for bottled water, which constitutes a minuscule percentage (<0.01) of total global water use.

The surprising fact is that even though for millennia it has been known that water is an essential requirement for the survival of humans and ecosystems, and for all types of social and economic activities, water has been seldom high up on national or international political agendas for any prolonged period of time for nearly all countries (Biswas & Tortajada, 2009).

The present paper focuses on urban domestic water use only. Reliable figures for global water use for different purposes are not available at present. However, generally, it is assumed at present that globally 11% of water is used for domestic purposes, 19% for industry, and 70% for agriculture. The tenuousness of these global estimates can

be realized by the simple fact that even for a major country like India, no ball-park estimates are even available for water used for different purposes. The situation is similar for nearly most other countries of the world. Accordingly, when water used for different purposes is not even known with any degree of reliability for many of the large countries, current global estimates for various uses should be considered to be somewhat indicative rather than definitive. One issue that is certain is that agriculture accounts for lion's share of water use on a global basis. However, on a percentage basis, the share of global water use for agriculture has been falling steadily over the past decades, even though, on an absolute basis, it is still probably increasing. Equally, the percentage of water used for domestic purposes is not high: most certainly significantly smaller than agricultural and industrial uses. Globally, the water used for industrial purposes has been steadily going up and is likely to go up progressively higher in the coming decades.

## 2 | URBAN WATER MANAGEMENT SINCE 1960

Overall, urban water management in the entire developing world, around 1960, left much to be desired. After 1960, urban water and wastewater management practices in most cities of developing countries started to deteriorate steadily. During the 30-year period from 1960 to 1990, populations in all urban centers of Africa, Asia, and Latin America started to increase for two reasons. First, they witnessed explosive population growth which was unprecedented in human history. Second, steady urbanization further aggravated an already difficult situation. For example, Mexico City had an increase in population from 3.1 million in 1950 to 5.5 million in 1960. Thereafter, the population rocketed to 14 million by 1980. This was primarily due to internal migration. Similarly, Delhi had a population of 2.3 million in 1960. This more than doubled to 5.56 million by 1980. Lagos had a population of less than one million in 1960. By 1980, its population had grown to 2.6 million (Figure 1).

While growth rates in many such large cities started to moderate in later decades, for example, in Mexico City, especially during the post-1990 period, several other cities have continued to grow at high rates. Among these continued high-growth cities are Delhi, Dhaka, and Lagos. They are likely to continue to grow till at least 2040.

Herein lies an important difference between the growth patterns of cities in developed and developing countries. During and following the Industrial Revolution, population growth and urbanization started to increase in the cities of developed countries like London, Paris, and New York, their growth rates due to both factors were manageable. In addition, the population levels of these cities were, for the most part, not that high when they were expanding, compared to the urban centers of the developing world during the post-1960 period.

Another major difference between the growth of the urban centers of these two sets of countries is that when cities of the developed world started to grow, their economic conditions were also improving concomitantly. Accordingly, they not only had the financial wherewithal to manage their growth due to urbanization but also had the necessary technical and institutional capacities to manage that growth.

In contrast, when the cities of the developing countries started to grow, their population numbers were already significantly higher than those of the cities of developed countries during their growth stages, and their financial conditions, as well as technical and institutional capacities, left much to be desired. Thus, not surprisingly, these cities simply failed to manage the rapid population growth in terms of building the necessary water infrastructure.

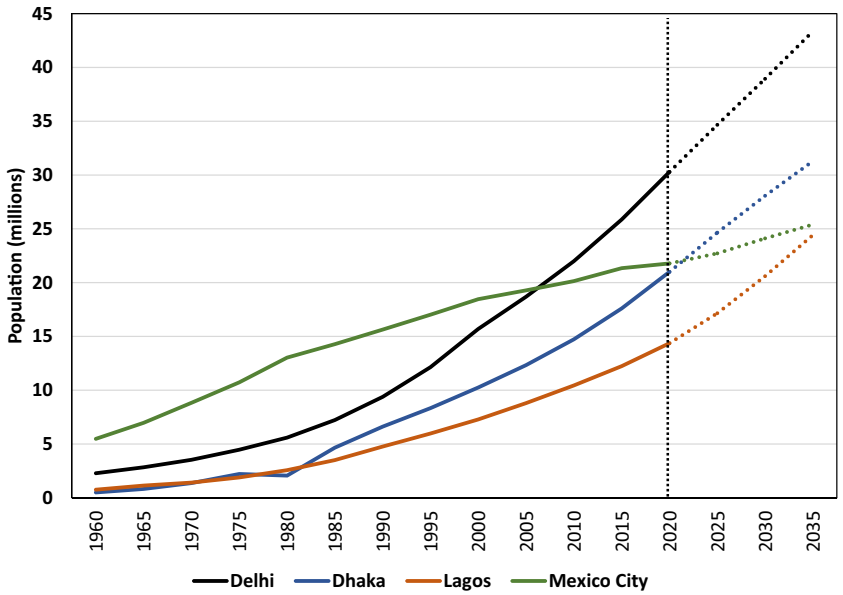


**FIGURE 1** Population growth in large cities, 1960–2035

In addition, poor operation and maintenance practices meant whatever infrastructures they could construct, their operational efficiencies started to decline within a short period of years.

## 3 | DEVELOPMENTS DURING THE POST-1975 PERIOD

Even though it was evident to the world that unsafe water supply and adequate wastewater management in all the urban centers of developing countries were contributing to serious social and public health problems, surprisingly they were not considered to be important issues for sustained discussions in major international political forums. These issues were first raised during the United Nations Conference on Human Settlements which was held in Vancouver, Canada, in 1976, at a high Ministerial level. Under Recommendation C.12, this major event pointed out that in less developed countries some 2/3rd of the population do not have reasonable access to safe water and even a greater proportion did not have access to hygienic waste disposal.

This Conference then went on to recommend that countries should take urgent action to adopt programmes which will provide water "with reliable standards for quality and quantity to provide for urban and rural areas by 1990, if possible." This was the first time that the international community decided that water supply and hygienic waste disposal were important requirements for the further development of developing countries (UN Conference on Human Settlements, 1976).

The United Nations Water Conference, the only Ministerial level meeting at the global level that has ever been convened on water, was held in Mar del Plata, Argentina, in 1977. This meeting firmly placed water and sanitation on the global political agenda. It reiterated the recommendation of the UN Conference on Human Settlements that the people in urban and rural areas should have access to clean water by 1990 and then went on to recommend that "similar considerations should apply to all that concerns the disposal of wastewater, including sewage, industrial and agricultural wastes and other harmful sources, which are the main tasks of the public sanitation systems… ."

The Water Conference then went further and recommended that "the decade of 1980–1990 should be designated the international drinking water and sanitation decade and should be devoted to implementing the national plans for drinking water and sanitation." It then outlined in considerable detail what countries should do to reach the Habitat target of all people having access to clean water by 1990, and also the roles of international organizations and other supporting bodies in making this possible (Biswas, 1978).

The reports of both the UN Conference on Human Settlements and the United Nations Water Conference were unanimously endorsed by its General Assembly.

## 4 | URBAN WATER MANAGEMENT: POST-1990 PERIOD

Any objective and retrospective analysis of the pre-1990 period would indicate that the International Water and Sanitation Decade proposed by the United Nations Water Conference was a remarkable success, especially for millions of people in developing countries who received access to water, which would not have happened without the interest it generated from governments, international and national organizations, funding agencies, and nongovernmental organizations (Biswas, 2019). However, some major problems were created by the UN organizations and multilateral and bilateral aid agencies during the post-1990 period in terms of how they approached the issues.

An important issue that was basically ignored during this period was that while millions of people did receive access to water, the quality of water provided was not a consideration. In fact, the monitoring of the performance of progress in access to water and sanitation was jointly carried out by two United Nations Agencies, United Nations International Children's Emergency Fund (UNICEF) and World Health Organization (WHO), from 1990. Unfortunately, they used the vague and imprecise term "improved" sources of water and sanitation, which was never properly defined by these two agencies, or individual national governments who accepted this terminology. Thus, basically what happened is that all developing countries, which were mostly the main sources of information for these two agencies, implicitly decided that as long as people received access to water, it was considered to be "improved." UNICEF and WHO simply accepted this situation and continued to use this term for some 25 years.

The quality problem was further obfuscated by all the UN agencies, and multilateral and bilateral development agencies by using terms like "clean" and "safe" water interchangeably with "improved" sources of water, in the same reports. Thus, almost universally, it was accepted that the vague term "improved" sources of water was the same as "clean" or "safe" water. Accordingly, even though access to water in nearly all developing countries improved significantly, the water provided, for the most part, was of unacceptable quality, and, thus, could not be drunk straight from the tap, or the source, even though international organizations and national governments called them "safe" and "clean." Households, for the most part, knew better. They treated water received at home to improve its quality, before drinking it since the overwhelming perception was the water provided was neither "safe" nor "clean."

In 2000, the UN system primarily repackaged the earlier individual international development goals as Millennium Development Goals (MDGs). MDGs had eight goals and 21 targets, all of which were expected to be achieved by 2015. Targets for drinking water and sanitation were that, by 2015, the percentages of the people who did not have access to safe drinking water and adequate

sanitation would be halved compared to the situations in 1990 when the decade had ended.

In 2010, the UN claimed, somewhat prematurely that the MDG goal of access to *safe* drinking water had been met five years before the target deadline of 2015. This claim, unfortunately, was not true. While the number of people who had received access to water during the MDG period had increased significantly, the water supplied was neither clean nor perceived by the population to be safe to drink.

The overly optimistic figures of the UN as to the number of people who had access to safe water and sanitation in 2000 when the MDGs started, and in 2015 when the MDGs ended, are provided in Tables 1 and 2.

In 2015, UN member states adopted the 2030 Agenda for Sustainable Development. This included 17 goals and 169 targets. Goal number 6 was for clean water and sanitation. For drinking water, the goal was "By 2030, achieve universal and equitable access to safe and affordable drinking water to all." The main difference between MDGs and Sustainable Development Goals (SDGs) on water is that the term "improved sources of water" of MDGs suddenly disappeared without any explanation. It was replaced by another new but still fuzzy terminology: "safely managed water services." UN claimed that this terminology represented *an ambitious new rung on the ladder*. While this new term is more linked to quality, compared to the earlier terminology, its direct linkage to clean and safe water services, unfortunately, still remains tenuous.

Later, in 2017, not surprisingly, WHO and UNICEF vastly increased the estimate of the number of people who did not have access to safe water. It noted that the number of people not having access to "safely managed" water services, was 1.606 billion, a number that was 2.42 times the 2015 number of 663 million who did not have access to "improved sources of water," which they had for decades claimed to be safe or clean water. Surprisingly, this major anomaly was not explained, and, even more surprisingly, this fundamental issue was not raised by either the water and development professionals or the academics over the past several years.

Unlike the MDGs, the SDGs were globally discussed and then framed. They have been universally accepted by all countries. The water-related target is to achieve universal access to safe and affordable drinking water for all by 2030. However, by the UN's own estimates of 2018, 2.944 billion people in developing countries still did not have access to clean water that is safe to drink (United Nations, 2020). The real number is likely to be one billion more.

Meanwhile, in the Western world, access to water and sanitation may be worse than what is generally believed to be the case. Consider the United States, the most powerful

**TABLE 1** Access to drinking water in 2000 and 2015

| | | Urban | | Rural | | Total | |
|---|---|---|---|---|---|---|---|
| Year | Service levels | Number (1000) | Percentage | Number (1000) | Percentage | Number (1000) | Percentage |
| 2000 | Safe | 2472 | 86 | 1292 | 39 | 3764 | 61 |
| | Unsafe | 396 | 14 | 1985 | 61 | 2381 | 39 |
| | Total | 2868 | 100 | 3277 | 100 | 6145 | 100 |
| 2015 | Safe | 3399 | 85 | 1734 | 51 | 5134 | 70 |
| | Unsafe | 582 | 15 | 1667 | 49 | 2249 | 30 |
| | Total | 3981 | 100 | 3401 | 100 | 7383 | 100 |

*Source*: WHO/UNICEF Joint Monitoring Program (2017, 2019).

**TABLE 2** Access to safe sanitation in 2000 and 2015

| | | Urban | | Rural | | Total | |
|---|---|---|---|---|---|---|---|
| Year | Service levels | Number (1000) | Percentage | Number (1000) | Percentage | Number (1000) | Percentage |
| 2000 | Safe | 1020 | 36 | 713 | 22 | 1733 | 28 |
| | Not safe | 1848 | 64 | 2564 | 78 | 4412 | 72 |
| | Total | 2868 | 100 | 3277 | 100 | 6145 | 100 |
| 2015 | Safe | 1808 | 47 | 1347 | 53 | 3155 | 49 |
| | Not safe | 2173 | 53 | 2055 | 47 | 4,228 | 51 |
| | Total | 3981 | 100 | 3402 | 100 | 7383 | 100 |

*Source*: WHO/UNICEF Joint Monitoring Programme (2017, 2019).

and richest country in the world. Over two million people still do not have access to piped water, basic indoor plumbing, and adequate wastewater management. Indigenous people in Australia, Canada, and the USA currently receive a lower quality of water services compared to an average household in a developing country city like Phnom Penh, Cambodia (Biswas et al., 2021).

It is not only in developed countries that the indigenous people have significantly poorer access to clean water supply and wastewater management but also the same is true for indigenous people in all developing countries, including Argentina, Brazil, India, Indonesia, Malaysia, and Mexico.

Yet, not even a single developed country, or international organization, has made any attempt to see to what extent the developed countries are progressing to meet the SDG targets by 2030, not only in water and sanitation but also in the rest of the SDGs. Most of the citizens of North America, Europe, and Japan are not even aware of what are the SDGs and their relevance and implications for themselves and the rest of the world.

The situation has mostly worsened after the emergence of coronavirus disease 2019 (COVID-19) in both developed and developing countries. The world over, most people are more aware that clean water is essential for frequent handwashing and maintaining good personal hygiene (Tortajada & Biswas, 2020). COVID-19 has increased the bar very significantly all over the world as to what can be considered to be "safe" or "clean" water. While the trust of the citizens in developing countries in the quality of water they receive from their utilities was never present, trust now has become an important issue in developed countries, especially after the emergence of COVID-19. The importance given to water quality by the general population, both in developed and developing countries, is likely to remain high for the foreseeable future.

The current global situation in terms of availability of clean water supply and wastewater management leaves much to be desired. According to a recent UN report (2020):

- In 2016, globally 25% of healthcare facilities did not have access to basic water services and 20% had no sanitation services.
- In 2017, 2.2 billion people did not have access to "safely managed drinking water," and 785 million did not have access to even basic drinking water.
- In 2017, 3 billion people lacked soap and water at home; 47% of schools in the world did not have handwashing facilities with soap and water; and 40% of healthcare facilities were not equipped to practice hand hygiene at the point of care.

Even before the emergence of COVID-19, UN Secretary-General noted "world was not on track" to deliver the SDGs by 2030 (United Nations, 2019). Both reports on UN-Water Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS), in 2017 and 2019, painted a bleak picture about the development of managerial and financial capacities to even deliver the most basic elements of SDGs, including water.

A major development worth noting is that the United Nations General Assembly, on July 28, 2010, adopted a nonbinding resolution that recognized "the right to safe and clean water and sanitation as a human right that is essential for the full enjoyment of life and all human rights." The resolution passed by a vote of 122 in favor and none against. However, there were 41 countries that abstained, which is nearly one-third of the number of countries that voted for the resolution.

A retrospective analysis of the global situation a decade after the UN resolution on water as a human right was passed, indicating that it does not appear to have had any perceptible impact in terms of the number of people who may have received access to water because of this development, or its quality.

## 5 | URBAN WATER SECURITY

No one will argue with the statement that reliable long-term urban water security, including proper wastewater management, is an essential requirement for the social and development of all countries.

While at first glance water security appears to be a rather simple concept to understand and appreciate, in reality, it is a very complex issue. Water security may seemingly appear to depend on a few discrete issues. However, it is a circuitous agglomeration of interplays between numerous interrelated issues, magnitudes, and extents, which often change over time and space. The problem becomes even more complex when it is recognized that there are many factors that have direct impacts on water security on which neither the water profession nor associated water institutions have any influence as they often have to react to these external forces only after they have occurred, often with no advance warning.

Among many issues, urban water security of any country depends on population (number, density, age structure, rate of increase/decrease, levels of education, and many other factors), urbanization rates (past, present, and future), physical quantities of water available in the area under consideration, extent of wastewater collected, properly treated and then reused, types and extents of agricultural, industrial and commercial activities, climatic conditions, capacities and effectiveness of water management institutions, legal and regulatory conditions and their timely enforcement, priorities accorded to water management by policymakers at all levels of governments (national, state, and municipal), levels of corruption in the country concerned, capacities of urban water managers and lengths of their stays in their respective positions, business models of water institutions to cover all their costs, and income and educational levels of the people, as well as a host of many other associated factors.

A small number of small countries like Austria, Denmark, the Netherlands, Singapore, Sweden, and Switzerland have managed these factors reasonably well. Other countries like Germany, Japan, and the Republic of Korea have responded well to a range of these factors. However, the fact remains that the effectiveness of urban water management performances in

most cities, even in those in developed countries, has left much to be desired in recent decades. Performances in developing countries, with a few notable exceptions in cities like Phnom Penh or Dhaka, are even worse.

There is no question that SDGs and their subgoals are steps in the right direction and could provide an appropriate roadmap for both developing and developed countries for formulating their future development plans for ensuring urban water security. However, to achieve the water-related goals and subgoals of the SDGs, it will be essential to approach urban water and wastewater management on a holistic basis. This will require formulation and implementation of a multidisciplinary, multisectoral, and multi-issues planning and management framework, which may vary from one city to another, depending upon their economic, political, social, environmental, and cultural conditions, as well as the efficiencies and effectiveness of their existing institutional, legal, regulatory, and political frameworks. Also relevant are their technical and administrative capacities to formulate and implement sustainable urban water development plans, which need to be updated at regular and reasonable intervals, say, every five years or so. The updated plans should incorporate new knowledge, technology, planning, and management practices, as well as changing social, economic, political, cultural, environmental, and climatic conditions.

Sadly, there are very few cities in developing or developed countries that currently formulate long-term urban water and wastewater management plans that are updated regularly and comprehensively every five years, and then reviewed and agreed to by senior policymakers. The only city that has such a good, long-term planning regime, which currently covers up to the year 2060, is Singapore due to its existential water challenges first identified in 1965. Not surprisingly, Singapore now has one of the world's best urban water and wastewater management system (see Box 1).

**BOX 1 Singapore water story**

In 1965, when Singapore became independent, its urban water management was similar to that of any average city in a developing country, like Delhi or Nairobi. The same year, the Prime Minister of Malaya said that Singapore must align its foreign policy with Malaysia: otherwise, Malaysia will cut off its water export to Singapore. Malaysia was then supplying over 80% of Singapore's water needs. Faced with this ultimatum, Singapore's first Prime Minister, Lee Kuan Yew, immediately asked its leading water experts to give him estimates of how much rain fell in Singapore in an average year, and how much of it can be collected, stored, treated, and used. He also realized water is an existential threat to Singapore's future. From then on Prime Minister Lee had three persons in his office who analyzed all policies from their water implications. He declared "every other policy had to bend at the knees for water survival." From 1965 to 1991 when Mr Lee retired, water remained at the top of the city-state's development agenda.

From 1965, Singapore explored seriously how its water supply from national sources can be steadily expanded and its water use efficiencies can be progressively improved. It used the latest scientific and technological advances to decrease its dependence on importing water from Malaysia.

Over the ensuing decades, Singapore started an ambitious program to catch as much rainwater as possible by making much of the country water catchment areas where development activities are strictly regulated, ensuring all the wastewaters from domestic and industrial sources are collected, treated, and reused, and seawater is desalinated. From 1997, Singapore water pricing was revised to reflect the marginal cost of producing new sources of water (which was, desalination at that time, but now this includes both desalination and NEWater). It has an excellent educational and public awareness programme on the importance of water and the need for water conservation.

Singapore now imports little above 50% of water from Malaysia. It signed two agreements to import water from Malaysia in 1961 and 1962. In 2011, the first agreement expired and was not renewed. The second agreement runs till 2061.

With continuing direct support from the Prime Minister, within a period of less than 25 years, Singapore's urban water management was transformed from that of an average city in developing countries in 1965 to one of the very best in the world. Currently, it is the only city in the world that has a long-term water plan till 2060. It is scrupulously implemented. It is updated every five years based on the latest scientific, technological and management developments and approved by the ministers.

There are several reasons why Singapore has become one of the world's most successful examples of urban water management. Probably, the most important one is water has been continually high up on the political agenda since 1965. Second, its water price has been maintained at the marginal cost of producing water. Third, its senior management is always selected on the basis of merit, and its salaries are benchmarked to the private sector. Fourth, lower-income families get targeted rebates/assistance from the Ministry of Finance and are not subsidized by its water utility. Sixth, it is one of the very few global water utilities that practices preventive maintenance. A good example is each year it replaces nearly 2% of its water, sewage, and stormwater drainage networks. Through good management, its water losses from the system for the last several years have remained at about 5%. In contrast, a fully privatized water utility like Thames Water current losses of about 25%. Seventh, it is always searching for better practices from anywhere in the world that it can modify and use. Finally, both the water utility and the Singapore Government spend a very significant amount of money each year on R&D, which has in the past helped significantly to improve its operating and management practices and efficiencies.

*Source*: Tortajada et al. (2013).

Good long-term planning, and what is equally important, its subsequent implementation, is essential for all cities to assure their sustainable urban water security. This is because major uncertainties will continue to take place due to rapid changes in many factors, including climate change, evolving societal perceptions and attitudes to water-related issues, scientific and technological advances and their adoption rates, and advances in management practices.

The SDG6 process has at least introduced a formal reporting program for all aspects of the goals. However, this is only for developing countries. Even if the progress being made to date may be dispiriting, at least it is generally known which cities are making progress and why, and which are not. Unfortunately, the number of such success stories from the developing world is not at present encouraging.

## 6 | QUANTITY AND QUALITY CONSIDERATIONS

During the post-1975 period, globally, the main emphasis was almost exclusively on providing access to drinking water to more people. Water quality considerations have consistently taken a backseat. Hundreds of millions of people in developing countries have received access to water, which is most certainly laudable. However, the water supplied is neither clean nor perceived by an increasing number of users to be clean.

In addition, in nearly all developing countries, collection, treatment, and discharge of treated wastewater to the environment have been neglected by policymakers (Biswas & Tortajada, 2021). A direct result of this neglect has been that almost all water bodies, within and around urban centers of the developing world, are now seriously contaminated with known and unknown pollutants. Viewed from a different perspective, currently, only about 10%–12% of the people in the developing world have access to appropriate treatment of domestic and industrial wastewaters.

With rapid industrialization, industries are mostly discharging inadequately treated wastewaters to their nearby water bodies, often containing unknown and hazardous substances. Urban areas downstream of these wastewater discharges have to use this contaminated water as a source for their drinking water.

The absence of adequate technical, managerial, and administrative capacities, lack of political will to address pollution-related problems, and inadequate investments over many decades in constructing, operating, and maintaining wastewater treatment systems, have ensured that a very high percentage of wastewater treatment plants have become dysfunctional, often after some 3–4 years after their completion.

Accordingly, in all developing countries, water qualities of rivers, lakes, and groundwater have steadily deteriorated with time, and, in most such countries, water quality is likely to deteriorate further due to continuous discharges of untreated, or partially treated wastewaters. There are no real signs that this unfortunate situation will improve in the near future.

The problem is further compounded by the fact that water quality monitoring is a complex topic and continues to be poor in most developing countries. Even when water quality monitoring systems exist, these often measure only some physical and microbiological parameters like pH, TDS, conductivity, DO, BOD, fecal coliform, and total coliform. If one considers one of India's major and the holiest river, the Ganga, even these seven parameters are not measured regularly, and not at all the existing measuring stations. In addition, because of inadequate technical capacities, poor supervisory practices, lack of sustained interest of senior policymakers in water quality information, and the reliability of even the limited data collected remain highly doubtful.

This means not only water qualities of source waters on which cities depend are often unknown but also the water utilities seldom measure more than 10–15 parameters, with appropriate frequencies and locations, for water they supply to the consumers. Thus, not surprisingly, the consumers in all urban centers of the developing world have no faith in the quality of piped water they receive in their houses.

In contrast, in a city like Singapore, its water utility is now measuring regularly 346 water quality parameters. The parameters monitored have increased from only 35 in 1963 to almost 10 times this number by 2019 as shown in Figure 2.

Water quality management is neglected, both nationally and internationally, in most countries. Access to sanitation is only one component of domestic wastewater management that is now receiving some attention. Not much thought is being given to what may happen to the septic tank wastes from hundreds of millions of septic tank wastes that have to be periodically cleaned. Currently, most countries do not even have regulations, or even some general guidelines, as to how and where these wastes can be disposed of in an environmentally safe manner.

Equally septic tank cleaning is often carried out by small entrepreneurs with limited knowledge or financial capacity. These wastes are discharged to the nearest river, land, or forest, which means water and land are becoming increasingly contaminated.

This is for domestic wastewater management only. For industrial wastewaters, which invariably contain more hazardous contaminants, major institutional and legal changes are essential before they can be effectively controlled. Unfortunately, there are no signs as yet that these changes are likely to happen in the foreseeable future in most developing countries.

The past and the present attitudes of continued neglect of water quality considerations, and the focus of exclusively water quantity issues, are no longer viable. Steadily increasing water contamination, along with the inabilities of developing countries to treat water that is

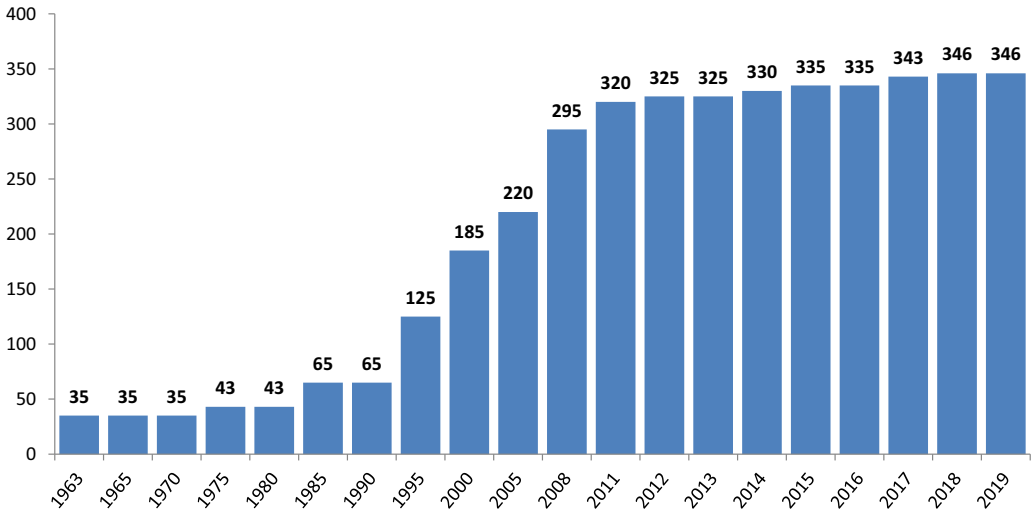


**FIGURE 2** Number of water quality parameters monitored in PUB, 1963–2019. *Source*: PUB (personal communication, 2020)

already highly contaminated with hazardous and toxic industrial wastes like heavy metals and numerous chemicals, means that source waters in many places can, or should, not be used for municipal purposes because of their potential serious adverse human health impacts. Currently, nearly all developing countries do not have the necessary technical and management capacities, and financial wherewithal, to treat industrial wastewater properly and regularly before they are discharged into the environment.

There are also other major constraints that should be considered. During the past several decades, developing countries have focused primarily on the construction of new water supply systems. Nearly 80% of all domestic water used by households becomes wastewater over time, which needs to be collected, treated, and disposed of in environmentally safe manners. The construction of sewer systems that could connect all households and wastewater treatment plants is expensive and complex, compared to the construction of water supply systems. Wastewater management is significantly more complex than water supply. In addition, politically, improving access to water is often viewed as a major vote winner. Wastewater collection and treatment do not attract much attention from the general public, even though over the long term it is a serious health and environmental issue.

Policymakers all over the developing world, international institutions and aid agencies, in recent decades have given the provision of water supply much higher priority in terms of construction and financing compared to the construction of sewer networks and wastewater treatment plants. In a few megacities, like Bengaluru, India, the municipal authorities have now given up on the provision of wastewater collection and treatment. Instead, housing developers are now legally responsible for the construction of wastewater treatment plants for housing complexes they build. Subsequently, the owners become responsible for managing them, and also for disposal of wastewaters from these individual small treatment plants. Such decentralized wastewater treatment plants are not functioning properly since people in charge of running them seldom have adequate knowledge and capacity to manage them and there is no regulatory supervision of their performance.

Another major constraint is the lack of training facilities available for technicians who can properly manage and operate sewage treatment plants. In the absence of such vocational training and lack of trained operators, efficiencies of sewage treatment plants start to decline 2–3 years after their construction.

Training of water supply and sewage treatment plant operators would create a skilled labor force and will also ensure all treatment plants are properly operated and maintained and thus contribute to water and environmental conservation. The private sector can play an important role in funding/supporting such operator training programs even beyond those who may work in their plants. These steps, if and when taken, will be immensely beneficial to all developing countries on many fronts.

## 7 | CONCLUDING REMARKS

It has been close to 50 years since access to clean water for drinking became an important issue for global discussions at high political levels. During this period, millions of people all over the developing world have received access to water. However, there are still significant percentages of urban centers in the developing world, which do not have access to water on a $24 \times 7$ basis. In addition, a major neglected problem of the past half-century has been that almost exclusive focus has been on the physical supply of water. Very little consideration was given to the quality of water supplied. Consequently, in all urban centers of developing countries, people do not trust the water they

receive because of its poor quality. Accordingly, the majority of households had to install, operate, and maintain their own point-of-use treatment systems so that the water they receive can be adequately treated before drinking, and often for even cooking.

At present, anecdotal evidence indicates that at least four billion people receive water whose quality they do not trust (Biswas & Tortajada, 2021). COVID-19 incidences have not only increased the bar significantly in terms of awareness of the importance of water quality but also have contributed to the realization that reliable water supply systems are essential for frequent handwashing and hygienic purposes (Tortajada & Biswas, 2020).

The targets the world community had placed to provide everyone with a clean water supply have so far been regularly missed. The UN Conference on Human Settlements recommended, in 1975, that everyone on this earth should have access to clean water by 1990. The UN Water Conference recommended that the 1980s should be considered the International Water Supply and Sanitation Decade, at the end of which everyone should have access to clean water. These targets were widely missed.

The water objective of MDGs was that by 2015, the number of people having access to clean water should be halved, compared to 1990. In 2010, the UN Secretary-General, with a great deal of fanfare, proclaimed that this target was reached, five years ahead of the target date. Unfortunately, this was possible by only manipulating definitions and facts, rather than properly fulfilling the agreed targets.

SDGs similarly have the lofty objective that everyone should have clean water by 2030. Based of current progress, it will be a real miracle if this target is met.

Yet, there is no reason as to why developing countries cannot provide clean water to all their urban citizens within about a decade. This will require a major change in the mindsets of senior national policymakers as well as all the international institutions that provide financial and technical assistance in this area. Most developing countries have enough resources to make this possible. For example, Singapore was a developing country in 1965 when it realized that water was an existential consideration for this city-state. With strong and sustained very high-level political support, Singapore's urban water supply and wastewater management systems were transformed from being an average third-world city to being one of the best in the world within 20 years.

Similarly, Phnom Penh Water Supply Authority (PPWSA) was nonfunctional and almost bankrupt in 1993. With good management, eliminating politicians' direct interferences in running the city's water supply system and ensuring institutional autonomy, Phnom Penh successfully solved its urban water problems in about two decades. At present, many of PPWSA's performance indicators are better than the water utilities of London, Paris, and Los Angeles. If Phnom Penh, a city in the least developed country, can solve its urban water problems, there is absolutely no reason why cities like Delhi, Mumbai, Lagos, Nairobi, Buenos Aires, and Bogota, which have more financial resources and better technology and management expertise, compared to Phnom Penh, cannot provide clean water to all their inhabitants.

Providing clean water supply is a less complex and less expensive process than the provision of a functional and sustainable wastewater management system. Yet, to ensure water and health securities, it is essential that all wastewater produced, both from domestic and industrial activities, be collected, properly treated, and then reused, either directly or indirectly. Wastewater is a significant source of energy, which all developing countries are not using. Proper treatment of wastewater will not only create new additional sources of water but also can generate considerable energy. In addition, proper treatment will ensure significant benefits to society by reducing health and environmental costs.

As we approach the second quarter of the 21st century, it is important to recognize that everyone all over the world, in both developed and developing countries, should have access to safe water and proper wastewater management on a reliable basis. The performances thus far, in both developed and developing countries, indicate reasons for optimism as well as pessimism. Optimism in the sense that a few urban centers, irrespective of all the constraints they face, have managed to provide their inhabitants clean water on a reliable 24/7 basis, which can be drunk straight from the tap without any health concerns. If some cities can achieve this goal, there is no reason why other cities cannot follow in their footsteps.

Unfortunately, however, an overwhelming percentage of urban centers in developing countries have failed to reach their target of providing clean water to all on a reliable basis. The global target to meet clean water was missed by a wide margin in 1990, and then again in 2015. Based on the latest data available, it is highly unlikely that it will be met by the SDG target date of 2030. The progress is likely to be slow unless political and institutional aspects are given priority consideration. Unfortunately, there is no sign that this is likely to happen in the near future in the majority of urban centers of developing countries.

Wastewater management is by far worse, compared to water supply. Individual households can transform intermittent water supply to a $24 \times 7$ continuous one. They can also transform poor-quality water into drinkable water by installing point-of-use treatment systems. However, for wastewater management, individual households cannot ensure that it can be managed on a reliable basis. This would require the construction, operation, and maintenance of wastewater plants on a communal basis. This is far more complex and difficult to achieve, compared to the provision of water supply.

There is no reason why both developing and developed countries cannot provide functional and sustainable water and wastewater management facilities to all their citizens. Countries, in general, have access to the financial resources and expertise needed to achieve these targets, even though financing is often claimed to be the major constraint. What urban centers of developing countries do not have is the long-term political support from senior policymakers, which would allow major institutional changes.

Regrettably, for most urban centers, there are no signs that this is likely to happen in the foreseeable future. Thus, the most likely scenario in the coming years is likely to be incremental progress for years to come.

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## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ETHICS STATEMENT

The author assures that this article follows the core practices of the Committee on Publication Ethics. The paper has not been published anywhere.

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