WATER AND WASTEWATER INFRASTRUCTURE AND SUSTAINABILITY IN DEVELOPING COUNTRIES – A REVIEW

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Abstract- Urbanization creates water sustainability issues, which increases water consumption. For instance, in the Asia–Pacific areas, water consumption per day per person ranges from 250–300 litres, whereas in developing countries it is projected to range from 60–200 litres person per day, the increasing urbanization which leads to higher water consumption and the related demand for sanitation services dwelling large strain on water resources and infrastructure. The wastewater treatment plant is also compromised as cities expand because the infrastructure becomes unable to deal with the growing load of wastewater generated. Moreover, disposal of untreated sewage to water bodies is not acceptable and even transport over long distances through aging infrastructure taking the danger of leakage and contaminate groundwater due to leachate. The paper review four major challenges to providing safe water and sanitation on a global basis: (1) Climate change, (2) Population growth, (3) water pollution, (4) Rapid urbanisation growth

Keywords- Water, Wastewater, Infrastructure, Sustainability, Developing countries.

I. INTRODUCTION

Sustainable water systems are well-defined as water schemes that are able to satisfy varying water stresses placed on them (human and environmental) nowadays and into the future, whereas maintaining ecological and environmental integrity of water schemes (ASCE/UNESCO, 1998). To operationalize sustainable water schemes, which is viewed as the present challenge, recent studied states that sustainability is "not a state to be arrived at but a broad evaluative framework for understanding and justifying social practice" (Lundie et al. 2005). Urbanization is key issues affecting water as a resources and wastewater management difficulties in developing countries. According UN, (2004) Urbanization is relocation of people from village to city. China and India facing immense growth in urbanization and they are accounting together for approximately one-third of the population growth expected to be in urban in pending decades (United Nations, 2008). Some of developing countries have been regarding urbanization growth as a contributing factor for national
economic growth. Nevertheless, people continue migrating into cities to pursue a better life and economic chances.
It is presently projected that 1.1 billion people in the whole over world have no access to quality water resources and
2.6 billion People lack access to acceptable sanitation (UNICEF et al. 2004). The international health burden associated estimated that about 4000 – 6000 kids are dying every day from water related diseases due to lack of access to clean drinking water, lack of access to sanitation and poor hygiene (WSSCC 2004). The UN Millennium Development Goals (MDG) aimed to reduce at least by half the percentage of people without sustainable access to clean drinking water and basic hygiene by the year 2015. Though, some parts of the world are making hopeful development in meeting these goals. Lack of access to clean drinking water is still a serious issues in greater percentages of Asia where an estimated 675 million people are without safe drinking water resources (UNICEF et al. 2004). In Sub-Saharan Africa, only about 36% of the populace has access to basic sanitation (UNICEF et al. 2004). The Millennium Development Goals estimated that sanitation must be provided for about 2.1 billion people from 2002 - 2015 when adjusting for population growth. To provide toilets for 2.1 billion people over 13 years a minimum of 44,300 installations will be required per day for the next 13 years (assuming 1 toilet per 10 people). Assuming cost per installation is $100 USD for basic dry sanitation, then the investment requires just to install basic level of sanitation over the next 13 years cost $4.4 million USD per day (UN Millennium Project 2005). In 1991, a global survey of water loss as a proportion of water supplied reported that in developed countries water loss ranged from 8 - 24%. However, in intermediate income or newly industrialized countries, water loss ranged from 15 - 24%, and in developing countries, water loss was projected between 25 - 45% (WHO 2001). Several biggest documented waterborne epidemics in the last two decades have been related with

cross-contamination in the water conveyance system due to leakages (Renkevich et al. 1998).

2.0. Background Information

2.1 Climate Change

Various counties face crises associated to the increasing impacts of climate change drivers, particularly on water resources. The consequence of these impacts are aquifer depletion and water contamination, increased water stress, access to quality drinking water, as well as socio-economic and environmental vulnerability.

2.2 Effect of Climate change on sustainable water supply

- Increase water scarcities due to changes in rainfall patterns and amount. Particularly, the subtropics and mid-latitudes, where most of the world's poorest peoples live, are expected to become considerably drier (Meehl et al., 2007). Less rainfall in some arid areas could cause exponentially greater drops in groundwater tables (David, 2008)

- Reduce natural water storage volume from glacier/snowcap melting, and consequently decrease long-standing water availability for more than one-sixth of the world's population that lives in glacier river basins, including main areas of India. China, Pakistan and the western U.S. • Increase the susceptibility of environments due to temperature increases, changes in rainfall patterns, regular severe climate actions, and continued droughts. These issues, in turn, will supplementary reduce the capability of natural systems to filter water and generate buffers to flooding.

- Affect the capacity and dependability of water supply infrastructure due to flooding, extreme climate, and sea level rise. Most prevailing water treatment plants and delivery systems were not constructed to withstand predictable sea level rise and increased frequency of severe climate due to climate change (Corinne. 2008).

- Increase water demand for agriculture, mainly for irrigation, due to extended dry periods and severe drought. Some studies reveal that there may be over 40% increase in land demanding for irrigation by 2080 (Gunther et al, 2007).

- Due to higher atmospheric temperatures demand for hydration needs increases for billions of farm animals.
- Increase quantities of water needed for industrial cooling due to increased atmospheric and water temperatures (Smith et al, 2005).

2.3 Climate change impact on water quality

- Increase extreme rainfall and flooding, which will increase erosion level and wash soil based contaminants and toxins into water bodies.
- Pollute coastal surface and subsurface water resources due to sea level rise, causing saline intrusion into rivers, deltas, and aquifers.
- Increase water temperatures, leading to additional bacterial and other microorganism's blooms that supplementary pollute water supplies.
- Contribute to ecological health dangers related with water. For example, changes in rainfall patterns probably increase flooding, and as a consequence mobilize more pathogens and contaminants (Gunther et al, 2007).It is projected that by 2030 the risk of diarrhoea will be up to 10 percent higher in some countries due to climate change (McMichael. 2003)

3.0 Population growth

Over the earlier century, the expansion of water resources has been mainly driven by the demands of growing populations for food, fibre and energy. Robust revenue growth and rising living standards of a growing middle class have led to sharp increases in water usage, which can be unsustainable, particularly where supplies are susceptible or scarce and where its use, delivery, price, consumption and management are poorly accomplished or controlled. Demand for water is estimated to increase in all segments of production (WWAP, 2012). By 2030, the world is estimated to face a 40% worldwide water shortage under the Business-As Usual (BAU) climate scenario (2030 WRG, 2009).

Population growing is another factor, but the relationship is not linear: over the last decades, the rate of demand for water has doubled the rate of population growth (Shiklomanov, 1999; USCB, 2012). The world's population is growing by almost 80 million people per year (USCB, 2012). It is projected to reach 9.1 billion by 2050, with 2.4 billion people living in sub-Saharan Africa, the region with the greatest heterogeneously distributed water resources (UNDESA, 2013a). More than 50% of people on the planet today live in cities, with 30% of all city inhabitants residing in slums. City populations are estimated to grow to a total of 6.3 billion by 2050 (WWAP, 2012). Developing countries account for 93% of urbanization globally, 40% of which is the expansion of slums. By 2030, the urban population in Africa and Asia will be twice (UN-Habitat, 2010). Extreme water extractions for agriculture and energy can supplementary exacerbate water shortage. Freshwater extractions for energy production, which presently account for 15% of the world's total (WWAP, 2014), are expected to increase by 20% through 2035 (IEA, 2012). The agricultural sector is already the major user of water resources, accounting for roughly 70% of all freshwater extractions globally,

and over 90% in most of the world's least-developed countries (WWAP, 2014).

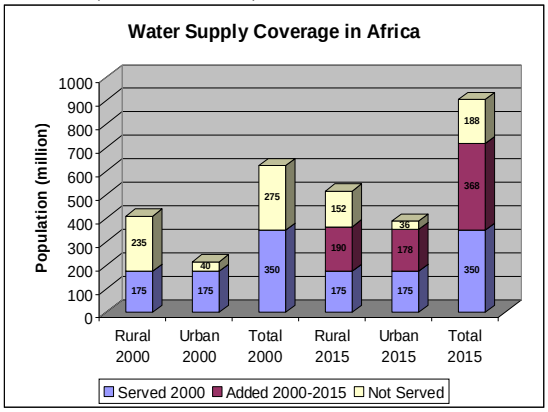


Fig. 3.1: Water supply coverage in Africa

4.0 Water pollution

Contamination of river waters with harmful microorganisms, including bacteria, viruses, parasites, as well as fungi, has been on stable increase in recent times (Niyogi, 2005; Abraham et al., 2007). Access of pathogens into rivers can happen either from a point source, non-point sources or both. Non-point concentration of pathogens in the water (Niyogi, 2005). Waterborne pathogens causes health risk to people using river water as a source of drinking, bathing, irrigation of crops eaten raw, fishing, and recreational activities (Liu et al.,2006; Hellweger and Masopust, 2008). In order to decrease waterborne disease epidemics World Health Organization (WHO) developed bacteriological quality guidelines based on intended water uses. The guidelines specify that faecal coliforms (FC) must not exceed 10^3 per 100 mL of water to be used in irrigation of crops that are eaten uncooked, sports fields, and public parks in unrestricted areas (WHO, 1989). Environmental Protection Agency (EPA) standard is stricter, and needs zero (0) FC / 100 mL of water to be used in irrigation of any food crops not commercially processed including crops eaten raw (EPA, 1992). Kenya standard for drinking water quality states that no Escherichia coli, Shigellae, Pseudomonas aeruginosa or coliforms should be detectable in 250 mL of drinking water (WASREB, 2006). Wastewater produced by residents of megacities pollutes rivers traversing them (Abraham, 2010).

The quantities of water required for domestic usages, and particularly ingestion, are usually very small compared to those for agriculture and industry: 20 litres per person per day for drinking and personal hygiene is considered to be 'basic' access (WHO, 2011). Domestic water accounts for at most 11% of freshwater extractions (FAO, 2011a). Changing climate is also predictable to impact water resource availability, putting more pressure on already stretched resources and increasing the risk of contamination and may encourages frequent and powerful flooding (WHO/DFID, 2009).

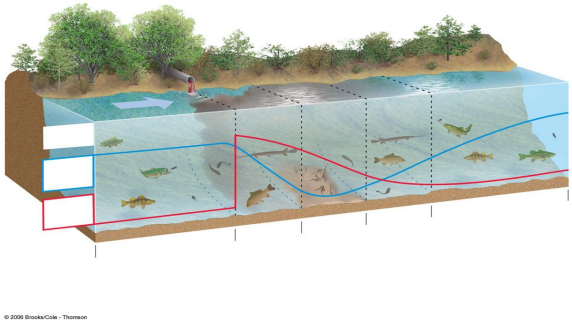


Fig. 4.1: Pollution in Streams

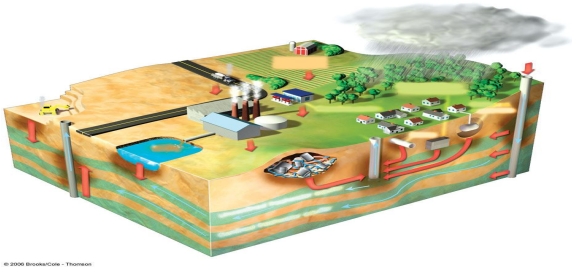


Fig. 4.2: Groundwater Pollution

5.0 Rapid urbanization

Cities have become the place where increased challenges and chances increasingly come face to face. In 2014, 3.9 billion people, or 54% of the global population, lived in cities, and by 2050, two-thirds of the global population will be living in cities (UNDESA, 2014). Moreover, most of this growing is happening in developing countries, which have inadequate capacity to deal with this rapid change. Cities influence the hydrological cycle in numerous ways by removing substantial amounts of water from surface and subsurface water sources; extending impermeable surfaces therefore stopping recharge of subsurface water and worsening flood risks; and contaminating water bodies through the release of untreated wastewater. Cities also import substantial amounts of food, consumer goods and energy from outside the city, which needs huge amounts of water at the point of production, transportation and sale. This virtual demand of cities significantly exceeds direct water usage (Hoekstra and Chapagain, 2006). As simply available surface water and subsurface water sources have been depleted in several urbanized regions, cities will have to go further or dig deeper to access water, or will have to depend on innovative solutions or additional progressive technologies such as reverse osmosis for desalination, or reclaimed water to meet their water hassles (WWAP, 2015).

The condition is worse in sub-Saharan Africa, where urbanization is happening most speedily. In this area, the proportion of people who enjoyed piped water on their buildings, which is the preferred option for urban areas, really reduced from 42% to 34% (WHO and UNICEF, 2014a). This obviously shows

that access to 'safe' drinking water sources continues to be a main problem in cities in the developing world. similar to trends in drinking water, the numeral of urban inhabitants without access to better hygiene increased by 40%, from 541 to 754 million, between 1990 and 2012 (WHO and UNICEF, 2014a).

CONCLUSION

The sustainable water and wastewater infrastructure problems in developing countries is at various angles. Most of the developing countries facing economic crises that they can no able to meet the demand gap of fresh water required. Despite the effort of various governments and international organisations to meet the demand gap of adequate freshwater resources the objectives failed to achieve due to rapid population growth, urbanisation, climate change, poor sustainable strategies to properly implement and corruption.

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