

Urban Infrastructure

The Problem

India is urbanizing rapidly. The number of metropolitan cities in India with a population of 1 million and above has increased from 35 in 2001 to 50 in 2011 and will further rise to 87 by 2031 (HPEC, 2010). It is expected that India's urban population of 400 million will double by 2050 at approximately 2 percent compounded growth rate (Shah, <https://counterview.org/>, 2017). As a result, all cities are expected to witness rapid increase in demand for urban services such as piped water supply, sewage and wastewater treatment, and solid waste management (McKinsey, 2010). As per a high-powered expert committee report (HPEC, 2010), the duration of water supply in Indian cities ranges from 1 -6 hours; about 21 percent of the wastewater generated is treated, and less than third of municipal solid waste is segregated (HPEC, 2010).

India has 17 percent of the world's population and 15 percent of its livestock, whereas it occupies 2.45 percent of the landmass and a relatively small share of 4 percent of world's water resources. The country ranks 133 (out of 180 nations) on water availability and 120 (out of 122 nations) on water quality. It is estimated that 80 percent of India's surface water is polluted, resulting in a loss of US\$6 billion annually due to water-borne diseases (Bose and Srivastava, 2017). As per a report on urban infrastructure and services by ICRIER, 64 percent urban Indians are connected to a household water system. It has been estimated that inadequate sanitation costs India Rs. 2.4 trillion a year and the national cumulative sanitation market has the potential of Rs. 6.87 trillion (US\$152 bn) over the 2007- 2020 period. (World Bank, 2011)

Growing economic activity and population expansion in Andhra Pradesh (AP) have put heavy pressure on urban infrastructure and there is an urgent need to address present and emerging infrastructure needs.

The aim of this study is to evaluate urban infrastructure investments towards meeting the challenge of improving water and sanitation services. The 3 interventions analysed are 24x7 piped water supply to 100 percent population in Vijayawada, Provision for sewerage for all households in Vijayawada with 100 percent collection and treatment of wastewater and third, 100 percent door-to door collection, processing and treatment of solid waste. The project period of the three urban interventions has been considered to be 25 years with investment being made in 2019. The benefits occur over the lifetime of the interventions.

Solutions

Interventions	BCR	Total benefit (INR crore)	Total cost (INR crore)
Provision of 24x7 Piped Water Supply	3.3	18,299	5,481
100 percent Sewage and Wastewater Treatment	1.1	3,829	3,385
100 percent Solid Waste Management	2.1	2,824	1,335

Total costs and benefits are discounted at 5%

The full paper by **Parijat Dey** from IL&FS and **O Rajesh Babu** from APUIAML can be downloaded on www.appriorities.com/urbaninfrastructure

Provision of 24x7 Piped Water Supply

The Problem

Vijayawada city has adequate raw water to meet the demand of its consumers. The per capita water supply was 168 Lpcd in 2016. An estimated 61 percent of total households are connected to piped water supply. However, there are shortcomings in the service delivery owing to deficiency in the water distribution network. Most of the pipes are old and damaged leading to leaks and contamination. The contribution of NRW (non-revenue water) was assessed to be 46 percent (APUIAML, 2017). Inadequate coverage, intermittent supplies and low pressure, are some of the most prominent issues related to water supply.

The Government of Andhra Pradesh (GoAP) has estimated an investment requirement of Rs 1.02 lakh crore over next five years (Vijayawada Commissioning, 2018) to address the gaps in urban infrastructure such as piped drinking water supply, sewerage lines and roads across the state. As a part of this plan, significant infrastructure development is intended for Vijayawada considering that it is the town city of the new capital Amaravati. GoAP has given utmost importance for providing safe and adequate water supply (APUIAML, 2017).

The Solution

The Intervention aims at provision of 24x7 piped water supply distribution to 100% household in Vijayawada along with 80 percent of existing distribution network pipes to be replaced.

The intervention will be implemented by the Public Health and Municipal Engineering Department (PHED) and is expected to provide piped water connection to all households in Vijayawada. This intervention will also provide water connections to the incremental population as the population grows over the project life.

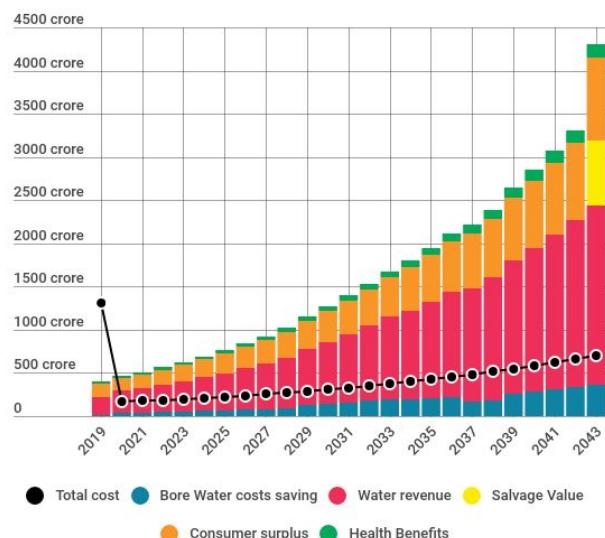
Costs

It has been assumed that the intervention will start in 2019 and all households without piped water connections will be connected during the year. The project life is for 25 years.

Total capital investment and opex requirement has been derived from the per capita investment cost (PCIC) norm. Key cost items include capital expenditure for water production, extension of

distribution network and replacement or upgradation of existing network; and operating expenses. The total cost of the intervention is estimated at approx. Rs. 5,481 crores.

Urban 24x7 piped water supply benefits and total cost 2019-2043



Costs and benefits in crore rupees from author's estimates

Benefits

Water revenue is calculated based on the tariff schedule provided by Vijayawada Municipality Corporation (VMC) for 2013 and escalated at 7 percent annually till 2017. Post 2017, the tariff has been escalated at the real wage growth of AP to account for increase in Willingness to Pay (WTP). The avoided cost of bore water pump installation and maintenance is considered as an indirect benefit. While calculating the cost of bore water pump installation and maintenance, various elements including borewell drilling cost, pump cost and maintenance cost (energy consumption), and cost of basic RO and their corresponding maintenance cost have been considered.

Salvage value of the asset has been estimated using a depreciation rate of 3 percent. Positive health impacts from clean drinking water has been estimated based on the burden of disease data, relevant to water and sanitation, sourced from meta-studies and Global

Burden of Disease database. Relevant data has been used to calculate the death (Years of Life Lost or YLLs) and morbidity (Years Lost to Disease or YLDs) and finally the Value of avoided Disability Adjusted Life Year (DALY's) at different discount rates. The estimated total benefits due to this intervention is approx. Rs. 18,299 crores.

100 percent Sewage and Wastewater Treatment

The Problem

Approximately 36 percent of the households have access to sewerage connections and 35 percent of the sewage generated by the city is treated (APUFIDC, 2017). Vijayawada has inadequate sewer connections, and flooding of sewers is common in various areas. Poor coverage, and damaged and unserviceable network are the most prominent sewerage issues.

The Solution

The intervention aims to address Underground sewerage system with complete coverage and 100 percent collection and treatment of wastewater.

The intervention may be implemented by the PHED or through private sector participation. Vijayawada has a decentralized sewerage system that is divided into four sewerage zones. The city has six sewerage treatment plants with a total treatment capacity of 120 MLD. The main sewerage network covers about 80 percent of the city. However, 36 percent of the households have access to sewerage connections and 35 percent of the sewage generated by the city is treated. It intends to connect the remaining 74 percent of households to the sewerage network in 2019 and treat the entire bulk of 148 MLD of waste water generated.

Costs

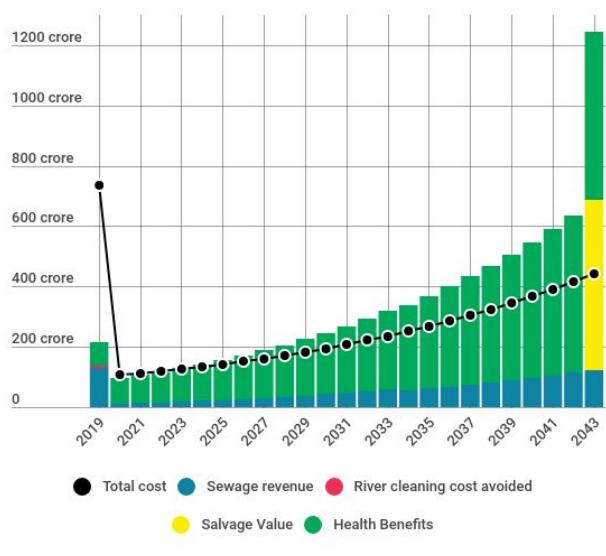
The intervention will be implemented from 2019 and the project life is 25 years. Total capital investment and opex requirement have been derived by from the per capita investment cost (PCIC) norms. The total direct and indirect cost of this intervention is estimated at approx. Rs. 3,385 crores.

Benefits

The benefits comprise direct benefits – revenues accrued through the tariffs, salvage value of the project, cost avoided for river cleaning and indirect benefits – disability adjusted life years (DALYs). The

total direct and indirect benefits are estimated at approx. Rs. 3,829 crores.

Urban sewage and wastewater treatment benefits and total cost 2019-2043



Costs and benefits in crore rupees from author's estimates

100 percent Solid Waste Management

The Problem

India generates over 150,000 tons of municipal solid waste (MSW) per day. Yet only 83 percent of waste is collected and less than 30 percent is treated (Ahluwalia, 2016). About three-fourths of the municipal budget for solid waste management goes into collection and transportation, leaving very little for processing/resource recovery and disposal.

On an average, ULBs in Andhra Pradesh generate about 9,754 MT of waste per day with per capita waste generation ranging from 0.2-0.4 kg/per day (Swachh Bharat Mission, 2016). It has been estimated that ULBs in Andhra Pradesh spend Rs. 500 - 1500 per ton/day, of which, 60-70 present is spent on collection, 20-30% on transportation and less than 10% on processing and disposal activities. Low investments by majority of the

ULBs result in lack of proper treatment and disposal facilities (Swachh Bharat Mission, 2016).

The estimated municipal waste generation in Vijayawada is estimated to be about 550 tons per day from all sources. Vijayawada Municipality Corporation (VMC) claims a collection efficiency of 100 %, however, waste processing and treatment is almost non-existent. The bulk of mixed waste is transported to dumping sites for disposal. Despite past initiatives by VMC, segregation of waste at the household level is low. Most of the segregation is carried out in the informal sector, where ragpickers and kabariwalas take out high-value recyclable waste and sell it to recyclers.

The Solution

This intervention targets 100 percent of management of solid waste in terms of collection, transportation, and treatment for Vijayawada, as per Municipal Solid Waste 2000 Rules.

It is estimated that 10% of total collected waste is recyclable and 25% is inert, which is sent to the landfill. Approximately 50 percent of input is converted to compost and 16 percent of the input is converted to refuse derived fuel (RDF)

Costs

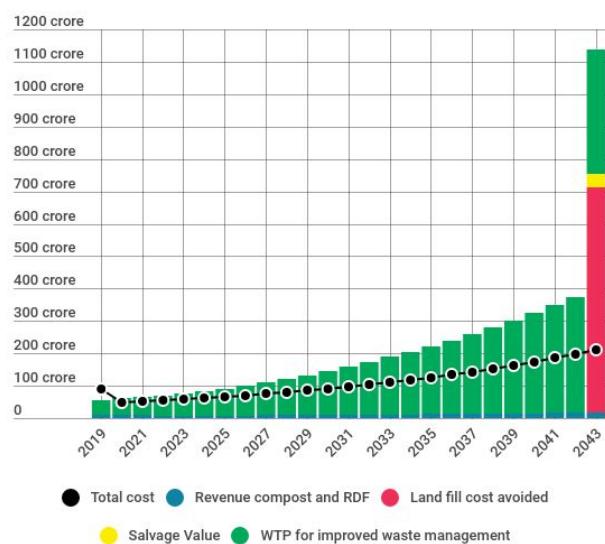
Total capital investment and opex requirement have been derived by multiplying per capita investment cost (PCIC) with the city population. The total cost of this intervention is estimated at approx. Rs. 1,335 crores at 5% discount rate.

Benefits

Revenue for local municipality through sale of compost and RDF, salvage value of the project, willingness to pay for improved solid waste management and avoided landfill cost are considered as benefits. The cost of

remediation of that landfill can be avoided through the intervention on solid waste management, as the average life of a landfill is 25 years (Mahadevia, n.d.), as a result the landfill would need closure in the year 2043. Land value savings due to this intervention is also considered as benefits, as improved solid waste management will result in lesser space requirement for landfills. Total direct and indirect benefits of this intervention is estimated at approx. Rs. 2,824 crores at 5% discount rate.

Urban waste collection 100% benefits and total cost 2019-2043



Costs and benefits in crore rupees from author's estimates