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Centralized Wastewater Management in Kabul City, Afghanistan

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Abstract

The aims of this study are to find the current sanitation process, segregation & locations of wastewater treatment plant in Kabul city. Most of resident's use pit latrines, and store in septic tanks, discharge miscellaneous wastewater to streets or city drainage. Sewer lines and sewage treatment plants are operated generally, apartment complexes it is called Macrorayon, without any treatment discharge in Kabul River. The resident's empty in vacant land, or in solid collection point. Distribution of on-site and sewerage systems of inhabited area. In Kabul 71.3% use vault/dry toilet, 1.3 sewerage systems of Macrorayan, and 27.4% septic tanks with pour flush toilet. 90% Kabul resident's use from underground water without treatment, 70% of underground and surface water contaminate by wastewater. Hence, elevated concentrations of faecal bacteria and nutrients can be found in the shallow groundwater, Diarrhea 73% and typhoid/malaria 18% are the high percentage diseases, moreover 6 children died per hour and 62% residents were visiting doctor once a month. Only 23% resident's access water supply. Water supply and centralized systems the best solutions in the mentioned city, for to develop appropriate three deferent locations for centralized wastewater treatment system by using secondary treatment for Kabul city. Safe and protects environment, health, and water quality.

Keywords: *Safe and Protects Environment; Health; Water Quality*

1. Introduction

Water is essential element for life on the earth. It comes from the nature made it three sources (snow / ice, liquid, vapors / steam), and polluted by discharging industrial and domestic wastewater (Metcalf & Eddy, 2004). Growing of the populations in the cities and rapid urbanization without sanitation the big challenge in developing country, still now 2.5 billion population of the world is living without sanitation (Ehsas, 2013).

According to (WHO) report globally, billions of people lack of access to adequate sanitation and clean water. The council of water supply & sanitations shows that 25 percent in developing country urban dwellers lack access to sanitation services and so higher in the rural populations it reached 82 %. The

diseases increasing in that countries (Masoud et al, 2009). By treatment of wastewater protect environment and increasing public health's (Dedication, 2009). 1.1-billion population lack of access to water supply and 2.4 billion to improved sanitation (JICA, 2009). " Afghanistan is one of the worst places in the world regarding sanitation, every years the percentage of sanitation goes to the negatives (Ehsas, 2013)."Kabul is located in center of Afghanistan, it is the capital of Afghanistan, located between Longitude 69-12" Latitude and 34-31" North East at an altitude of 1800 m above sea level, it is one of the world's highest capital cities. The population of Kabul has no public sewage system; 18 percent of the people access water supply. Kabul is strategically situated in a valley surrounded by mountains at cross roads of north- southwest trade routes (Eqrar, 2008). " According to the national coverage access to safe drinking water is 27percent which only 20 percent in rural area to have access to safe drinking water (DACAAR, 2013).

2. Materials & Method

The data collected from three sections, questionnaire survey, organizations, and the world wastewater treatment method, and analysis by GIS software.

3. Result

3.1. Sewage System in Kabul City

Only apartment complexes called Macrorayan connected with sewerage system the other area of Kabul used dry latrine and traditional toilet and store in septic tanks or ditch in pavements. Only area of Macrorayan is connected to a biological treatment in Kabul city, and it takes about (172,200) inhabitants of Kabul are connected to a sewerage system. In Kabul city 71.3% used vault/dry toilet, 27.4 used septic tank/access pour flush toilet, and 1.3 used sewerage system of Macrorayan (Eqrar, 2008). From point of water supply and sanitation Afghanistan is located in lower stage of the Asian countries. According the report of UNDP (2007) the access of water consumption in Afghanistan inhabitant is 50 l/day/capita (Marcos, 2007).

3.2. Populations in Kabul City

Kabul is one of the populated capitals in the world, Since 2002 Kabul has witnessed a revolutions, afghans people comes from neighboring country & came from other provinces, to find jobs social and economic opportunities the city is believed to provide, this concentrate effect on environment, life without sanitations and water supply system(UN-HABITAT, 2015). The population of Kabul city 4.1 million now, it is increased to 5.7 million more or less in 2025. According to the socio-economic framework. The population in intermediate years is shows in table for planning purpose (Table 1).

"Table 1 shows increasing population of Kabul city (JICA, 2009).

Years	2008	2010	2015	2020	2025
Pop (000)	4007	4220	4751	5126	5500
Annual Increase (%)	0	2.6	2.4	1.5	1.4

3.3. Population Density in all districts of Kabul City

Trip generation of the populations increasing in the central part of the Kabul city. Figure 2, shows the concentration of private and governmental organizations and employment opportunities in the area, on the other hand it indicates the unbalance development of the Kabul city and less population presence due to limited employment opportunities in other areas.

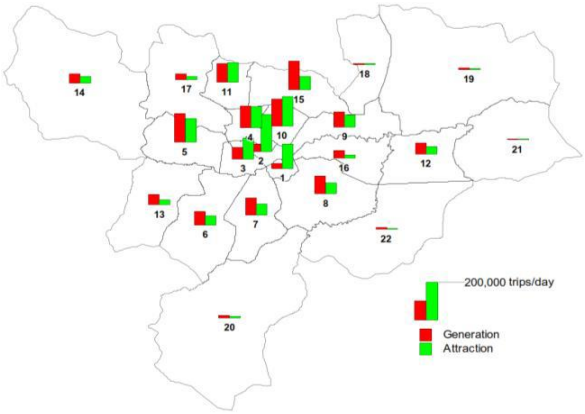

Figure 2. Shows density in all Kabul city districts (JICA, 2009).

3.4. Per Capita Water Supply and Water Consumption in Kabul city

According to water supply systems in Kabul city divided by third sections, each section covers the districts of Kabul city. Average of water consumptions shows in the below charts in all districts of Kabul city.

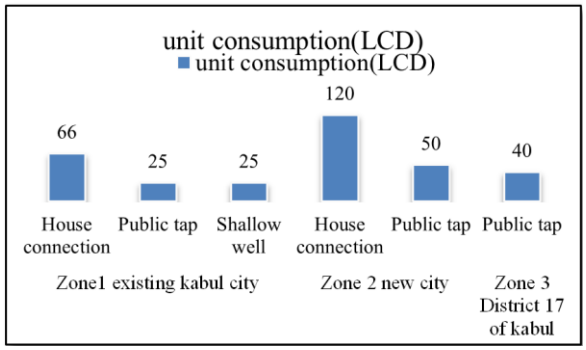

Figure 1 shows water supply in zones of Kabul city, Source: (JICA, 2009).

With comparing Afghanistan water supply with the below country afghnistan is the lowest case in the mentioned countries Source: (JICA, 2009).

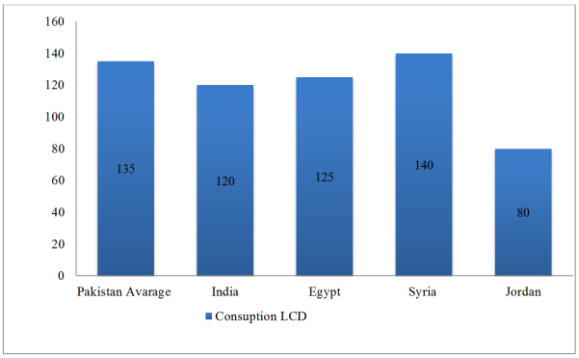

Figure 3 Practice of Neighboring Countries for Unit Water Consumption.

3.5. Sewer Network

The current sewer system in Kabul city be a separate, rainwater manage in drains of roads to minimize the scale of sewerage facilities. The rainwater should be drained by roadside ditches, finally drained discharge to Kabul Rivers.

3.6. Calculation of Wastewater Flow

3.6.1. Average Wastewater Flow

The consumer water would be outflow as wastewater. According the Japanese standers 100% water consumption as wastewater flow. The average wastewater flow as follows: Average Wastewater Flow = Average Water Consumption, the average waste water estimated is 51 LCD in Kabul city

3.6.2. Sewer Line

The sewerage line should be installed between sewerage service areas and sewage treatment plants. Kabul is a mountaine city; a gravity system could be basically applied for KMA. Concrete pipes are appropriate materials. Pipe diameters should be designed according to the Hmax wastewater flow in 2025 by the Manning formula as shown below:

- Design flow = Hmax Wastewater Flow
= Dmax Wastewater Flow / 24hour x 1.3
- $Q = A \times V = A \times 1/n \times R^{-2/3} \times S^{1/2}$

Where:

Q: Flow Capacity (m3)
A: Wetted Area (m2)
V: Velocity (m/s)
N: Manning Friction Coefficient
R: Hydraulic Radius (m)
= Wetted Area/ Wetted Perimeter
S: Slope (%) (Mara, 2004).

The below chart shows amount of Wastewater has been calculated for 2025Flow for Sewerage.

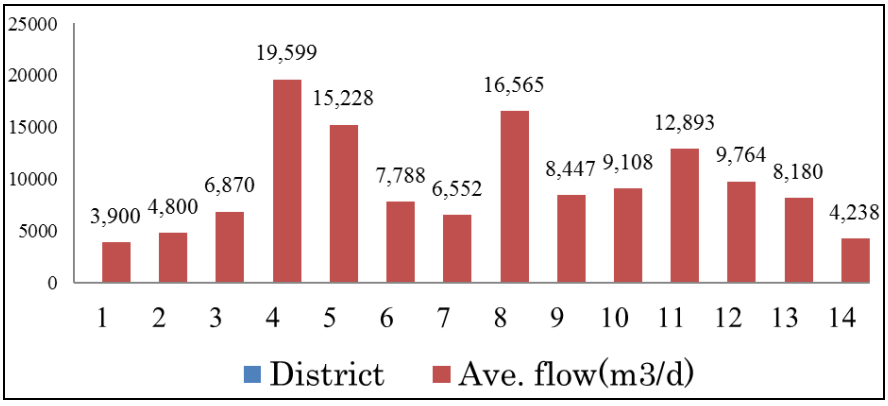

Table 2. Shows generations of wastewater in all districts of Kabul city. ”

3.6.3. Comparing Centralized and Decentralized Wastewater Treatment Systems

Centralized systems usually publicly owned collect and huge volumes of wastewater for entire large community, and use of large pipes, major excavation and manholes for access. On the other hand, decentralized onsite systems treat wastewater of individual homes and buildings. But decentralized systems collect, treat, and reused or dispose treated wastewater at near the generation point, centralized often reuse far from the generation point. According to the United States Environmental Protection Agency's (USEPA), decentralized wastewater management systems are used low-density communities and the cost is most effective than centralized system (Masoud et al, 2009). The decentralized wastewater treatment consists a variety of approaches to collect the wastewater, treatment, and dispersal/ re-use of wastewater for small community, individual dwellings, industrial, or institutional (Metcalf & Eddy, 2004).

3.6.4. Comparison of Centralized and Decentralized Wastewater System

Centralized wastewater treatment system	Decentralized Wastewater Treatment system
Advantage	Advantage
1. Satisfy the demand of highly population area 2. Success in improving public health and hygiene 3. Efficient and safe removal of matter, nutrients and pathogen bacteria 4. Protecting the water resources and the environment 5. In water-scarce regions for reuse purposes in order to reduce the pressure from the potable resource	1. Responds to suburban areas and rural centers, industrial, 2. Commercial and residential areas and low population 3. Huge contribution in the planning of isolated communities 4. Applicable to various levels from individual to community 5. Suitable where only a small space available for installation 6. Allows urine source separation 7. It supports treated wastewater recovery and reuse 8. It tends to stop the decrease of surface water quality
Disadvantages	Disadvantages
1. 60-80 % capital costs are related to the collection system 2. Whole collection system or part of it has to be renewed every 50-60 years 3. Strong dependency on electrical energy supply 4. Huge volume of potable water is required to keep the sewage system clean	1. Not applicable for densely populated areas 2. Home owner does not always look after the system 3. Problems may arise if repairs are not carried out promptly 4. Collection of the sludge expensive 5. Contamination underground water

In Germany, for example, over 95% of the population is currently connected to sewer systems, in Israel 96% of the population is connected to sewer systems, and Jordan 65% of the population is connected to collection systems.

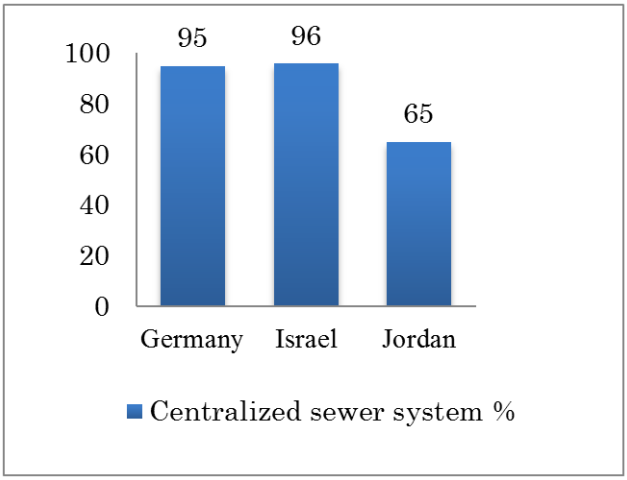

Table 3. Comparison of sewerage system with some country Source: (Hophmyer & Sharon, 2006)

After collection data to identify main situation of sanitations in Kabul city, day by day the population in Kabul is increase no management of wastewater, and discharge in Kabul river or ground water. It is the bad condition of environment, the health and illnesses of increase. However, the planned sewerage service area does not correspond completely to the planned water supply service area due to the restriction of topography, operation safety, and system adaptability.

According GIS analyzing of the data Kabul city as almost flat, the canal will be built along Kabul River to minimize the pump station and pipe.

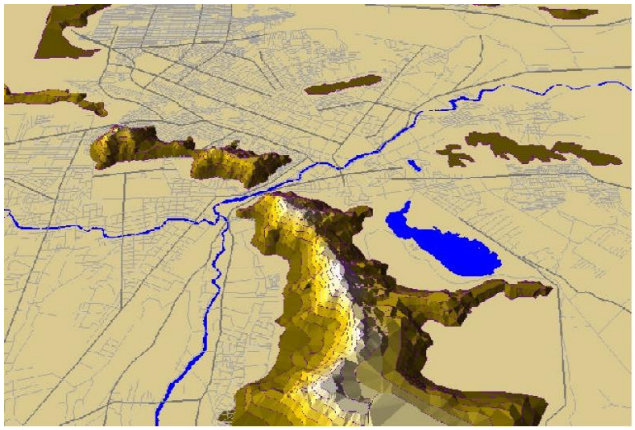

Figure 4. Shows the topography of Kabul city.

The study plane to divide the city into three areas, and each area has sewer networks and a treatment plant. The service areas, shown in Figure 5 are limited to the exiting urbanized areas. It is planned that the remained areas will be managed by on-site treatment. As the sewerage service areas cover the high population density area, the plan satisfies the basic aim of sewerage, which is to minimize risks to public health, pollution of groundwater, and influence for downstream at the minimum cost.

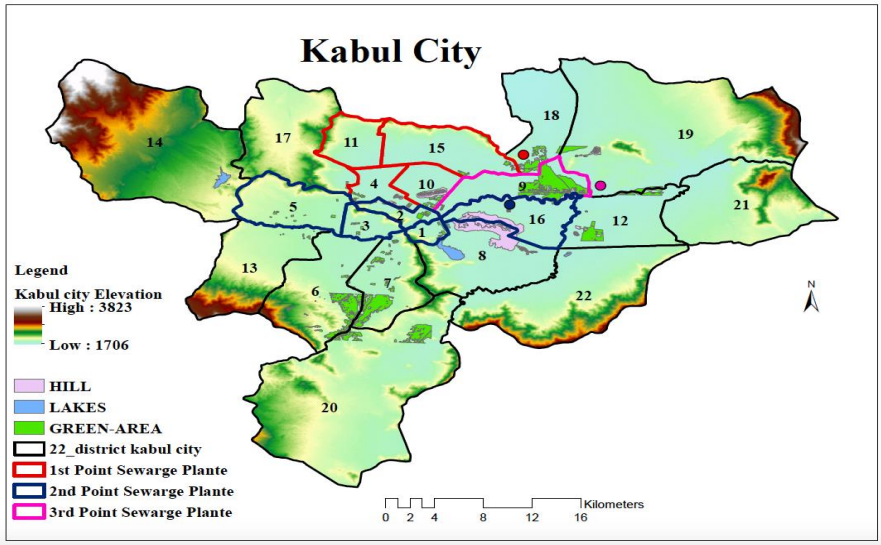

Figure 5. Shows the location of wastewater treatment plants in Kabul city.

Conclusion

The first aims of study evaluations current conditions of sanitations, no municipality wastewater management in Kabul city, some district manage onsite and offsite sanitations, and environmental challenge & health issues increasing in Kabul city, especially the diseases such as diarrhea, malaria, typhoid, cough, skin infection, etc. for improving and solving this problems manage sewerage system in Kabul city, without sewer couldn't overcome this challenge, priority offsite sanitations is best way in Kabul city, the remaining places manage onsite sanitations.

Recommendations

1) The results showed that water supply is the highest demand and need for improve sanitation system in Kabul city.

2) All traditional toilet change with flush toilets well is the best solution in the Kabul city.

3) According to the restriction of topography, population density, water supply area, and watershed of Kabul city, three deferent wastewater treatment plants are required for Kabul city with Conventional activated sludge, It is the most proven system and technology.

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