

# Status of Service Delivery related to Water Supply and Sanitation across Low- income Settlements of Delhi

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## A City Survey Report

Prepared for Swachh Delhi Swasth Delhi (SDSD) – Water Aid India

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By

Centre for Urban and Regional Excellence

**Research Team**

**Dr. Renu Khosla**

**Jonathan Ferguson**

**Anindita Mukherjee**

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## Acronyms

NCTD	National Capital Territory Of Delhi
NDMC	New Delhi Municipal Corporation
MCD	Municipal Corporation Of Delhi
DJB	Delhi Jal Board
MLD	Million Litter Per Day
PUD	Public Welfare Department
NSS	National Sample Survey
LPCD	Litter Per Capita Per Day
MGD	Million Gallon Per Day
CTC	Community Toilet Complex
CBO	Community Based Organization
NGO	Non Government Organization
CBIS	Community Based Information System
STP	Sewerage Treatment Plant
PPP	Public Private Partnership
WATSAN	Water And Sanitation
DPCB	Delhi Pollution Control Board
YAP	Yamuna Action Plan
CPHEEO	Central Public Health And Environmental Engineering Organization
BSUP	Basic Services For Urban Poor
MOHUPA	Ministry Of Housing And Urban Poverty Alleviation
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
CDP	City Development Plan
DUEIIP	Delhi Urban Environment And Infrastructure Development Project
CPCB	Central Pollution Control Board
CURE	Centre For Urban And Regional Excellence
CGWA	Central Groundwater Authority
SLF	Sanitary Land Fill
NIUA	National Institute Of Urban Affairs
WSP	Water And Sanitation Programme
DDA	Delhi Development Authority
DEDA	Delhi Engineering Development Agency
NWP	National Water Policy
BWSSB	Bangalore Water Supply And Sanitation Board
JJC	Jhuggi Jhonpri Cluster
HB	Harijan Basti
UNRC	Unauthorised non-regularised colony
URC	Unauthorised regularized conlony
UV	Urban Village
RV	Rural Village

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## Executive Summary

The Centre for Urban and Regional Excellence (CURE) undertook a city wide survey to assess the status of water and sanitation services in urban low-income communities in Delhi. Specifically, the objectives of the study were to:

- ▶ Review the urban water and sanitation scenario in Delhi using available research and literature; particularly to examine current arrangements for delivery of municipal services to slums and underserved settlements.
- ▶ Develop a baseline on the current status of water and sanitation services in slums and low-income settlements of Delhi; and
- ▶ Make recommendations for policy reforms in the sectors of water and sanitation.

### **WATSAN Services in Delhi: A Situational Analysis**

A vicious relationship exists between poor quality water and sanitation services, people's health and household and city economic development. Delhi, one of India's fastest growing metropolises, is challenged by increasing demand for water and sanitation services, in particular to slum and underserved areas and faces major challenges for service delivery including institution building, sector policies and governance reform.

Delhi (NCTD) has an estimated population of 13.78 million people (Census 2001) and a population growth rate twice that of rest of India contributing to an overall population increase of 4.6% annually. Over time, Delhi has also emerged as a major trading, commercial, banking, insurance, retail and entertainment centre of India; a growth that has attracted migrants. The existing infrastructure has however, been unable to cope with this growth. Large sections of the city's population are living in unplanned colonies and slums with minimal or no access to basic services. Delhi's high intensity construction and densely built areas add to the immense pressure on the city's water and sewerage infrastructure. Inequity in population distribution across the city is also reflected in the variable access to water and sanitation services by various groups.

The Constitution of India guarantees every citizen fundamental rights to equality and states that no citizen should be subjected to any restriction on use of water resources and has right to get pollution-free water. Towards this end, the Urban Development Department of NCT is the nodal department for policy planning and setting service standards, supervision and regulation. The Master Plan Delhi sets minimum water supply norms and recommends management systems. Delhi Jal Board (DJB) has a citizen's charter that outlines obligatory functions to all consumers including in unauthorized colonies, for water. The Charter has little commitment and no accountability to supply water to slum settlements. Increased judicial activism and political pressure has however, created an environment under which DJB is obligated to serve the poor first albeit as political patronage.

### **Programmes for WATSAN**

Two key initiatives in Delhi that have implications for WATSAN services to the poor are the Jawaharlal National Urban Renewal Mission (JNNURM) aimed at stimulating urban development with institutional, structural and fiscal reforms and the Yamuna Action Plan (YAP). JNNURM's sub mission on poverty has a 7-point charter that focuses on basic services to the poor. Delhi is one of the first

generation cities under JNNURM with funds for WATSAN infrastructure development. YAP too, is supporting a programme for city sanitation that is aimed at cleaning up the Yamuna River.

### **Institutions for Water and Sanitation (WATSAN)**

Delhi comprises 9 districts, 134 wards and 70 assembly constituencies, 165 villages. It has three local agencies – the Municipal Corporation of Delhi (MCD), the New Delhi Municipal Committee (NDMC), and the Delhi Cantonment Board (DCB) that provide civic services in the city; with MCD reaching roughly 94% of the city population for solid waste management, street lighting, community toilets, road development, etc.

The Delhi Jal Board, MCD and NDMC are responsible for water and sanitation services. DJB is a parastatal body that plans, designs, constructs, operates and maintains water and sewerage infrastructure. It has divided Delhi into 21 water zones based on population and outlet-inlet points of water pipeline network.

The conservancy and sanitation department of MCD collects, transports, and disposes solid waste. Its Slum Wing provides basic services in slums and relocation sites. Water services are provided jointly by the DJB and MCD to slum areas; the former provides the water lines up to main roads and latter, the internal piping and community water points. The DJB, MCD and Public Works Department (PWD) are also jointly responsible for the construction and maintenance of drains in the city.

### **Informal Settlements in Delhi and Access to WATSAN services**

Poor people without access to proper housing often live in informal or slum settlements that are mostly un-served or underserved. Large-scale migration has resulted in a huge proliferation of unplanned settlements across Delhi. Per capita income in 2000-01 was Rs.24450, significantly higher than the national per capita income. The income of the slum population is however, estimated to be much lower at Rs.3073/m or Rs575 per capita/m.

Informal slum settlements are generally located close to work sites, commercial centres, industrial areas, construction sites or residential housing. They are illegally and located on land owned by the government or land deemed environmentally untenable, making the provision of water and sanitation services very difficult. Figures on percentage of Delhi's population that lives in slums vary. GONCT estimates that population living in J.J. Clusters, Slum Designated Areas, Unauthorised Colonies and Resettlement Colonies stands at 52% of the total population. The 2002 National Sample Survey 58th Round results estimate nearly 1,867 slum settlements in Delhi with 379,000 households. However, there is no accurate mapping or numbers of slums in the city.

Slum dwellers are significantly affected by the limited access to water and sanitation services. Resettlement colonies are developed for slums to provide improved quality of housing. Despite planning, houses in resettlement sites initially lack services. Over time, water and sanitation services are provided but growing population pressures, commercialization of land use, and unorganized development stresses service delivery and generated slummy conditions.

Housing shortages has led to unregulated urban growth and the development of unauthorized colonies. There were 1432 unauthorized colonies in Delhi, home to 30 lakh people. Infrastructure here is only marginally better than that of slums and no proper roads or network supplies for water or sewer lines exist. Periodically, these areas are regularized through appropriate legislation. Such regularization gives residents regular access to basic services. Other areas in



Delhi with minimalist and insular infrastructure include rural areas that get wrapped into city boundaries, *Lal Doras* or urban villages assimilated within the city space and characterized by high-density development and inadequate infrastructure. High-cost of extending main trunk infrastructure to these remote areas is the primary reason for their neglect. Besides, water and sanitation services to the poor are closely linked to land tenure, lack of which excludes them from individual water and sanitation connections.

**Water Supply**

Delhi has an average water availability of 225 lpcd. Besides shortage of water, there is also uneven distribution and inequitable policies that discriminate between the rich and the poor. As against a demand of 830 million gallons water per day (MGD), DJB has the capacity of supplying 650 MGD, 20-40% of which is lost in transmission. The shortfall of over 300 MGD is met by private extraction from bore wells, tube wells etc.

**Water Supply Norms:** Water is state property and supplied as paid service to citizens. Norms for services depend on whether one is a formal or informal citizen based on status of land tenure. While unauthorized colonies and slum settlements receive community services, well-off communities get in-house connections.

**Water Coverage:** DJB supply network is over 9000 kms with 15.5 lakh metered connections. A quarter of Delhi, mostly rural however, still does not receive tap water. 10% population has no piped water supply and 30% has grossly inadequate supply of about 4-10 lpcd through stand-posts against a planned level of 40 lpcd. Due to poor coverage nearly all underserved settlements depend on multiple sources such as privately owned bore and tube wells and private suppliers of water (water tankers, packaged water suppliers). Based on known extractors, nearly 11% of water supplied is estimated to come from groundwater.

**Service Delivery Systems:** 90% of water supply in Delhi is surface water through the Yamuna River that is tapped, treated and distributed. Even as water production has increased six times since 1961 to the present 2730 million litres per day, it fails to meet official consumption standards of 250 lpcd. An inefficient delivery system has forced people to make alternate arrangements with negative effect on water availability and compromised water quality through unregulated extraction, illegal online motors to boost pressure, etc.

**Quality of Water Supply:** Delhi's water supply sources are polluted with only a few palatable aquifers (CGWB, 1996). Poor water quality is especially observed in the slums with water containing high fluoride concentration exceeding permissible limits. To DJB's credit, most poor residents are happy with the drinking water quality it supplies.

**Coping with shortfall:** Poor pay the highest price for water shortage; long waiting lines at stand posts, struggling for supplies from water tankers, etc. Incidences of diverting water pipelines for personal usage are rampant leading to massive wastage and decreasing the already low water pressure supply at the tail end of the distribution chain. Water requirements peak during certain times forcing many households to obtain supplementary water supplies at high costs.

**Alternate Sources:** Almost every colony in Delhi has a bore or tube well to augment water supply. Legally, these have to be registered with CGWA. Laws, however, are seldom practiced and bore wells rarely if ever registered and continue to be drilled illegally. Tankers and pushcarts provide complimentary services in unauthorized colonies and slums. DJB tankers supply 10 lpcd water to slums settlements free of charge. Private water tankers have come into existence

due to failure of DJB to meet demand. There are approximately 250 private water tanker suppliers that supply untreated/non-potable water. Manufacturers of packaged water are generating soaring profits from the existing water crunch. DJB also supplies packaged water under the brand name of 'Jal'.

**Pricing Water:** Delhi residents pay for water both at a flat rate and through metered supplies with increasing block tariffs. According to DJB, just 30% households have metered connections. Although a graded tariff system for metered supplies is available, the top-of-the-block costs are also unable to meet the cost of supplying water to customers. The price for consumption at the highest level at Rs.4.50/Kl (kilolitre) is less than the cost of water supply at Rs.4.65/Kl. Poor are supplied free water, despite willingness to pay.

**Water Issues and Concerns:** The many challenges in delivering proper water services include; improving the quality of raw water, providing household connections to the poor, efficient provisioning of services, checking illegal tapping and transmission leakages, setting up distribution networks in high-density informal settlements with metering, strengthening weak grievance redressal and voice systems, proper pricing of water for cost recovery, etc. Lack of data and poor organization makes efficient provision of services nearly impossible.

### **Sanitation**

Sanitation refers to the provision of facilities and services for the safe disposal of waste, solid, liquid and human. Inadequate sanitation is a major cause of disease worldwide and improving sanitation has significant beneficial impacts on public health.

**Service for the Poor:** The Slum and JJ Department of MCD is responsible for basic sanitation services to low-income slum settlements. Norms for slum sanitation include community toilets, open and shallow street-side drains, community toilets usually linked to septic tanks and sometimes to underground sewerage. Underground sewerage networks for household toilets too are not available to slum settlements, unauthorized colonies and rural villages. Newly regularized colonies lack sewers now, but get eventually connected. Most urban villages have narrow lanes therefore underground sewerage and drainage is combined into a single network in these areas.

**Sewerage:** Sewerage, till very recently, got low priority in service plans of local governments mostly due to a lack of understanding of its importance and /or lack of finances. The result has been poor coverage as a whole and underground sewerage in particular. Only 65% population has access to sewerage services both underground and on-site treatment systems. None of these are slum dwellers except those with affordability and nearness to main trunk infrastructure who connect illegally. Besides, sewerage network in Delhi is old, poorly maintained and not properly networked to treatment systems resulting in blockages and environmental damage. Sewage generated from unconnected areas finds its way through surface and storm water drains into the river.

**Drainage:** Delhi has several natural and man-made drainage systems, drainage basins, storm water drains along roads and combined 'sewer and storm' water drains that eventually discharge into river Yamuna. Just half the households in the city are connected to drainage facilities, 13.58% were pucca; 82% slum areas had an open pucca/ kuchcha drainage system.

**Solid Waste Management:** The 3 municipal bodies ensure solid waste disposal in Delhi. The Delhi Development Authority (DDA) provides land for sanitary land filling. The Delhi Energy Development Agency (DEDA) implements solid waste

utilization projects for bio-gas or energy generation. Collection of waste and street sweeping is managed through sweepers at 1 per 216 persons. Most households are required to make personal arrangements for waste disposal as MCD is mandated to lift waste from dallaoos but not through house-to-house collection. Slum households mostly dispose waste themselves dumping on open sites or in drains resulting in unhygienic conditions.

**Community Toilets:** According to Census 2001 approximately 78% of Delhi's population had access to toilets, 66% of which were pour-flush. Delhi has a total of 1963 Public toilets not all of which are in slums. Estimates suggest that nearly 60% poor defecate in the open. Community toilets are managed by public agencies with NGO participation, and are available on a user per-charge basis or designated as free. User charge for slum residents is payable at Rs30 per family per month. However, the quality of service remains poor. 300 newly built toilets have already ceased to operate due to maintenance issues.

**Issues and Concerns:** Public provision of sanitation services for urban poor has met with limited success. Even though local bodies have been adding infrastructure, it generally suffers from gross neglect, poor maintenance, and limited usage. Institutional shortcomings include lack of uniform standards, weakly structured PPP arrangements, weak monitoring mechanisms, lack of sewer networks, limited community involvement, and a multiplicity of agencies responsible for services.

### **Supply of Basic Services: Challenges**

As service provisions in informal settlements are generally of a lower standard than desirable, the city is faced with several challenges to servicing the poor.

- **Defining WATSAN Vulnerability:** There is a need to define WATSAN vulnerability and identify vulnerable communities so as to develop inclusive policies for mainstreaming poor with sanitation and water systems. This will require the creation of new ways of working and servicing the poor.
- **De-linking Tenure and Services:** A key constraint in equitable services to the poor is the lack of land tenure. To ensure household level connections and services to non-tenure settlements without necessarily giving them a legal right to the land will be the key to sustainable development and poverty reduction.
- **Promoting Metered Connections:** Water standards for the poor too, should be metered household or group connections with options to incrementally upgrade as incomes rise. In addition to raising revenues for the operator, paid water supply to the poor will eventually reduce their coping costs and enhance their income earning potential. As paid clients, the poor are more likely to be heard and integrated into city systems with increased transparency and accountability.
- **Synergising Water and Sanitation Services:** Multiplicity of agencies confuses roles and responsibilities and reduces accountability. There is need to tie together the various operations and operators for a comprehensive and cohesive approach. This would call for a dialogue between agencies and establishment of mechanisms for synchronized delivery.
- **Readiness to Pay, Willingness to Supply:** Slum residents' readiness to legally connect to the system must be considered. When residents see

value additions it raises their confidence levels to pay for services. Individual connections that initially increase water consumption may over time decrease non-revenue water for the utility.

- **Political Economy of Water Supply and Sanitation Services:** Poor often face difficulty securing the resources needed to pay for legal connections and the plumbing costs. This is often interpreted as resistance to pay. Systems would need to be created to enable poor to access credit at affordable rates with paybacks in easy installments for getting the connections.
- **Partnerships with NGOs** will bring in crucial value addition by customizing water and sanitation solutions to demands and organizing communities to better manage service provisions.
- **Community-Service Provider Interface:** A functional water and sanitation system has four key stakeholders; organized and informed communities that are sufficiently empowered with knowledge and skills to negotiate; nongovernmental organizations that create a community-agency interface through their interactions with the community; political structures that invigorate public voice by advocating for the poor at appropriate forums; and a responsive administration supported by accurate and current information about the supply levels and who are enabled to take policy decisions. The Sanjha Prayas-Bhagidari platform for interactions needs to be strengthened for such interaction.
- **Data Deficiencies and Information Loops:** Management of water resources is affected by incongruence between demand and supply, and lack of information on underserved populations. A reliable information base that can be periodically updated such as the Community Based Information System (CBIS) needs to be developed to get data about underserved populations, state of supply infrastructure and a wish list of demands. Such systems also create information loops that improve decision making transparency, allowing the poor to reflect their needs in city plans and be better informed about their rights.

## **Status of WATSAN Services to Urban Poor in Delhi: A Study**

### **Methodology**

All low-income settlements in the city were included; Slums/JJ Clusters (Slum/JJC), Harijan bastis (HBs), Regularized Colonies (URCs), Non-Regularized colonies (UNRCs), Urban Villages (UVs), Rural Villages (RVs), and Resettlement Colonies (RCs). Of the total 3215 low-income (LI) settlements in the city, 150 settlements were selected, in proportion to their numbers in the stratified list. Actual settlements were selected through random sampling using comprehensive lists for each type of settlement. 10 households were selected randomly from each settlement. Households in each category were therefore in the same proportion as the settlements. The total household sample size was thus 1500 households. A questionnaire was used to collect data from each household on availability and access to water supply and sanitation services, quality, satisfaction, demand etc.

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## Findings of the Survey

**Spatial Location, Tenability and Tenure:** One in every 5 slum settlements was situated in close proximity to contaminated water sources like nullah/large drains. An equal percentage of urban villages and some Harijan Bastis (5%) were also located along rivers, ponds etc. that were mostly polluted. 11 percent slums were along railway lines, with poor environmental conditions.

Slum/JJ clusters were encroachments on government land, mostly (51%) belonging to DDA, 11 percent to local bodies, 10 percent to Railways and 11 percent was private land. Half the urban villages land (48%) falls under *Lal Dora* and 17 percent was private.

**Demographic Profile:** The total population of 1500 surveyed households was 7721. The male/female ratio was 55:45. Around 40 percent population was in the working age-group of 26-60 and average family size was 5.14. The dominant religion was Hinduism. More migrant families were living in Slum/JJ Clusters (60%). Migration rates over the past decade were; 4% in Slum/JJ Clusters, 6% Harijan Bastis and 8% UNRCs.

**Income and Expenditure on Water:** Average monthly household income in Slums/JJ Cluster was low at Rs.6630. UNRC had the highest average household income per month at Rs.13000, indicating a wide inequity in family earnings and affordability. 48 percent households in Slum/JJ Cluster are Above Poverty Line (APL) which is nearly half that in other settlements (92%).

Most families in all types of settlements spend up to 2 percent monthly income on procuring water. Slums/JJ Cluster, URC and Urban Villages also spend an additional 1-2 percent on toilet facilities. For poor families, this amounts to an average Rs264 per month.

**Housing:** 55 percent Slum/JJ households have pucca houses in contrast to nearly all in other areas. The latter also all own the houses they live in, have ownership papers and access to metered power connections in the homes. Only 66 percent households in Slum/JJ Clusters have metered connections.

## Access to Water Supply

Sources of water for the study have been grouped into municipal and ground water. Some municipal sources are in the house such as taps, hand pumps, etc. whereas others are common to all households such as stand posts, tube wells/bore wells, community hand pumps, tankers, open wells. Nearly all households (90%) in all types of settlements use municipal or DJB water sources for drinking and cooking. Dependence on groundwater sources ranges between 6-12 percent; UNRC and Rural Villages being more dependent on these. Up to 3 percent households across all settlements, except Resettlement Colonies use both sources. Municipal water is also used for all activities besides drinking and cooking, in most settlements except UNRC, where there was greater dependence on groundwater sources. All URC households use only municipal water.

## Municipal Sources of Water

**Taps** in the house are the predominant municipal source in all settlements except Slum/JJ Clusters. While nearly 90 percent families in Harijan Bastis, Resettlement Colonies and Urban and Rural Villages have taps in the house, only 53 percent in URC, 34 percent in UNRC and 30 percent in Slum/JJ Clusters have municipal taps. Respondents however reported that many of these connections were illegal, in

particular in the Resettlement Colonies where the percentage was nearly 90 percent. Percentage of illegal or *galli* connections in slums was the highest among the rest at 18 percent.

Tap water is supplied daily, mostly twice a day and for up to 2 hours in all settlements. Most residents found the supply timings convenient. Majority of households indicated that current quantity of water supply was adequate even as most got 50 liters per day<sup>1</sup> per household against a recommended 265 liters per capita per day. Half the households also agreed that quality of supply was good except for poor water pressure.

**Community Stand posts:** Up to 60 percent households in Slum/JJ Clusters, 30% in URCs and just 14% in UNRC use community stand posts. These are mostly located within the settlement areas. However, nearly half the residents (46%) felt that these were responsible for creating tension during supply hours.

Water through community stand posts was also supplied twice a day, morning and evening. Residents of Slum/JJ Clusters and URC acknowledged that supply was adequate and households could collect up to 10 buckets (100 liters) of water per day. However, about 46 percent slum households claimed that pressure and quality was both bad. Distance to stand posts ranged from nil to 20 meters, with an average walking time of 5-10 minutes and collection time of one hour in slums. The high collection time, especially in Slum/JJ Cluster and URC has high opportunity cost.

**Tanker Supply:** Tanker supply to settlements is either through the Delhi Jal Board (DJB) or private suppliers. UNRC (30%) residents depend on tanker supplies and not just as an alternate/subsidiary source. Between 88 and 100 percent residents in UNRC and URC respectively, felt that tanker water was of good quality but was inadequate/difficult to collect.

**Groundwater Sources:** Access to water through tube /bore wells was found in Rural Villages (8%), UNRC (7%), and Harijan Bastis (4%). A very small segment in Slum/JJ Clusters also draws ground water. The pressure at which the water is received depended on the power of the water motor used. Water quality varied, ranging from average to very poor, except for rural villages.

Personal hand pumps are used in UNRCs (4%), Rural Villages (3%), URCs and Urban Villages (2%) and Slum/JJ Clusters (5%). 60 percent of slum households perceived the water quality to be poor/very poor. Public hand pumps are used by 3-4 percent households in Slum/JJ Clusters and Harijan Bastis and the water quality was rated low. Time taken for collection of water from hand pumps is similar to community stand posts, except that these are accessible all day.

**Buying water:** Buying water for drinking and cooking has emerged as an option as water situation is getting precarious and unreliable, of poor quality with increasing contamination of groundwater sources. However, the percentage of households buying water is still small.

**Collection, Storage, Treatment and Water Hygiene:** Women are mainly responsible for water collection. In settlements with greater dependence on tanker supplies, role of men is enhanced. Collection time too, in settlements with community sources, is more than the average one hour; (UNRC-22%, and Slum/JJ Clusters - 10%).

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<sup>1</sup> The slab 0-5 measures number of 10 liters buckets filled per day by a household.



A very small percentage (15-20 percent) of households reported treating water before use. Slum/JJ Clusters and UNRC families also used dug pits under pipes to collect and store water and to beat the limited (twice a day), erratic and unreliable service.

**Water Supply and Health Risks:** Slum/JJ Cluster and Urban and Rural Village reported 40 percent people being sick in the 30 day period prior to the study, in particular in settlements situated along high health-risk areas such as nullahs/large drains, river/river beds/ponds and railway tracks. Prevalent diseases include Acute Respiratory Infections (ARI), Colds, Coughs, Fever. Typhoid and Malaria is commonly attributed to fecal matter that contaminates water. There is a high correlation between use of community stand posts and cases of diarrhea, dysentery and gastroenteritis. Slum households that do not treat water, or use pits etc. to store water also report higher rates of illness (70%) as compared with others. Of the respondents which reported illness and treatment, 60-70 percent used government facilities.

**Preferred Choice of Water Supply:** 72 percent households in UNRC and 53 percent of households in Slum/JJ Clusters prefer in-the-house water supply.

**Willingness to pay:** Most households in all types of settlements have shown willingness to pay for water, but at half the current monthly tariff. Water connection charges are generally low and DJB also offers the option of payment in installments to poor settlements other than slums, however, just about half the respondents in various clusters are willing to pay, although most will not need credit for the same.

## Access to Sanitation Services in Settlements

**Toilet Facilities:** Nearly all households in all types of settlements, except Slums/JJ Clusters use private toilets. In Slums/JJ clusters only 28 percent use private toilets and nearly 60 percent, community toilets. Percentage of people defecating in the open is around 12 percent in Rural Villages, Harijan Basti, Resettlement Colony and Slum/JJ Cluster.

**Private Toilets:** Most private toilets, in all types of settlements, are connected to underground sewers. However, for the slum/JJCs, percentage of private toilets connected to septic tanks is also significantly high (32%). In URCs, 42 percent households use small pits inside houses as toilets. Of households with private toilets, nearly 66 percent also have taps inside the toilet, with two exceptions; Resettlement Colonies where the percentage is low at 22 percent and Slums/JJCs with just 1%. Private toilets are used all the time by almost all family members; men and women alike.

**Community Toilets:** 88 percent slum households reported using community toilets regularly. 13 percent however complained of inadequate water supply because of which people have to carry water from outside. 75 percent reported toilets as dirty, 27 percent reported overflowing septic tanks, 56 percent felt that community toilets are not safe and waiting time was 10 minutes during peak hours. Although respondents agreed that there were basins for washing hands but because there was no water, people could not wash hands.

**Drainage:** Drainage systems in all settlements were largely pucca but open and shallow. Urban Villages had high incidence of informal drains at 28 percent followed by UNRC (19%) and Harijan Basti (16%). As drains were poorly made, these remained choked with stagnant water. 30-40 percent people said that

drains were cleaned only occasionally or rarely. In Resettlement Colonies and Urban Villages, about 10 percent drains opened onto vacant lands. 5 percent households have a sanitation pit to collect wastewater.

**Solid Waste Management:** In Slum/JJ Clusters and Urban Villages, 50 percent respondents disposed waste in Dhallaos mostly by themselves. Households have also reported disposal of waste in drains, parks and pits. Majority of the respondents in all type of settlements are reported to be satisfied with the ongoing sanitation services ranging from 40% to as high as 80%.

## Sanitation and Health Risks

Nearly all respondents wash hands with soap after defecation in all settlements except Resettlement Colonies where the percentage was low at 60 percent. Nearly all also wash hands before eating; between 65-80 percent wash after eating and just 20-40 percent wash before preparing food/cooking.

Incidence of illness and open drains was found to be associated. Urban and Rural Villages that had 60 and 80 percent open and choked drains respectively also reported 38 percent illnesses. 33 percent Slum/JJ Clusters residents reported incidence of illness in the past month.

Majority of households also complained about poor quality of water supply and toilet facilities in schools; with dirty water, ill maintained toilets and stagnant water in toilets.

## Study Recommendations

1. All settlements without legal right to land should have the right to paid water supply through household connections, without such supply giving them a legal right over land.
2. This will reduce dependence on Community Stand posts and Tanker Supplies with improved health outcomes for the poor.
3. Water standards for the poor should ideally be metered household connections. Alternatively, the poor could be offered group metered connections, paid supply through water reservoirs in each settlement, metered stand posts etc. as a start with options to incrementally upgrade services with rises in incomes.
4. Water Connection and Tariff Reform will enable poor households to connect formally to the system with better quality services and improved health.
5. Promoting construction and use of private toilets with hygiene awareness in slums is critical for the socio-economic well being of poor households.
6. Public Private Partnerships must be promoted and extended to slum area for improving Solid Waste Management systems in these settlements and improving the quality of environment.
7. Drainage networks must be rehabilitated in all slums and linked to proper outfalls with funding support of JNNURM.



## Rationale for the Study

Like other areas of infrastructure in India, the water supply and sanitation sector in urban areas, particularly large cities, is faced with increasing demand but quantitatively and qualitatively inadequate services. There is a vicious relationship between poor water quality and sanitation services, people's health and household and city economic development. The problem of infrastructure is specifically acute in urban areas, especially mega cities, because of fast rate of growth and constant influx of migrants.

Delhi is a fast growing metropolis, which is urbanizing at the rate of nearly 12% per annum. The National Capital Territory of Delhi (NCTD) has an estimated population of 13.78 million people (Census 2001), making it one of India's most populated urban areas. Delhi's high level of economic development makes it an attractive destination for employment. Its rapidly growing population has put a tremendous demand on housing and services. Poor people without access to proper housing often live in informal or slum settlements that are mostly unserved or underserved.

The quality of urban water supply and sanitation services in India is low, notwithstanding the recent significant investments in the sector. Most poor are not connected to municipal supplies and the rate of water borne disease is among the highest in the world. Sanitation services have had a very narrow scope and despite clear linkages between the water and sanitation sectors, the two remain disconnected.

Delhi lacks its own water source and is dependent on raw water supplies from neighboring states. It is also challenged by a rapidly growing and large population, nearly half of who live in slums and unauthorized settlements with poor and inequitable access to municipal services. Quality of infrastructure is poor and inefficient service delivery adds to real costs of supply, making it one of the more expensive supply services compared to other cities in the region. Supplying water and sanitation services in Delhi, in particular to slum and underserved areas in the city, thus presents major challenges for service delivery, institution building, sector policies and governance reform.

Half of Delhi lives in its slums and settlements, with poor and inequitable access to municipal services. Large-scale migration has also resulted in a huge proliferation of unplanned settlements across the city. Only 23.7% of the total city population actually resides in planned colonies while the rest live in either resettlement colonies or unplanned settlements. The apportionment of population according to the type of settlement is tabulated below:

<b>SI No</b>	<b>Type of Settlement</b>	<b>Estimated population (in millions), 2001</b>	<b>% of total population</b>
1.	JJ clusters	2.072	14.8
2.	Slum designated areas	2.664	19.1
3.	Colonies	0.74	5.3
4.	JJ resettlement colonies	1.776	12.7
5.	Rural villages	0.74	5.3
6.	Regularized colonies	1.776	12.7
7.	Urban villages	0.888	6.4
8.	Planned colonies	3.308	23.7

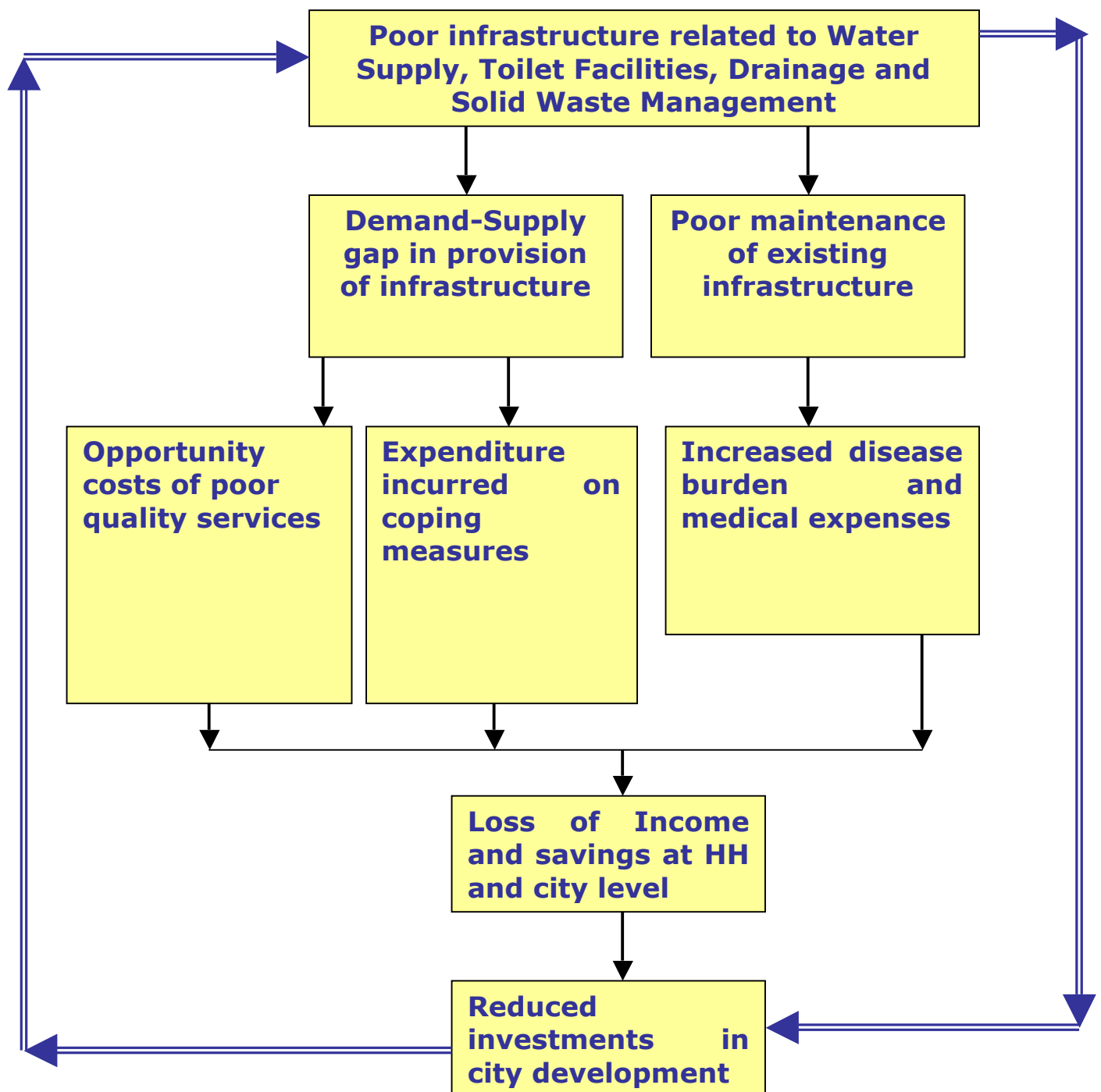
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Figures from Census 2001 suggest that the slum and squatter population accounts for 15.72% of the total population of National Capital Territory of Delhi. Another estimate suggests that the population living in J.J. Clusters, Slum Designated Areas, Colonies and Resettlement Colonies stands at 52% (Government of Delhi, 2002: 129). Although the percentage of people living in slums in Delhi ranges between 15 and 50 percentage, those who are poor or below the income poverty line in Delhi is an estimated 10.2%. The first ever enumeration by the Census of India 2001 for Delhi estimated 18.5 lakhs persons to be living in slums alone. For the same period, the Ministry of Environment put the figure at two and half times the Census at 47 lakhs. While this constitutes between one fifth and one third of the total city population, this excludes people living in the recognized yet underserved areas.

In such a scenario, bridging the gap between the demand and supply of infrastructure, especially for the ever increasing poor population, has been a recurrent challenge for government and civic agencies given the impacts of lack of infrastructure on human and economic development.

The lack of basic infrastructure like water supply, sanitation, drainage and solid waste management lead to multi-faceted problems which are weaved in a vicious circle where one problem accentuates the other as depicted in Figure below. While the high and middle income groups are still able to cope with poor quality infrastructure/services, it is the poor which are most vulnerable and bear the brunt with their limited incomes.

### Poor Infrastructure and Vicious Circle of Problems



### Water and Sanitation Services in Delhi

Delhi's own water sources are inadequate and it is dependent on raw water supplies from neighbouring states, or ground water extraction to cater to its rapidly growing and large population. It's over exploitation of ground water, is both rapidly depleting the ground water resources and steadily degrading the quality of ground water.

The poor pay the highest price while coping with the greatest shortfall in water supply. Poor households in slums are not connected to piped municipal supplies

at home and are mostly dependent on community stand posts, tanker supplies or shallow hand pumps for drinking and other household chores. Long lines in front of water stand posts and water tankers are a common sight. Inconvenient timings of supply exacerbate the problem with many residents having to give up a day's earning in order to secure water for the family. In most cases more than one member of the family is involved in water collection. In high-demand locations water collection queues start forming very early in the morning. Incidences of diverting water pipelines for personal usage are rampant and it often leads to massive wastage of water. Similarly, illegal tapping into water pipes to alleviate individual household water problems is common, which worsens the situation for others down the distribution chain by decreasing the already low water pressure supply.

In Delhi, the Slum and JJ Department of the MCD is responsible for providing basic sanitation services to low-income slum settlements. The level of sanitation services currently provided to slums was determined by standards set in the 1970s under the Environmental Improvement of Urban Slums scheme. Norms for slum sanitation include community toilets (1 seat for 50 users), and open and shallow street side drains for household wastewater disposal that link to community stand posts. Community toilets are usually linked to septic tanks and sometimes underground sewerage where networks are available. They are known to be poorly maintained and mostly dysfunctional. As a result, poor people in the city mostly defecate in the open.

Underground sewerage networks for household toilets are not available to slum settlements. Sewers are also not provided to colonies and rural villages. Newly regularized colonies lack sewers as well, but are eventually connected to the formal system in subsequent development. Most of the urban villages have very narrow lanes and it is difficult to provide separate sewerage and drainage networks along the streets. Therefore, underground sewerage and drainage are combined into a single network in these areas.

Solid Waste Management is an equally critical issue, with the city's waste being sorted largely through the informal sector and the residual content, primarily comprised of non-recyclable rubble and biodegradable matter ending up in SLFs (Sanitary Land Fills). The negligence of waste minimization and institutional efforts on recycling over the years has resulted in a number of problems with disposal emerging as a major one.

Slums also lack access to formal, covered drains and much of the waste water generated by households stagnates inside these settlements. The unhygienic environmental situation from open defecation and lack of waste water disposal in the settlements affects the health of people inside the settlement as also those living outside.

Provisioning of equitable water and sanitation services to the poor is closely linked to land tenure. Lack of legal land tenure excludes slum and communities from household connections.

Supply of water and sanitation services in Delhi, in particular to slum and underserved areas in the city, thus presents major challenges for service delivery, institution building, sector policies and governance reform.

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## **The Swachch Delhi Swasthh Delhi, (SDSD)**

The Swachch Delhi Swasthh Delhi (SDSD) project launched by Water Aid India (WAID) is aimed at improving access of urban poor to basic water and sanitation services and to create a critical mass of interventions to make a significant difference to quality of lives of urban poor. The overarching aim is to influence urban policy in Delhi and to advocate for the rights of slum dwellers to equitable WATSAN services. This city wide survey is part of the overall goal of WAID in achieving its mission.

### **City Wide Survey on WATSAN in Delhi**

The Centre for Urban and Regional Excellence, a development NGO with focus on pro poor urban development has been identified by WAI to undertake the survey on behalf of WAID.

The overall objective of this report is to create the evidence for influencing the WATSAN policy in the city. Specific objectives are:

- To review the urban water and sanitation scenario in Delhi using available research and literature; particularly to examine current arrangements for delivery of municipal services to slums and underserved settlements.
- To create a baseline on the current status of water and sanitation services in slums and low-income settlements of Delhi; and
- To make recommendations on sector strategies, reforms and intervention approaches for improving access of water and sanitation services for poor in the city.

## Status of WATSAN in Delhi – A Literature Review

### Delhi: Profile

Delhi is a city-state located in northern India that shares borders with the states of Uttar Pradesh and Haryana, and helps constitute the National Capital Territory of Delhi, which is the seat of the national capital and has an area of 1,483 sq. km.

#### 3.1.1 General Features and Water Resources

Delhi is a landlocked city. It has two main geographic features, the River Yamuna and the ridge. Delhi gets its raw water from three main sources:

- River Yamuna: The River Yamuna enters Delhi at Palla in the north and cuts across nearly 48 kms through the region before leaving Delhi at Jaitpur in the south. The city is situated on both banks of the Yamuna. Delhi's share of the river's resources, as per inter-state agreements, is 4.6%<sup>2</sup>.
- Groundwater
- Rainwater

Apart from these the Bhakra storage and the Upper Ganga Canal also provide water to the city.<sup>3</sup>

River Yamuna, the main source of fresh water in Delhi is increasingly becoming polluted through direct discharge of waste. The portion of the Yamuna that passes through the city is said to be the most polluted part of the river. Of the ten towns that dispose sewage in the Yamuna, Delhi's share is the highest at 79.10 %.<sup>4</sup>

Delhi's ground water table is rapidly depleting. Based on ground water availability, Delhi can be broadly divided into five water basins with varying levels of ground water ranging from 2-5m below ground level in Northeast Delhi to 30-45m below ground level in Southern Delhi. Table 1 shows a drop in ground water tables between 1960 and 2002 in all the five basins. Many of the natural lakes and wells in Delhi have dried up. As a measure of safeguarding its groundwater resources the Central Ground Water agency restricted the deepening and digging of private bore wells in 'notified areas'. Nonetheless illegal extraction of water, especially by private water tanker operators, is rampant. Much of the deficit in water demand is met through private water tankers and packaged water suppliers.

**TABLE 3.1: Water availability below ground level**

Area	1960 year	2002 year
Lodi Road	5 to 10m	10 to 15m
Gadipur	20 to 30m	45 to 50m
Tikri kalan	2 to 5m	10 to 20m
Haider pur	2 to 5m	5 to 10m
Dwarka	2 to 5m	5m

[http://www.rainwaterharvesting.org/index\\_files/ar\\_ea\\_wise.htm](http://www.rainwaterharvesting.org/index_files/ar_ea_wise.htm) Accessed April 2009

As a measure of safeguarding its groundwater resources the Central Ground Water agency restricted the deepening and digging of private bore wells in 'notified areas'. Nonetheless illegal extraction of water, especially by private water tanker operators, is rampant. Much of the deficit in water demand is met through private water tankers and packaged water suppliers.

The average annual rainfall in Delhi is 714 mm, three-fourths of which falls in July, August and September. Despite the overall water shortage, Delhi does

<sup>2</sup> <http://www.ccsindia.org/ccsindia/policy/trans/studies/wp0059.pdf>, Accessed April 2009, Shivani Daga, Private Water Suppliers of Delhi

<sup>3</sup> CSE, 2007, Sewage Canal, How To Clean The Yamuna

<sup>4</sup> <http://www.ccsindia.org/ccsindia/policy/trans/studies/wp0059.pdf>, Accessed April 2009, Shivani Daga, Private Water Suppliers of Delhi

experience periods of flooding. The River Yamuna has risen to dangerous levels on numerous occasions. Between 1963-1995 alone, the river crossed the danger mark 22 times.

#### **A city of Extremes – Floods in 1995**

*During September 1995, The Yamuna experienced high magnitude floods following heavy rains in the upper catchment area and resultant release of water from Tajewala water works. Slow release of water from Okhla barrage due to lack of coordination between cross state agencies further accentuated the problem. Fortunately, the flood could be contained within the embankments. However, it badly affected the villages and unplanned settlements situated within the riverbed, rendering approximately 15,000 families homeless. These persons had to be evacuated and temporarily housed on roadsides for about two months, before they went back to living in the riverbed with far site relocation as a sorry solution nearly 5 to 8 years later.*

The city is also serviced by 18 drains that carry away wastewater and rainwater. Two prominent drains are the Najafgarh Drain, which bisects from the southwestern part of the city to the north, and the Alipur Drain, which cuts across north Delhi.

### **3.1.2 Population**

The National Capital Territory of Delhi (NCTD) has an estimated population of 13.78 million people (Census 2001), making it one of India's most populated urban areas. Large sections of the city's population are living in unplanned colonies and slums with minimal or no access to basic services.

Delhi is also the fastest growing and one of the most densely populated cities in India with an average 9340 persons per square km. The walled city area population densities are higher, at 166,300 persons per sq km. Delhi's high intensity construction, rapidly growing population and densely built areas put immense pressure on the city's water, sewerage, and electricity infrastructure. According to Census of India, the density of population was 274 persons per sq km in 1901, increasing to 1176 persons per sq km in 1951 and 6352 persons per sq km in 1991. By 2001, the said figure was found at 9340 persons per sq km (see Table 2).

**Table 3.2: Delhi Facts**

	<b>Delhi</b>	<b>National/Urban Average</b>	<b>Source</b>
<b>Area</b>	1,486 sq km	-	-
<b>Density</b>	9340 person/km <sup>2</sup>	-	2001 Census
<b>Sex Ratio (F per '000 M)</b>	821	933	2001 Census
<b>Family size</b>	5.06	4.99 (Urban)	1991 Census
<b>Literacy</b>	81.67	82 (Urban)	2001 Census
<b>Decadal growth (1991-2001)</b>	46.3%	21.34%.	2001 Census

### 3.1.3 Migration

Delhi's growth is both natural and due to huge amounts of migration every year. Its population growth rate is twice that of the national growth rate. In 2002, for example, an estimated 33,234 households migrated to Delhi, 84.89% of which moved permanently<sup>5</sup>. The migration rate in Delhi has averaged nearly 1.3 times the natural growth rate, contributing to an overall population increase of 4.6% annually (1999-2000).

Migration trends show that nearly 50% of the total migratory population comes from the neighboring states of Uttar Pradesh and Haryana as seen in Table

Table 3.3: Trend in Migration		
States	Percentage	of Total Migration (1981-1991)
Uttar Pradesh	49.61	
Haryana	11.82	
Bihar	10.99	
Rajasthan	6.17	
Punjab	5.43	
West Bengal	2.79	
Madhya Pradesh	2.71	
Other States	10.48	

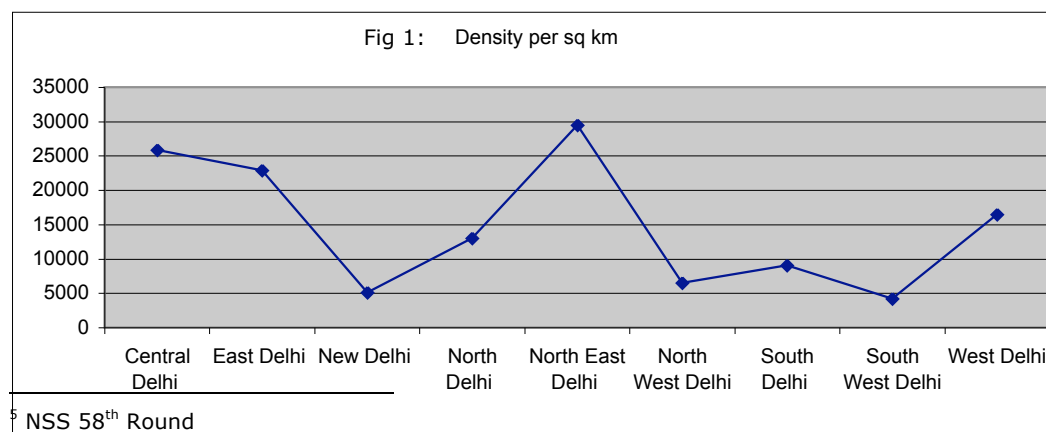
Source: Economic Survey of Delhi 2004-2005

3. In fact, states near Delhi including Uttar Pradesh, Haryana, Rajasthan and Madhya Pradesh, account for nearly 70% of the total migration.

### 3.1.4 Population Distribution

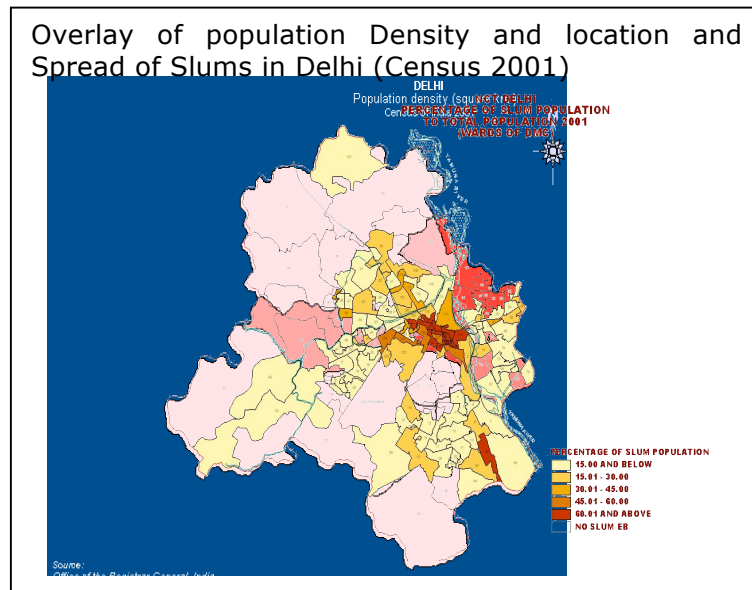
The state of Delhi is divided into 9 districts with an unevenly distributed population. Population distribution across its 9 districts (Census, 2001), shown in the graph below, indicates much lower populations in districts of North, Central and New Delhi, as compared with the others. Northeast and Central Delhi have the highest residential population densities. Northeast and East areas are comprised of congested residential apartment buildings, regularized and non-regularized colonies and slums, many of which were built over the dry Yamuna bed but have been systematically removed over the past few years as part of the process of cleaning up the River Yamuna and reclaiming land for development purposes. Unlike Northeast Delhi densities are drastically lower in the New Delhi Area mainly comprising of Lutyens Bungalow Zone, Government offices and posh localities.

The inequity in population distribution is reflected in the variable access to water and sanitation infrastructure across the city. A detailed table in **Annexure 1** shows the population densities and the decadal growth patterns in the nine districts of Delhi.





An overlay of the population density (Census 2001) and the spread of slums (Census 2001) in Delhi reveal that the slums are also located in the highest density areas of Delhi. Thus the poor are living in the overcrowded areas of Delhi with limited access to resources.



### 3.1.5 Rapidly Growing City

Delhi reports one of the highest per capita incomes among Indian states. In 2003–04, per capita income estimated in constant prices at Rs 29,231 was nearly two and a half times the all-India average of Rs 11,972<sup>6</sup>. Over the years, Delhi has emerged as a major trading, commercial, banking, insurance, retail and entertainment centre of India. It has capitalized well on the new economic opportunities that arose post-1990. Between 1993–94 and 2002–03, Delhi along with West Bengal, Karnataka and Tamil Nadu recorded the maximum growth rates in per capita income.

The growth in the service sector has attracted many people to new jobs in the city; however, the existing infrastructure has been unable to cope with the growth. As a result, the poorer populations, though an integral part of the growing service sector, have been pushed out into relocation colonies far from the city centre to make way for new development in line with the economic growth of the city. The distance of these relocation colonies from the city often results in a total disconnect from livelihoods with even less access to basic services, further deepening the cycle of poverty.

## 3.2 Governance Institutions of Delhi

Formerly a Union Territory, Delhi was granted the status of National Capital Territory (NCT) in the early 1990s. Delhi now has its own Legislative Assembly, Lieutenant Governor, Council of Ministers and Chief Minister. The legislative assembly seats are filled by direct election from territorial constituencies. Because the offices of the Central Government are also located in the city, Delhi is jointly administered by the Central and State Governments, making its governance complex, especially with respect to the distribution of sectoral responsibilities.

The Delhi metropolitan area lies within the National Capital Territory of Delhi (NCT). The National Capital Territory of Delhi is comprised of nine districts, 134 wards and 70 assembly constituencies, 27 tehsils, 59 census towns, 165 villages

<sup>6</sup> Economic Survey of Delhi 2004-2005

and three local municipal corporations – the Municipal Corporation of Delhi (MCD), the New Delhi Municipal Committee (NDMC), and the Delhi Cantonment Board (DCB).

### 3.2.1 Municipal Corporation of Delhi (MCD)

The Municipal Corporation of Delhi (MCD) was founded on 7th April 1958, under an Act of Parliament. It is among the largest municipal bodies in the world providing civic services to more than 13.78 million citizens. With roughly 94% of the population of Delhi under its directive, it provides civic services to rural and urban villages, resettlement colonies, regularized and unauthorized colonies, and slums.

The MCD divides its jurisdiction into 12 zones (**Annexure 2**) comprised of 134 wards<sup>7</sup>. These are, however, not coterminous with the nine districts of the state government of Delhi. Major functions of MCD relate to: solid waste management and city sweeping, maintenance of gardens, street lighting, managing encroachments, provision and maintenance of community toilets, community halls, parking lots, road development, managing

#### 74<sup>th</sup> Constitutional Amendment

The 74<sup>th</sup> amendment states that WATSAN services are to be one of 18 functions devolved to urban local bodies. Since its passing, however, the process of decentralization has been slow. As a result, the responsibility for planning and implementation of WATSAN projects continues to lie with state governments, while the O&M responsibility has been passed on to urban local bodies (ULBs). Still, in most cases the financial position and capacities of ULBs to manage these systems is weak, often causing them to defer to state governments to actually carry out the O&M functions.

The responsibility of city level planning, design and creation of infrastructure for water supply and sewerage has been entrusted to the Public Health Engineering departments of the state government, in most cases; while operation and maintenance continues with the municipal bodies. Provision of community toilets and their maintenance is the responsibility of the ULBs.

In large cities like Delhi, Hyderabad, and Bangalore, parastatal bodies have been created to deal with water supply and sewerage design, construction and maintenance. Community toilets and sanitation services continue to fall under the domain of municipal bodies.

property tax and licensing. Although according to the 74<sup>th</sup> Constitutional Amendment Act, an urban local body is expected to manage service delivery, in Delhi these functions have been handled by parastatal agencies.

### 3.2.2 New Delhi Municipal Council (NDMC)

New Delhi Municipal Council oversees just 3 percent of the land area (42.74kms) and 3 percent of the population in the centre of Delhi. It was organized under the Punjab Municipal Act (1911) to facilitate services to the various government establishments and residential neighborhoods in the area. After the enforcement of the 74<sup>th</sup> Constitutional Amendment Act, provisions were made to the Punjab Municipal Act in order to realign it with the Constitution; even as it was agreed that there must be commonality in the procedures adopted by the MCD and the NDMC in matters relating to taxation, revenue, budgeting, contracts, accounts

<sup>7</sup> Section 13, "Institutional Arrangement", CDP, Delhi

and audits, streets and sanitation, public health, public safety and suppression of nuisances etc.<sup>8</sup>

### **3.2.3 Delhi Cantonment Board**

The Delhi Cantonment Board is the third statutory body in Delhi with an outreach area of 42.97 km<sup>2</sup>. The functions of the Delhi Cantonment Board are carried out as per the Cantonments Act (1924). It is responsible for service delivery in the Cantonment area only including water supply, sanitation, public health, street lighting, birth and death registration, and primary education among other things.

## **3.3 Institutions for Water and Sanitation (WATSAN) in Delhi**

Water supply and sanitation services are critical components of infrastructure in every city. They serve as the primary indicators of a healthy city, and the quality and quantity of water supply as well as the condition and extent of sewerage and drainage networks directly affect the quality of life its citizens enjoy. Sanitation is comprised of a cluster of services that include wastewater drainage, storm water drainage, sewerage, solid waste management and street sweeping.

In Delhi, the Delhi Jal Board is the sole agency responsible for water supply. Because water supply and sewerage are interrelated, the DJB is also responsible for the treatment, transmission and disposal of sewage and wastewater across Delhi.

### **3.3.1 Delhi Jal Board (DJB)**

DJB, a parastatal body, is governed by the Delhi Water Board Act (1998) and is responsible for the planning, design, construction, operation and maintenance of water supply and sewerage infrastructure in MCD's Delhi Municipal Area. It is also responsible for the collecting, transmitting, treatment and disposal of wastewater from the city. It provides bulk water supply only to the NDMC and DCB area.

The DJB divides Delhi into 21 water zones based upon population and the outlet and inlet points of the existing water pipeline network in the city. Each water zone is headed by an Executive Engineer. The DJB provides intermittent water at an average 232 lpcd to planned colonies in Delhi; a per capita availability that is one of the highest among urban areas in India. However, many parts of Delhi face extreme water shortage in the summer months. To supplement the water supply, DJB supplies water tankers on request.

### **3.3.2 Municipal Corporation of Delhi (MCD)**

The conservancy and sanitation department of MCD is responsible for the collection, transportation and disposal of solid waste in the city. The various types of waste streams in the city are currently mixed, and include municipal waste, bio-medical waste, construction debris, industrial waste, slaughterhouse waste, and electronic waste.

At present the MCD has privatized the collection and disposal of waste in some of the Municipal zones. It does not provide door-to-door waste collection, which is mostly managed privately through sweepers. MCD however, is responsible for road/street sweeping managed by its staff.

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<sup>8</sup> NDMC. <http://www.ndmc.gov.in/>. Accessed May 2009.

The MCD slum wing is mandated to provide basic services in slums and relocation sites that include water and sanitation. Water services are provided jointly by the DJB and MCD to slum areas; the water lines provided by the DJB up to main roads and the internal network and the community water points provided by the MCD. Similarly, community toilets in slums and relocation sites are constructed and managed by MCD and linked to sewer lines provided by the DJB. Due to a lack of coordination between the two agencies, slum residents often suffer with little or no access to even the bare minimum of services.

The MCD has 12 zones in Delhi that are further divided into 134 wards. Each ward has a councilor who is directly elected to represent and serve the people in a specific ward. The ward councilor is the direct link between the council and the voters and represents the people on all municipal issues. **Annexure 3** shows the governance system of Delhi, highlighting water and sanitation institutions.

### **3.3.3 New Delhi Municipal Corporation (NDMC)**

The generation and supplying of filtered water to NDMC is the responsibility of the DJB. NDMC receives a bulk supply from the DJB from a number of reservoirs and from tapping from NDMC mains at Hans Bhawan, Nizamuddin, Moti Bagh and Netaji Nagar. In order to supplement the quantity of filtered water, NDMC has provided 100 tube wells and 700 deep well hand pumps. The total water requirement for the NDMC area at 225 million litres per day (MLD) far exceeds DJB supplies at 115 MLD, which the NDMC supplements through deep tube wells.<sup>9</sup>

### **3.4 Institutions for Management of Storm Water Drainage**

The DJB, MCD and Public Works Department (PWD) of the Delhi Government are jointly responsible for the construction and maintenance of drains in the city.

The responsibility of construction and maintenance of the large (natural) drains lies with the Irrigation and Flood Control Department of the State Government of Delhi. However, disposal of the silt removed from these drains is the responsibility of the respective municipal bodies. The DJB looks after drains with more than 1,000 cusec discharge. In addition, the PWD is responsible for drains in some identified areas. The three local municipal bodies (MCD, NDMC, DCB) have the mandate to look after the construction and maintenance (including desilting) of the drains in their respective areas, which are often aligned with the roads.

## **3.5 Urban Informal Settlements**

Delhi's high level of economic development makes it an attractive destination for employment. Its rapidly growing population has put a tremendous demand on housing and services, stressing the already deficient infrastructure of the city. Poor people without access to proper housing often live in informal or slum settlements that are mostly unserved or underserved.

Large-scale migration has resulted in a huge proliferation of unplanned settlements across the city. The apportionment of population according to the type of settlement is tabulated below<sup>10</sup>:

<sup>9</sup> NDMC. <http://www.ndmc.gov.in/>. Accessed May 2009.

<sup>10</sup> DUEIIP-2021

**Table 3.4: Settlement Typology in Delhi**

Sl No	Type of Settlement	Estimated population (in millions), 2001	% of total population
1	JJ clusters	2.072	14.8
2	Slum designated areas	2.664	19.1
3	Unauthorized colonies	0.74	5.3
4	JJ resettlement colonies	1.776	12.7
5	Rural villages	0.74	5.3
6	Regularized unauthorized colonies	1.776	12.7
7	Urban villages	0.888	6.4
8	Planned colonies	3.308	23.7

The above table reveals that only 23.7% of the total population actually resides in planned colonies while the rest live in either resettlement colonies or unplanned settlements.

Figures from Census 2001 suggest that the slum and squatter population accounts for 15.72% of the total population of National Capital Territory of Delhi. Another estimate suggests that the population living in J.J. Clusters, Slum Designated Areas, Unauthorised Colonies and Resettlement Colonies stands at 52% (Government of Delhi, 2002: 129). Although the percentage of people living in slums in Delhi ranges between 15 and 50 percentage, those who are poor or below the income poverty line in Delhi is an estimated 10.2%<sup>11</sup>. The first ever enumeration by the Census of India 2001 for Delhi estimated 18.5 lakhs persons to be living in slums alone. For the same period, the Ministry of Environment put the figure at two and half times the Census at 47lakhs. While this constitutes between one fifth and one third of the total city population, this excludes people living in the recognized yet underserved areas.

Per capita income at constant prices in Delhi in 2000-01 was Rs. 24450, significantly higher than the national per capita income at Rs.16487<sup>12</sup>. The income of the slum population is much lower. A 2002 survey by the National Council of Applied Economic Research estimated the average household monthly income of slums dwellers at Rs. 3073/mo and the per capita monthly income at Rs. 575/mo.<sup>13</sup>

Urban poor typically live in informal slum settlements that are located close to work sites, commercial centres, industrial areas, construction sites or residential housing. These settlements are illegally located on land owned by the government, land allocated for private development purposes, or land deemed environmentally untenable, making the provision of water and sanitation services very difficult. If unchecked, these informal settlements grow into large unplanned habitats exacerbating demand and challenging service delivery arrangements. According to NSS 58th Round results for 2002, there are 1867 slum settlements in Delhi with 379,000 households, of which only 16.91% are notified slums and 79% are situated on public land.

<sup>11</sup> Economic Survey Report, Government of Delhi, Delhi, 2001

<sup>12</sup> *Ibid*

<sup>13</sup> Manjistha Banerji. "Provision of Basic Services in the Slums and Resettlement Colonies of Delhi". Institute of Social Studies Trust, 2005. (National Council of Applied Economic Research (2002), The burden of ill-health among the urban poor: The case of slums and resettlement colonies in Chennai and Delhi, NCAER, Delhi)

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### **3.5.1 Slums**

There are various figures on the percentage of Delhi's population that lives in slums. Some figures from Census 2001 suggest that the slum and squatter population accounts for nearly 16% of the total population of NCT. An estimate by the Government of Delhi suggests that the population living in J.J. Clusters, Slum Designated Areas, Unauthorised Colonies and Resettlement Colonies stands at 52% of Delhi's total population<sup>14</sup>.

The 2002 National Sample Survey 58th Round results estimated nearly 1,867 slum settlements in Delhi with 379,000 households. 16.91% were estimated to be notified slums, 79% of which were located on public land. Until recently, most slums were located in East Delhi, the densest part of the city. Several development projects in the area have led to evictions, resettlements and relocation of many of these slums/slum dwellers. It is presumed that households not entitled to resettlement packages may have moved to other parts of the city, especially near the Okhla Industrial Estate in South Delhi.

Urban poor constitute the bulk of population that resides in slums, mostly migrants from villages and smaller towns across the country. Many slum households are second and third generation residents, having lived in the city for over 30 years. Working in the informal sector as service providers including domestic helps, hawkers and vendors, and low paid workers in industrial, commercial and trade/business sectors, their quality of life is further affected by their limited access to water and sanitation services, substandard and high density housing and low-income levels.

### **3.5.2 Resettlement Colonies**

Slum resettlement is an agreed upon government policy. Forty-seven resettlement colonies were developed between 1961-77 under the resettlement scheme. Nearly 240,000 households were accommodated on a "sites and services" plan. Despite planning, these houses initially lacked water supply and sanitation services. Over time, water and sanitation services were provided to these resettlement colonies, but growing population pressures (due to low cost and affordable housing for the poorer families), commercialization of land use, and unorganized development has resulted in overcrowded and slummy conditions in these areas.

A second wave of resettlement started in the late 1990s in an effort to improve the city. Eleven relocation sites were set up, including Bawana, Holambi Kalan, Rohini, Narela, and Savda Ghevra. Over the past 20 years, particularly after May 2006, more than 150 slums in Delhi have been demolished/ relocated to make room for new city infrastructure and for the Commonwealth Games. In all, there are five resettlement colonies in the southeast, eight in the northeast, fifteen in the northwest, seven in the southwest and twelve in central Delhi. There are three principal relocation sites currently being used; Rohini, Narela and Savda Ghevra<sup>15</sup>.

### **3.5.3 Unauthorized Colonies**

Housing shortages in the city has led to unregulated urban growth and the development of unauthorized colonies carved out of rural land mostly on the city

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<sup>14</sup> Manjitha Banerji. "Provision of Basic Services in the Slums and Resettlement Colonies of Delhi". Institute of Social Studies Trust, 2005. (Government of Delhi (2002), Economic survey of Delhi 2001-02, accessed online at <http://delhiplanning.nic.in/Economic%20Survey/Ecosur2001-02/Ecosur2001-02.htm> on 25th May, 2006)

<sup>15</sup> City Development Plan, Delhi, October, 2006

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fringe. This unplanned development has resulted in part due to large-scale land acquisition by the Delhi Development Authority (DDA) throughout the city reducing availability of land for housing for the poor and low-income groups.

There are 1432 unauthorized colonies in Delhi, home to 30 lakh people. Periodically, these unauthorized colonies have been regularized through appropriate legislation; first in 1961, when over 100 colonies were regularized, and second, in 1977 when around 600 colonies were regularized. In February 2007, the Union Government paved the way for regularization of over 1500 unauthorized colonies, which will give residents regular access to water and sanitation services.

Unauthorized colonies have been built on private land developed by builders. Infrastructure in these colonies is marginally better than that of slums; however, no proper concrete roads or network supplies for water or sewer lines exist in these areas.

#### **3.5.4 Urban and Rural Villages**

As the frontiers of Delhi expand, a large number of rural areas get wrapped into the city boundaries. Those assimilated in the city space are called urban villages or *Lal Doras*. They are granted special status and held to a separate set of building by-laws and planning norms.

There are 165 urban villages within the NCT that play an active economic role in the city. These urban villages have undergone significant physical and functional transformation relative to their particular location in the city. In general, arguments supporting the preservation of urban village identities in an effort to conserve the cultural heritage of the city have waned and they have become a normal part of proper Delhi. These villages are characterized by high-density development, mixed land uses (residential, commercial, industrial because of deflated norms), narrow circulation space and inadequate infrastructure. High density coupled with poor infrastructure has made development in urban villages a serious challenge.

Rural space on the peripheries of the city-state is shrinking. Infrastructure here is minimalist and insular. The high-cost of extending main trunk infrastructure to these remote areas is the primary reason for their neglect. Because there is no requirement for building plan sanctions in rural areas, in many cases land developers have moved in to create residential complexes and unauthorized colonies.

According to the CDP Delhi, in 1999 more than 103 lakh people (78% of the city's population) were estimated to be living in low-quality settlements on the city margins. The reason for the concentration of poor and low-income households at the city periphery can be attributed to the availability of affordable land in the rural fringe and relocation of slums to far off sites. These settlements are comprised of people who are poor, lack a cohesive public voice, and have been moved due to "a systematic process of marginalization of the urban poor whereby they have been shifted from the core of the city to its periphery"<sup>16</sup>. As such, most of the development is informal and /or unplanned and most areas have unacceptable /inadequate level of services.

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<sup>16</sup> WaterAid India. Profiling "Informal City" of Delhi: Policies, Norms, Institutions, and Scope of Intervention. 2005.

### 3.6 Water and Sanitation Services in Delhi

Similar to other cities and towns in India, the lack of access to water and sanitation services leads to severe hardships in the daily lives of Delhi's poor. Though the government has made several attempts at provision of these services, these efforts are seen more as 'free services' that are provided as charity to the under-privileged. However, the poor actually pay a heavy price both in terms of time and cost, far greater than legitimate users of the services. Hours of waiting in queues at water points and fights around water tankers are a common site in the slums of Delhi. Similarly, open defecation and overflowing sewerage and drains are also regular features of urban slums in the capital city. Both have led to severe health and hygiene problems directly affecting the quality of life of slum dwellers.

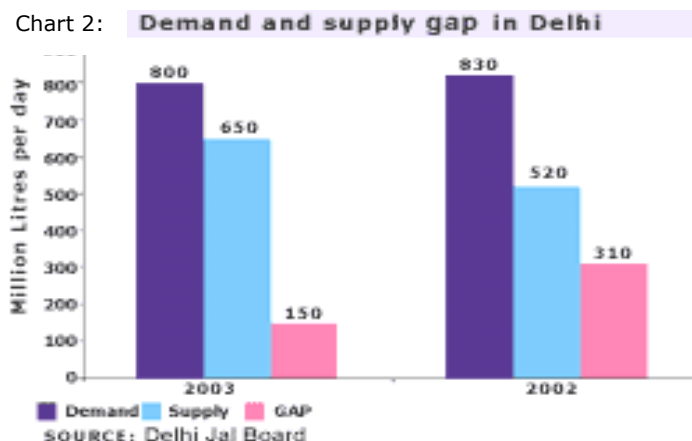
Water and sanitation services to the poor are closely linked to land tenure. Lack of legal land tenure excludes slum communities from individual connections for water supply and sanitation. Provision of 'in the house' services is unfortunately seen as a recognition of one's land tenure.

#### 3.6.1 Water Supply

Delhi has an average water availability of 225 lpcd. Besides shortage of water, there is both an uneven distribution of available water resources and inequitable policies that discriminate between the rich and the poor. Delhi Jal Board (DJB) is the sole government agency responsible for meeting water demands of the city.

It has the capacity of supplying 650 million gallons water per day (MGD). When accounting for the 20% lost via transit, the DJB only supplies around 520 MGD of water. The city demands approximately 830 MGD of water a day. Thus, there is a shortage of almost 300 MGD of water, which is met by private sources such as bore wells, tube wells and private and packaged water.

Chart 2:



##### 3.6.1.1 Water Supply Norms

Water is State property and supplied as a service for which citizens pay<sup>17</sup>. However, its supply is uneven and those who pay less or not at all get a lower level of services. Poor people in informal settlements are not entitled to 'in-the house supply' of reliable and safe drinking water. Instead, they receive less reliable services (less than 40 lpcd) at community points.

The inequality of supply is confused further by different agencies recommending dissimilar norms that vary by city size, presence of sewerage infrastructure and land tenure.

<sup>17</sup> Vrinda Grover, *The Periphery To The Centre, A Rights Based, Approach To Urban Poverty*, pg. 39, CARE PLUS, June 2002



**Table 3.5: Norms for Water Supply as specified by Different Agencies**

	<b>Norms</b>	<b>Agency</b>
<b>City Size</b>	<ul style="list-style-type: none"> <li>Towns with piped water supply but without sewerage system: 70 lpcd</li> <li>Cities with piped water supply and existing or planned sewerage system: 135 lpcd</li> <li>Metropolitan and mega cities with piped water supply and sewerage: 150 lpcd</li> <li>Public stand posts: 40 lpcd</li> </ul>	<b>CPHEEO (10th Plan, 1999)</b>
<b>Supply per capita</b>	<ul style="list-style-type: none"> <li>363 lpcd for urban population</li> <li>100 lpcd for rural population</li> </ul>	<b>Delhi's Master Plan</b>
<b>Stand posts</b>	<ul style="list-style-type: none"> <li>1 source for 150 persons, with a maximum walking distance of 100 metres</li> </ul>	<b>8<sup>th</sup> Plan</b>
<b>Slum Supply</b>	<ul style="list-style-type: none"> <li>125 lpcd for settlements where piped water supply and underground sewerage systems are in place</li> <li>70 lpcd for urban areas with piped water supply but no underground sewerage system.</li> <li>40 lpcd for spot sources and/or stand posts, with one source for 20 families within a minimum walking distance of 100 meters.</li> </ul>	<b>9<sup>th</sup> Plan</b>
<b>Supply in Informal Settlements</b>	<ul style="list-style-type: none"> <li>1 public tap to 45 HH or 100 persons</li> <li>Water tankers (10 lpcd)</li> <li>154 lpcd for unauthorized regularized Colonies</li> <li>60 lpcd for JJ clusters</li> <li>50 lpcd for unauthorized colonies</li> <li>131.75 lpcd for resettlement colonies and urban villages</li> <li>42.5 lpcd for rural villages</li> </ul>	<b>DJB</b>
<b>Supply to approved colonies</b>	<ul style="list-style-type: none"> <li>225 lpcd</li> </ul>	<b>DJB</b>

The Delhi Jal Board has varying norms based on the type of settlement. While it provides for 225 lpcd for approved colonies its norms are diluted for other settlement types. While it is committed to a provision of 131 lpcd to urban villages and resettlement colonies, both of the settlement types face extreme shortages, especially in the summer months. The new resettlement colony at Savda Ghevra is still dependent on tanker supplies, which meet only drinking water needs at 10 lpcd.

Norms for community level stand posts according to the Government of India are those that are used in the Environmental Improvement in Urban Slums (EIUS) scheme @ 1 tap to 50 users. As part of Care's PLUS initiative in Delhi, residents of New Sanjay Amar Colony, a slum settlement filed a Right to Information in the DJB in 2003. In response to the RTI, DJB stated their stand post norm to be 1:70<sup>18</sup>. Water supply to the poor according to DJB is 60 lpcd, one and a half times more than the average proposed by all agencies. However, in unauthorized areas or those served by tanker supply, DJB norm per capita is a mere 10 litres per

<sup>18</sup> Review of Literature: WSS service to the Poor, CURE, 2006

day, one sixth of the expected supply in recognized JJ clusters. Interestingly, the unstated norm used by DJB's executive engineers working at the grass root level is 45 lpcd.

Norms for services are dependent on whether one is a formal or informal citizen based on status of land tenure.

While unauthorized colonies and slum settlements receive community services, well-off communities are served with in house connections. Norms are not just inequitable and lower for the poor, they are

also silent on service standards and conditions under which individual connections could be made available to these areas. Such inconsistency needs to be harmonized if water services to low-income communities are to improve. As part of the JNNURM primer on BSUP, the MOHUPA are suggesting the following standards and norms for provisioning of water services to slum communities.

#### **Water Supply Norms**

- ▶ Individual water tap connections with meters and lifeline tariff.
- ▶ If household-level provision is not possible, then 1 public water supply stand post for 25 persons or less or 1 stand post in every street in case of less number of households, linked to proper waste water disposal systems and covered drains.
- ▶ In case of community services, minimum 40 lpcd to be supplied at convenient timings, for adequate duration, with appropriate pressure and good quality supplies.

*Source: Extracted/Modified from JNNURM BSUP Reform Proposal, Agra Developed by Centre for Urban and Regional Excellence*

#### **3.6.1.2 Water Coverage**

The Delhi Jal Board water supply network is large at 9000 kms, and provides approximately 15.5 lakh metered water connections. Metered connections in the house are provided to all JJ clusters by the DJB, but many unauthorized colonies and some regularized colonies remain unconnected to network supplies. Slums also get municipal piped supplies; however, not in the house, but rather through community stand-posts. A quarter of Delhi still does not receive tap water. Half of rural Delhi has to depend on sources other than tap water. A detailed table of water supply coverage in underserved settlements is given in **Annexure 4**. Around 75% of the households in Delhi are reported to have access to piped municipal supply either through a private connection or a common stand point, and around 20% of the population relies on hand pumps tapping shallow aquifers with high health risk (See Table 4).<sup>19</sup> 10% of Delhi's population has no piped water supply and 30% of the population has grossly inadequate water supply, about 4-10 lpcd through stand-posts against a planned level of 42.5 lpcd.

**Table 3.6: Access to piped water and reliance on hand pumps in NCT Delhi**

Year	Households with access to piped water	Households relying on hand pumps
1991	75.3 %	20.06 %
2001	75.6 %	18.68 %

*Source: The role of ground water in Delhi's water supply, Augustin Maria, CERNA, Ecole Nationale Supérieure des Mines De Paris, France, 2004*

<sup>19</sup> The Role Of Groundwater In Delhi's Water Supply, Augustin Maria, CERNA, 2006.

Due to poor coverage nearly all underserved settlements depend on multiple sources for their water supply, such as privately owned bore wells and tube wells, and private suppliers of water (i.e. private water tankers, packaged water suppliers). Based on known extractors, nearly 11% of the water supplied comes from ground water; however, the actual extraction of ground water is difficult to calculate as a large number of tube wells, owned by individuals, industries and bottled water companies, remain unregistered.<sup>20</sup>

In slums, while municipal supply is available, it is through common taps or tankers. A baseline study prepared on water conditions in selected project slums of Delhi found that 68% residents used community taps/stand posts, 13% used bore wells, and remaining households used water from hand pumps or tankers. Just 4% of households had managed to arrange private connections.<sup>21</sup>

#### **Water Supply to JJ / Slum Clusters**

Around 20 lakh people are settled in JJ clusters with water requirement of 270 MLD. Water supply is provided through public water hydrants, tankers and hand pumps. To date, the Slum & JJ Dept. has undertaken four projects of in-situ upgradation in JJ Clusters, including locations at Ekta Vihar (414 families), Proyog Vihar (260 families), Shanti Vihar (113 families) and Shahbad Daulat Pur (4800 families). DJB is capable of meeting around 60-65% of the water requirement of slum dwellers. Other sources, such as hand pumps, tankers and water trolleys, contribute 25-30% of the water supply.

*Source: CDP Delhi-2006*

#### **3.6.1.3 Ineffective Service Delivery System**

Delhi obtains almost 90% of its water supply from surface water through the Yamuna River, whose flow is largely diverted upstream in Haryana and Punjab through canals for irrigation purposes. When the river reaches Delhi, it is tapped in various treatment plants. Water production has increased by about six times since 1961 to reach its present estimate of around 2730 millions litres per day. Despite continuous progress in the overall production figures and an official consumption figure of around 250 lpcd, the level of service in Delhi is inadequate.<sup>22</sup>

While DJB is expected to provide pipeline supplies to all, their inefficient delivery system has forced people to make alternate arrangements. This has had a negative affect on water availability and compromised water quality by tapping into ground water through bore wells and hand pumps, fixing illegal online motors to boost pressure, constructing large storage systems to convert intermittent supplies to a 24x7 system, and establishing small scale service networks with water entrepreneurs.

DJB has the capacity to supply 650 million gallons water per day (MGD). Recent estimates suggest that DJB loses 40% water in transmission. Residents bridge the gap through ground water tapping. Contribution of groundwater to municipal supply is around 11% of total water volume used in Delhi (i.e. 370 million liters per day (MLD)). This demands a major overhaul of supply management. Even planned areas of MCD with house connections have a shortfall of 42%. The following table shows that although production of treated water is adequate, 10%

<sup>20</sup> <http://rainwaterharvesting.org/Crisis/Urbanwater-scenario.htm>

<sup>21</sup> Assessment of the Baseline Conditions of the Urban Poor in Delhi March 2008, Water Aid

<sup>22</sup> Organisational Analysis of Water Boards/Municipalities: Lessons from Calcutta, Chennai, Delhi and Mumbai, Joël Ruet and Marie-Hélène Zérah, 2002

of Delhi's population has no piped water supply and 30% of population has grossly inadequate water supply.

**Table 3.7 Status of water Supply in Delhi**

Type of Settlement	Population In lakhs	Demand in million litres per day (MLD)	Supply in MLD	Shortfall/ Excess
JJ Cluster, Designated Slum Area and unauthorized colony (I)	13.96	59.33	No piped supply	(-) 100%
JJ Cluster, Designated Slum Area and unauthorized colony (II)	40.80	173.40	20.43	(-) 88%
Planned Area (H.C) (MCD)	75.50	1698.75	990	(-) 42%

Source: Status Report for Delhi 21: Delhi Urban Environment and Infrastructure Improvement Project (DUEIIP).

### 3.6.1.4 Quality of Water Supply

Delhi's sources of water supply are polluted. The Yamuna River gets polluted even before it enters the city (Agarwal, 1997). According to the Central Pollution Control Board (CPCB, 1995), groundwater in Delhi carries traces of pesticides, and has a high fluoride and nitrate content. Central Ground Water Board found only a few aquifers in Delhi to be palatable (CGWB, 1996). Besides chemical pollution, the city's untreated sewage is also finding its way into the river and aquifers, increasing the bacterial and viral strains within the water (Ahmed, 1998).

There is a growing lag between increased wastewater discharges and treatment capacities that will worsen the quality of existing raw water sources and increase the costs for treatment if not properly addressed. Measures taken by the DJB for ensuring good quality water are included in **Annexure 5**.

Groundwater in Delhi also has a high concentration of total dissolved solids, electrical conductivity, chloride, nitrate, sulphate and fluoride as it relates to drinking water standards. Poor water quality has been observed in many places in the NCT. Those areas most affected by nitrates are Kanjhawala and the western part of Najafgarh.

Due to the shortfall in water supply, especially in the poorer areas and slums, ground water extraction through hand pumps and Bore wells is common, but this water contains high fluoride concentration that exceeds the permissible limit of 1.5 mg/l.<sup>23</sup>

To the DJB's credit, most poor residents are happy with its drinking water quality. This opinion is supported by several studies undertaken by CURE as well as a baseline study conducted by WaterAid in March 2008. According to WaterAid's study, up to 44% of respondents reported the quality of water as "good", 37% as "average", and 19% as "bad". Data also reveals that only 13% find it necessary to purify the water, while 87% of respondents do not purify the water.

<sup>23</sup> Urban Hydrology And Water Resources Management In Urban India: Case Of Delhi Mega City, Anju Singh, Department of Geography, Banaras Hindu University

**Water Data**

- Slum dwellers are mostly dependent on hand pumps installed by the Delhi Jal board instead of the one tap for 150 people. Water from 40% of these hand pumps is unfit for drinking.
- Resettlement colonies lack water pipelines and are served only through DJB tankers. Of the 975 tankers supplying to resettlement colonies, private operators manage 400.
- DJB spends approximately Rs.330 per shift for the tanker service. It spends daily more than 3 lakhs per shift on tankers. In 3 shifts a day DJB spends over 35 crores to supply water through tankers annually.
- According to government statistics, it costs Rs.55 to supply water through one-meter of pipe length. Annual expenditure for one-meter supply can connect 2.5 lakh houses to piped water supply.
- 2500 families from 15 slums said that they require 90 lpcd of water per day while the middle-income families have a need for 110 lpcd.
- Water available in Delhi, if well distributed, can provide at least 200 lpcd, twice the felt need.

**Source:** (Review of Literature: WSS service to the Poor, CURE, 2006)

### 3.6.1.5 Coping with the Shortfall: Vulnerability of Slum Dwellers

The poor pay the highest price while coping with the greatest shortfall in water supply. Long lines in front of water stand posts and water tankers is a common sight. Inconvenient timings of supply exacerbate the problem with many residents having to give up a day's earning in order to secure water for the family. In most cases more than one member of the family is involved in water collection. In high-demand locations water collection queues start forming very early in the morning. Incidences of diverting water pipelines for personal usage are rampant and it often leads to massive wastage of water. Similarly, illegal tapping into water pipes to alleviate individual household water problems is common, which worsens the situation for others down the distribution chain by decreasing the already low water pressure supply.

Water requirements reach a peak during certain times, typically mornings. During this time, households draw the largest proportion of their daily requirements. But gravity-backed water flows are not adequate to service the needs during this peak time. Consequently, many households do not receive water and need to obtain supplementary water supplies.

To get enough water to fulfill their daily water needs people in Delhi, have adopted multiple coping strategies.<sup>24</sup>

- 85% households have storage arrangements for water that converts the limited supply into continuous supply. Around 78% of slum residents also store water in drums or buckets in their homes (PWC, 2003).
- Almost 45% of households with individual house connections also supplement water from tube wells and hand pumps. 41% of slum dwellers use hand pumps to bridge the water gap and an almost equal number (42%) use booster pumps/tube wells.
- Tankers are the most common alternative for filling the gap in water supply
- A small percentage of households rely on small-scale service providers or pushcarts for meeting their water needs

<sup>24</sup> Review of Literature: WSS service to the Poor, CURE, 2006

- Many poorer households tap into the system illegally. Both legal and illegal coping strategies are used to meet water demand; boring hand pumps, tube wells or bore wells, purchasing water from private water vendors and/or transporting water in carts.

### **3.6.1.6 Alternate Sources of Water supply**

#### ***Private tube wells and bore wells***

Invariably, almost every colony or complex in Delhi has a bore well or a tube well to augment water supply. Legally, bore wells have to be registered with Central Ground Water Authority (CGWA). Laws, however, are seldom practiced and the bore wells are rarely if ever registered. People in these areas rely more on groundwater than on water supplied by DJB. CGWA is the authority in charge of groundwater regulations but lacks complete information on number of bore wells and tube wells in the city since they are seldom registered. CGWA has forbidden extraction of groundwater in some 'notified' areas but people still continue to drill illegally.

#### ***Water Tankers***

Tanker and pushcarts provide complementary services in unauthorized colonies and slums. DJB tankers supply 10 lpcd water in most slums settlements free of charge. During periods of shortage and emergencies DJB hires services of up to 400 tankers. Apart from the DJB tankers, approximately 250 private tankers also supply water in the city. Groundwater used in these tankers is also mined in the neighboring states of Haryana and Uttar Pradesh and is of extremely poor quality<sup>25</sup>.

#### ***Private Water Tankers***<sup>26</sup>

Private water tankers have come into existence precisely due to failure of the government to meet the water demand of the city. There are approximately 250 private water suppliers supplying water through tankers in Delhi, mostly local vendors from Delhi, Noida, Gurgaon and neighboring areas. Private water tankers supply untreated or non-potable water and do not take responsibility for its quality. These suppliers get water for sale by drilling bore wells and tube wells or filling from the river. Despite supplying untreated water, the business of water tankers has grown over the years.

Private water tankers serve under supplied areas or rural areas such as Narela and Kapashera where the groundwater is unfit for all purposes: drinking, construction or industrial. Private tankers (400 on hire) also supply water on behalf of DJB to slums and rural areas, DDA colonies, regularized colonies, upcoming societies, areas of low pressure, government hospitals, jails, and construction sites such as metro project sites, during breakdowns and/or epidemics. Private water suppliers do brisk business during hot summer months when demand is high and supply is short.

#### ***Packaged Water***

The manufacturers of packaged water are generating soaring profits from the existing water crunch in Delhi. Available in pouches, cups, bottles and bulky transparent jars, people buy packaged water because they are health conscious and in order to stock drinking water in their homes for those times when the DJB supply falls short. Industries also purchase packaged water in bulk in order to

<sup>25</sup> Daga, S. Private Supply of Water in Delhi. Markets and Regulations. Research Internship Paper, CCS. 2003

<sup>26</sup> Private Supply of Water in Delhi, Shivani Daga



meet drinking water requirements. Since packaged water is treated, it is preferred over water supplied by the tankers.

DJB also supplies packaged water under the brand name of 'Jal'. Priced at Rs 15 per 20 litres, the packaged drinking water conforms to the standards laid out by the Bureau of Indian Standards (BIS).

### 3.6.1.7 The Pricing of Water<sup>27</sup>

Delhi residents pay for water both at a flat rate and through metered supplies with increasing block tariffs. According to DJB, just 30% clients have metered connections. Flat rate charges are based on estimated consumption by dwelling type. Although a graded tariff system for metered supplies is available, the top-of-the-block costs are also unable to meet the cost of supplying water to customers. The price for consumption at the highest level at Rs.4.50/Kl (kilolitre) is less than the cost of water supply at Rs.4.65/KL. Besides, this estimated cost of water does not include depreciation costs. About 60 % of all consumers consume less than 30KL a month.

#### **Cost of water vending**

Venturing into the water supply business requires little capital. The initial costs of installing a simple bore well varies from Rs 30,000 to Rs 2.5 lakhs. One can bore bore wells in any part of Delhi with little hassle. In order to bore a tube well or a bore well in a 'Notified Area' one has to acquire permission from the Central Ground Water Authority (CGWA). Given the laxity in enforcement of the laws by CGWA, the private water suppliers are able to bore tube wells in notified as well as unnotified areas with equal ease. Fleet size of a water supplier varies from 2-25 tankers depending upon the size of his business. Thus, it is not surprising to find the water tanker owners accruing large amounts of money during hot summer months.

**Table 3.8: Existing tariff structure**

- DJB acts mandates cost recovery
- Slab wise – increasing blocks, volumetric rate subject to minimum charges
- 50% surcharge on water bill as sewerage charges

C I		C II		C III	
Slab	Tariff(Rs/Kl/month)	Slab	Tariff(Rs/Kl/month)	Slab	Tariff(Rs/Kl/month)
Up to 10 kl	Rs 0.35 + 50%	Up to 50 kl	Rs 5 + 50%	Up to 50kl	Rs 8 + 50%
10-20 kl	Rs 1 + 50%	> 50 kl	Rs 10+ 50%	50-100 kl	Rs 12+50%
20-30 kl	Rs 1.5 + 50%			>50kl	Rs 16+ 50%
>30 kl	Rs 3.0 + 50%				
Min Rs 20 + 50% /month		Min Rs 100 + 50% /month		Min Rs 300 + 50% /month	

**(Source: DJB, Overview of urban water supply and sewerage sector in Delhi, 2004)**

### 3.6.1.8 Challenges faced by DJB

As a single agency responsible for water supply and distribution, DJB faces many challenges in delivering proper services to the city. Poor quality of raw water and

<sup>27</sup> The cost of water, pricing and its impact on the consumers in Delhi, Moho Chaturvedi

erratic power supplies complicate the delivery, sometimes leading to shutdowns in treatment plants. The DJB's general challenges can be categorized as follows:

***Illegal tapping***

Distribution networks are one of DJB's greatest challenges, especially when serving high-density informal settlements where the illegal tapping of main lines leads to low pressure and numerous leakages. Illegal ice factories and other non-conforming industries are also responsible for the large-scale, unlawful tapping of water mains in Delhi. There are an estimated 18500 unauthorized connections in Delhi, and of the authorized connections, only 35% have a working meter.

***Poor customer service***

The DJB lacks a formal grievance customer redressal system. As a result, the poor are left with limited options of demanding better services. Most urban slums depend on local political leadership for better water and sanitation services. Additional water pipelines and new community toilets are often seen as crucial political agendas in urban slums. In the absence of a formal mechanism for demanding infrastructure improvements, the promise of 'free' watsan services is often used as a political manifesto, albeit with little to show in the way of end results.

***Poor cost recovery***

Delhi has one of the lowest water tariff structures in the country. The water tariff was last revised in 1998 and any efforts to change or upgrade tariffs since then have been faced with resistance. The poor continue to remain outside the network of water tariffs as they are supplied with 'free water'. Unfortunately, free water not only comes at a high price to the poor but also to the DJB. The 40% quantity lost through transmission and leakages adds to the problem of water cost recovery.

***Organisational issues***

The differing zonal boundaries recognized and used among Delhi's various municipal entities makes the efficient provision of services nearly impossible. DJB's water zones do not align to the municipal zones established by MCD making it difficult to share data and easy for poor areas to be neglected. Furthermore, there is a great need for a more systematic approach to training DJB employees and staff on the best practices of delivery, operation and maintenance of Delhi's water supply as well as customer service.

***3.6.2 Sanitation***

Sanitation generally refers to the provision of facilities and services for the safe disposal of human waste. Inadequate sanitation is a major cause of disease worldwide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. Sanitation is a broad term that refers to the maintenance of hygienic conditions through the provision of various services such as sewerage, wastewater disposal, garbage disposal, and proper drainage. It is a critical indicator of a city/settlement's health and has a strong impact on the well being of citizens.

***3.6.2.1 Service for the Poor***

In Delhi, the Slum and JJ Department of the MCD is responsible for providing basic sanitation services to low-income slum settlements. The level of sanitation services currently provided to slums was determined by standards set in the 1970s under the Environmental Improvement of Urban Slums scheme. Norms for slum sanitation include community toilets (1 seat for 50 users), and open and



shallow street side drains for household wastewater disposal that link to community stand posts. Community toilets are usually linked to septic tanks and sometimes underground sewerage where networks are available. Underground sewerage networks for household toilets are not available to slum settlements. Sewers are also not provided to unauthorized colonies and rural villages. Newly regularized colonies lack sewers as well, but are eventually connected to the formal system in subsequent development. Most of the urban villages have very narrow lanes and it is difficult to provide separate sewerage and drainage networks along the streets. Therefore, underground sewerage and drainage are combined into a single network in these areas.

Solid Waste Management is an equally critical issue, with the city's waste being sorted largely through the informal sector and the residual content, primarily comprised of non-recyclable rubble and biodegradable matter ending up in SLFs (Sanitary Land Fills). The negligence of waste minimization and institutional efforts on recycling over the years has resulted in a number of problems with disposal emerging as a major one. Twenty SLF's were created over the last three decades, of which fifteen are exhausted and two are suspended. Only three are operational at Bhalaswa, Ghazipur, and Okhla, and even these are close to exhaustion.<sup>28</sup>

### 3.6.3 Sewerage

Sewerage, till very recently, was deemed a 'Cinderella' service, getting low priority in service plans of local governments, mostly due to a lack of understanding of its importance and /or lack of financial capacity. The result has been poor coverage of sanitation services as a whole and underground sewerage in particular. A 2002 survey of housing conditions in Delhi showed that none of the slums in Delhi had the comfort of septic latrine. About 70% had service type latrines at their disposal and 30% of the slums had no latrine facility, thereby leading to an unhygienic environment in and around slums and a consequent deterioration in health conditions. None of the 1868 slums had an underground sewerage system<sup>29</sup>. Only 65% of the population in Delhi has access to sewerage services<sup>30</sup> both through underground systems and on-site treatment by septic tanks. Because MCD does not provide household connections to sewerage in the slums, households with affordability and nearness to main trunk infrastructure, connect to the system by puncturing the pipelines, thereby damaging the system. Harsh Mander, convener of Aman Biradari, writes in an article in the Hindustan Times that an official National Sample Survey Organisation study found that none of the non-notified slums in Delhi had underground drainage, only 3% had underground sewerage, less than half had any latrines, 72% are waterlogged in the monsoons, and a third had no primary schools within one kilometre. Another study finds that where latrines exist, one services 27 households<sup>31</sup>. There are no estimates on numbers of slums in the city linked to underground sewerage system.

The sewerage network in Delhi is old, poorly maintained and not properly networked to treatment systems. This has resulted in system blockages, raw system overflows and environmental damage. Data from CDP Delhi presented

<sup>28</sup> Garg A, Kumar V, Verma V, 'Public Private Partnership for Solid Waste Management in Delhi: A Case Study', Proceedings of the International Conference on Sustainable Solid Waste Management, 5-7 September 2007, Chennai, India, pp 552-559

<sup>29</sup> Housing Conditions in Delhi (NSS 58<sup>th</sup> Round State Sample), Directorate of Economics and Statistics, Government of National Capital Territory of Delhi, 2006

<sup>30</sup> [http://www.jnnurm.nic.in/nurmudweb/cdp\\_apprep\\_pdf/CDP\\_Appraisals\\_CEPT/Delhi\\_CEPT.pdf](http://www.jnnurm.nic.in/nurmudweb/cdp_apprep_pdf/CDP_Appraisals_CEPT/Delhi_CEPT.pdf)

<sup>31</sup> Harsh Mander, 'Democracy Wall – In our metropolis: The urban poor in Delhi is routinely crushed under a cycle of negligence', [www.karmayog.org/urbandvlp/urbandvlp\\_14129.htm](http://www.karmayog.org/urbandvlp/urbandvlp_14129.htm)

below suggests an extremely slow growth in expansion of the sewerage network; 8th Five Year Plan (1992-97) targets to cover unauthorized-regularized colonies and urban villages with sewerage systems, is yet to happen. As a result, sewage generated from such areas finds its way through the surface drains into storm water drains and then discharges untreated into the river. At present there are 17 Sewage Treatment Plants (STPs), equipped to treat 512.4 MGD of sewage capacities varying from 2.2 MGD to 140 MGD.

**Table 3.9: Sewerage Status**

Head	99-00	00-01	01-02	02-03	03-04	04-05	05-06
Trunk Sewer (Km)	130	132	135	140	143.6	147	150.54
Branch Sewer (Km)	4693	5653	5703	5844	5956	6000	6070
Unauthorized / Regularized colonies 567	366	402	427	458	482	493	506
Urban villages (135)	82	93	93	93	98	99	105

*Year-wise status of sewerage system (CDP, Delhi)*

### 3.6.4 Community Toilets

The provision of community toilets is the standard solution for a lack of sanitation facilities in slum communities. According to Census 2001, approximately 78% of Delhi's population had access to sanitation services with 66% having pour flush toilets.

There are a total of 1963 Public toilets in Delhi; of which 959 were built under the Yamuna Action Plan Phase I, 393 by Slum and JJ Wing (MCD) and 611 by the General Wing of MCD; however, not all of these toilets are in slums or specifically designed for the poor. Sanitation services provided in slum settlements by the Slum Wing have largely been designed as large community toilets or Jan Suvidha Complexes (JSC). Large amounts of money are invested in these complexes annually. Despite this effort, the sanitation situation in these settlements does not appear to have improved. Estimates suggest that nearly 60% of the poor continue to defecate in the open. Even where toilets are provided by the local government these remain unutilized due to poor maintenance.

#### Community Toilets: Indore

The Slum Networking Strategy for slum upgrading piloted in Indore and other cities, recommends provision of community toilets only when absolutely necessary, e.g. where lack of space prohibits the construction of private toilets. Otherwise, it states that community toilets "is wasted investment", especially when income levels in the slum increase.

*Source: Building and Housing Foundation, 1997, Slum Networking: An Innovative Approach to Urban Development, New Delhi.*

These findings have been reiterated through a number of studies, which indicate that around 60% of the poor population continues to defecate in the open, while only about a third of the households have access to toilets.

There are several prominent studies from which these figures are derived:

*NIUA study on Jansuvidha Complexes:* NIUA's 2003 study on Jansuvidha Complexes highlights that only 376 JSCs had been provided for the 1080 low-income settlements in the city, meaning approximately one third (34.81%) of the settlements were provided toilet services. Of these, 237 (63%) were of permanent nature and 139 (27%) were prefabricated or mobile units. Nearly 8% of all JSCs were without water. In addition, another 5.6% had water supply which was non functional and nearly the same number had water supply less than 24 hours a day. Electricity connections were missing in 5.6% of toilets, mostly in the prefabricated units, suggesting that these remained dark with low utilization. Together these complexes provided 10484 seats covering 5,24,200 poor people. Coverage in terms of total slum population was therefore less than one fourth (23.09%) of the poor<sup>32</sup>.

*Delhi Urban Environment and Infrastructure Improvement Project:* Slum households with access to community or household toilets ranged between 31 and 52%. This data was reaffirmed by DUEIP (2000) on the basis of 9 slum settlement visits.

*Delhi Jal Board:* Results of a 2006 DJB study of services conducted by CURE to poor settlements in two zones (South II and South III) reported that slum dwellers mainly relied on community toilets. In several slum clusters (20%), a majority of people resorted to open defecation (more than 50% in 21 settlements).<sup>33</sup>

*NIUA study on Delhi slums:* Children are among the most vulnerable with respect to access to community toilets in slum areas. A 2002 NIUA citywide survey among slum dwellers in Delhi revealed that nearly 63% of children in slums defecated in the open or just outside the house. This makes them vulnerable to disease and raises other safety and security issues. Poor quality of services within the public toilet, lack of child-friendly facilities within toilets and exploitative payment systems by local contractors are among the primary reasons for the high rate of open defecation among children. Adult men and women rely mainly on public toilets for sanitation; however, surprisingly, nearly 25% of men and 22.2% women still defecated in the open.<sup>34</sup>

*Water and Sanitation Programme – South Asia:* Similarly, a 2005 survey by WSP-SA covering 252 toilet complexes, spread across 24 colonies (two each in the 12 zones of MCD) and 504 households, stated that 8% of the slum population in Delhi had access to individual toilets, more than half used no kind of toilet facilities<sup>35</sup>, 34% of the respondents living in slum clusters defecated in the open.

Since sanitation is equated with the presence or absence of a community toilet in a settlement rather than its actual utilization, coverage is by-and-large over estimated. Use of community toilets among slum dwellers wherever they exist, is reasonably low due to their poor maintenance, overcrowding, lack of water supply, difficulty in accessing, and risk of sexual abuse.<sup>36</sup>

<sup>32</sup> National Institute of Urban Affairs, 'Evaluation of Jan Suvidha Complexes and Bastee Vikas Kendras in Delhi', carried out for GNCTD, 2003

<sup>33</sup> DJB Survey for poor settlements in 2 zones of Delhi. Survey Conducted by CURE, 2006.

<sup>34</sup> National Institute of Urban Affairs, 'Evaluation of Jan Suvidha Complexes and Bastee Vikas Kendras in Delhi', carried out for GNCTD, 2003

<sup>35</sup> The Water and Sanitation Scenario in Indian Metropolitan Cities: Resources and Management in Delhi, Calcutta, Chennai, Mumbai; Occasional Paper CSH-Joel Ruet, VS Saravanan, Marie-Helene-Zerah

<sup>36</sup> Khosla R., April, 1996, The Urban Reality. Experience of Government Programmes/NGOs/CBOs. Plenary paper on Women, Children and Sanitation.. Department of Women and Child Development. Vigyan Bhavan, New Delhi

When these facilities are pay-and-use toilets, there is a tendency to avoid using the facility. Because nearly all persons without private toilets in their homes belong to poor households, the share disproportionately lack access to sanitation services.

#### **Sanitation Solutions for Resettlement Sites in Delhi**

*Savda Ghevra (SG)* is a new resettlement site at the North West fringe of the city. Once fully occupied, over 8000 households will have been relocated to SG from various slum settlements inside the city. Without access to basic infrastructure, SG has enormous development challenges, in particular related to sanitation. Although 9 toilets have been built for community use, only 4 have been made functional, and without effective O&M plans. Residential plot sizes are too small for private toilets and people lack the technology/affordability to plan and construct personal toilets. Without pucca roads lined with drains, wastewater is draining into open spaces causing major environmental problems. People use soak pits to collect household wastewater and empty these in vacant plots. Solid waste is currently being dumped in the open as local agencies have yet to develop collection and disposal systems.

#### **3.6.5 Drainage**

There are two types of drainage, storm water drainage and surface drainage. Delhi's drainage situation is complex; it has several natural and man-made drainage systems, five drainage basins, large natural drains, storm water drains along roads and combined 'sewer and storm' water drains (sometimes as a bypass arrangement for blocked sewer lines).

The length of natural drains in the city is 350 km carrying discharge of 1000 m<sup>3</sup>. The total length of manmade drains is 1700 kms spread over 12 municipal zones. There are close to 1300 drains with 339 km within the Civil Lines Area and 5 kms within the Paharganj Sadar Area. Most of the water collected through these various drainage systems is eventually discharged into the river Yamuna.

The drainage system in the slums is either absent or inadequate. According to a 2002 government survey, 50.06% of households were covered by underground drainage facilities throughout NCT, 13.58% had pucca drainage types, 33.93% had open drainage, and 2.43% had no drainage arrangement at all; 82% of slum areas had an open pucca/ kuchha drainage system<sup>37</sup>.

In some areas the street level has increased with repair and renovation and/or new roads have been built. A majority of the large drains are not lined. There are also a large number of mid-size drains that are unlined or have damaged lining. The spread of diseases like malaria, filaria, dengue and annual recurrence of gastroenteric diseases is a testimony to the failed drainage system. Many urban villages and regularized colonies have been provided with underground sewerage and drainage systems built in the centre of roads in order to deal with the limited road widths available in these areas; however, this too presents a major design challenge often resulting in choked sewers and flooding during monsoon seasons. **Annexure 6** provides the list of drains in the different MCD zones of Delhi.

<sup>37</sup> Housing Conditions in Delhi (NSS 58<sup>th</sup> Round State Sample), Directorate of Economics and Statistics, Government of National Capital Territory of Delhi, 2006

### 3.6.6 Solid Waste Management

A suitable solid waste management system is a crucial part of a city's public health and aesthetic environment. The presence of different types of waste streams in Delhi complicates the solid waste management scenario leading to deficiencies in planning and management. Unplanned slums and squatter settlements further complicate the scenario in Delhi.

Three municipal bodies - the Municipal Corporation of Delhi (MCD), the New Delhi Municipal Council (NDMC) and the Delhi Cantonment Board (DCB), are responsible for solid waste management in Delhi. MCD alone manages almost 95% of the total city area. The above authorities are supported by a number of other agencies in their efforts. The Delhi Development Authority (DDA) is responsible for siting and allotment of land to MCD for sanitary land filling. The Delhi Energy Development Agency (DEDA) under Delhi Administration (DA) is responsible for solid waste utilization projects aiming at bio-gas or energy generation in consultation with the Department of Non-Conventional Energy Sources (DNES), and Ministry of Environment and Forests (MoEF), Government of India. The Department of Flood Control of Delhi Administration looks after the supply of soil to be used as cover for sanitary landfills by the MCD.<sup>38</sup>

In addition to the above public agencies, there are other important agents who play a role in the overall scheme of solid waste management in the city. There are private sweepers and garbage collectors employed by residents for cleaning privately owned premises, waste pickers and waste dealers, and even recycling industries, which consume recyclable waste to produce recycled products.

The Delhi Government has privatized waste collection and transportation in 6 zones of Delhi. As per Article 5.15 of the Contract, the ownership and control of recyclable wastes and control and rights over the Dhalao space too has been passed on to a private corporation.

**Waste Collection Services:** Total sweeping staff available through MCD and NDMC is 1 per 216 persons and 1 per 326 persons, respectively. This is higher than the prescribed norms of 1:500 in the Central Public Health and Environmental Engineer Organisation (CPHEEO) manual. However, most households are expected to make their own arrangements for waste disposal, as MCD's mandate is to lift waste from *dallaos* and dustbins but not engage in house-to-house garbage collection. With no door-to-door collection services, it is the poorer neighborhoods that are most affected. Many households in slums have no formal arrangements for door-to-door collection and dispose of waste themselves. Waste is generally dumped at the nearest open site such as parks, open plots, street corners and in drains resulting in unhygienic conditions in public spaces.

<sup>38</sup> Sarkar, Papiya "Solid Waste Management In Delhi, 2003

### **Private Collection Making a Difference**

The informal economy, with its recycling-driven business model, is doing the national capital city a great service. The formalization of the waste economy underway has come through the Municipal Solid Wastes (Management and Handling) Rules, 2000, issued by the Union Ministry for Environment and Forests. As per the Rules, all urban waste must be segregated on the basis of waste sources (that is, industrial, biomedical, and household) and the nature of the waste (that is, biodegradable, non-biodegradable and recyclables) and disposed of accordingly. The implementation of these rules has required a marked departure from the existing practices, and many urban local bodies in cities such as Delhi, Mumbai and Chennai have handed over waste collection and segregation to private waste management companies.

Municipal Corporation of Delhi estimates that privatization has resulted in a steep reduction in the costs of garbage collection and transportation, and the MCD expected to save Rs.30-40 crores annually. The waste collection efficiency of the MCD stood at about 60%, in spite of dedicating almost 95% of its budget for waste handling, collection and transportation and leaving only 5% for actual disposal. The MCD's inefficiency in waste management has meant that almost 20% of Delhi's waste passes through the informal waste collection and recycling network at some stage.

*Source: - Toxics Watch-Alliance against Pollution & Corporate Crimes, Corporatization of Waste Underway, Wednesday, January 07, 2009*

**Issues and concerns:** Over the years, the public provision of sanitation services for the urban poor has been met with limited success. Even though local bodies have been adding infrastructure, it generally suffers from gross neglect, poor maintenance, and limited usage. Many institutional arrangements have also tried to provide efficient and reliable services for sanitation. Past experience indicates the following institutional shortcomings:<sup>39</sup>

- **Lack of uniform standards:** Public toilets constructed in different locations do not conform to a universal benchmark, either in terms of adequacy of toilets per capita, or the standards of service provided. It has been seen that the various schemes fail to ensure a uniform pattern in terms of accessibility to different services (Sudarshan and Bhattacharya, 2006). In the absence of standardized norms, people living in different parts of the city have differential access to services. In some settlements women and children are allowed free access to community toilets, while in others there is a payment involved. Further, lack of uniform standards makes the accountability structures diffused and it is difficult to hold a service provider accountable for defaults.
- **Weakly structured PPP models:** The different PPP models adopted over the years have not yielded the desired results. One of the key reasons for failure of the contracting arrangements with NGOs has been the lack of proper definition of roles and responsibilities and weak incentive structures. NGOs were entrusted with the responsibility of operation and maintenance on a fixed fee contract, but with no built in incentive for the NGO to upgrade the services beyond the existing level. The task became even more challenging in absence of well-defined performance

<sup>39</sup> City Development Plan, Ministry of Urban Development, Central Government, Delhi 2006



benchmarks. The NGO was given part responsibility for minor repairs, while major repairs remained with MCD.

- **Weak monitoring mechanisms:** The periodic monitoring of performance at the cutting edge level, through the JJ and Slum wing of MCD, has been rather ineffective. The staff at the operative level does not possess the requisite skills to interface with the poor communities, in terms of community mobilization skills or negotiation skills. The community residents perceive the municipal staff as distant and removed from the community. Past experiences have revealed that the municipal staff responsible for cleaning and maintaining the toilet blocks usually failed to perform the necessary duties. Additionally, there has been the frequent problem of the late removal of accumulated sludge from septic tanks. Both problems have often led to disrepair and disuse of these toilet blocks.<sup>40</sup>
- **Lack of sewer networks:** The DJB, as a matter of policy has not laid sewer lines in slum clusters, on account of a High Court Order. The net result of this policy is that the community toilets in slum clusters are based on pit latrines and septic tanks. In the event of poor maintenance of septic tanks, the overflow usually discharges into drains adjoining the community.
- **Limited community involvement:** The community toilet infrastructure in most cases has been constructed as a top down intervention and there is minimal involvement of the community either in the planning, design, construction or operations stage. There has been no effort to mobilize the community or to influence the public's behavior patterns by encouraging better usage of community facilities.
- **Multiplicity of agencies:** MCD is responsible for the construction, operation and maintenance of community toilets while DJB is responsible for water supply and sewerage. As a result, there is often a mismatch between the infrastructure for toilets and the external services necessary for efficient operations. Delhi is unique in that urban planning is the responsibility of the Central Government, urban policy and regulation are the responsibility of the state urban development department, and enforcement and service delivery are the responsibility of the municipal body and Water Board.

### **3.6.7 Management of Community Toilets in Delhi**

MCD has the mandate for providing sanitation through community toilets in all slum settlements under its jurisdiction, while the NDMC and DCB provide similar services for slums in their respective territories. These toilets are constructed with public money and managed by public agencies or NGOs, and are available on a user per-charge basis or designated as free.

**Community toilet complexes in slums:** For nearly three decades, MCD managed and constructed community toilets with the help of Sulabh International. However, this arrangement was unsuccessful due to a lack of accountability and a diffused responsibility. MCD defaulted in cleaning septic tanks and providing water and electricity, which created a general unhygienic condition in the complexes. In 2006, the contract awarded to Sulabh International was terminated by MCD on account of poor service provision.

<sup>40</sup> Hansen, S., Bhatia, R., 2004. Water and Poverty in a Macro-Economic Context. The Norwegian Ministry of Environment, The Nordic Consulting Group Oslo, and The Resources and Environment Group New Delhi.



In 2000-2001, under the JBIC funded Yamuna Action Plan (YAP), Phase 1, MCD constructed 959 toilet blocks across the city, the O&M of which was auctioned off to nearly 90 NGOs that were to operate and maintain the toilets on payment of a fixed fee to MCD. However, even with a huge capital investment, the YAP proved to be of no avail and the quality of service delivery remained as is. Of the 959 public toilets constructed, 300 toilets ceased to operate due to difficulties of maintenance by NGOs due to low utilization.<sup>41</sup>

In April 2008, MCD called for expressions of interest for the operation and maintenance of all community toilets in Delhi for a period of seven years. The toilets were clubbed into three packages and the scope of work includes carrying out all minor and major repairs in the toilets, provision of water and electricity and incurring all recurring costs. In return, the agency awarded reserves the rights of advertisements, but would pay an advertisement tax to MCD. In all, 1544 community toilet blocks have been awarded to three different agencies under this contract.

There is a user charge instituted for these toilets. The user charge for slum residents is payable at the rate of Rs 30 per family per month (family pass), while any other person using the toilet would pay Rs 1/- per use. Children are not charged for usage. However, most of the toilets in slums are still being managed by the MCD, and while MCD managed toilets are meant to be free of cost, nearly all them continue to follow the old pay-and-use system, with the money being pocketed by petty contractors and the cleaning staff at toilets. Exploitation at the hands of the MCD staff, wherever the toilets are still operational, is common.

### **3.7 Legal and Policy Framework for WATSAN**

#### **3.7.1 Institutional Arrangements for Water Supply and Sanitation**

The Delhi Jal Board (DJB), a parastatal body, is governed by the Delhi Water Board Act and is responsible for the planning, design, construction, operation and maintenance of water supply and sewerage infrastructure in Delhi. However, NDMC and DCB manage the internal water supply and sewerage in their respective territories and there is a bulk supply arrangement with DJB.

Some of the roles of DJB are as follows:

- Responsible for production of portable water in Delhi and distribution in MCD area.
- Bulk supply of portable water to NDMC and DCB.
- Collection treatment and disposal of sewage in bulk from NDMC, DCB and MES.
- Regulate and manage the exploitation of ground water in Delhi in consultation with central ground water authority.
- Promote measures for conservation, recycling and reuse of water

Other government departments that deal with water supply quality and norms are Central Ground Water Board (CGWB), Central Public Health and Environmental Engineers Organisation (CPHEEO), Delhi Pollution Control Board (DPCB).

In large cities like Delhi, Hyderabad, and Bangalore, parastatals have been created to deal with water supply, sewerage design, construction and maintenance, while community toilets and sanitation remains in the domain of municipal bodies.

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<sup>41</sup> Asian Water Development Outlook, 2007, ADB

### 3.7.2 Mainstreaming WATSAN Services for the Poor

**Current Policies:** India does not have an exclusive and comprehensive water law. Water-related legal provisions are dispersed across various irrigation Acts, central and state laws, constitutional provisions and court decisions.

According to the state list, under the Seventh Schedule of the Constitution, states have jurisdiction over water resources within their borders. The powers of the states are subject to:<sup>42</sup>

- The Union list under the Seventh Schedule of the Constitution that allows the central government to regulate and develop inter-state rivers and river valleys when declared by Parliament as a matter of public interest.
- The central government's regulatory role in inter-state water projects (Article 252).
- The Environment (Protection) Act, 1996, and notifications issued under it by the Union Ministry of Environment and Forests (MoEF), which require states to get central clearance for major water projects.
- The central government's role in resolving inter-state water disputes as per the provisions under Article 262. Under this Article, Parliament enacted the Inter-State Water Disputes Act of 1956, under which a number of tribunals have been set up to resolve water disputes among the states.

The Constitution guarantees every citizen fundamental rights to equality, life and personal liberty. Article 15 (2) of the Constitution further states that, no citizen shall be subjected to any restriction with regard to "the use of wells, tanks, bathing ghats".

Following a severe drought across the country in 1987, the Centre framed a National Water Policy (NWP) that laid down certain principles for Conjunctive use of water. The 1987 NWP was modified in 2002. Major policy additions included recognition of the role of private sector participation and the need to shift from development of new projects to performance improvements in existing ones.

In the *Subash Kumar Case*, the Court said that the right to life includes the right to enjoyment of pollution-free water and air for full enjoyment of life. It was added in the *D.D. Vyas v Ghaziabad Development Authority Case* (1993) that "[i]f anything endangers or impairs that quality of life in derogation of laws, a citizen has the right to have recourse to Art. 32 of the Constitution for removing the pollution of water or air which may be detrimental to the quality of life."<sup>43</sup>

As previously mentioned, the DJB is responsible for planning, design, construction, operation and maintenance of water supply and sewerage infrastructure in Delhi. However, NDMC and DCB manage the internal water supply and sewerage in their respective territories and there is a bulk supply arrangement with DJB. The Urban Development department of the Government of National Capital Territory of Delhi is the nodal department for policy planning in terms of notification of settlements in a certain category or otherwise setting the

<sup>42</sup> Poorest Areas Civil Society (PACS). "Water law and rights in India". <http://www.empowerpoor.com/background.asp?report=616>. Accessed June 2009.

<sup>43</sup> A. Rosencranz and S. Rustomjee, "Citizens' Right to a Healthful Environment under the Constitution of India", Water Human Rights, Appendix II. at 7. <http://data.iucn.org/dbtw-wpd/html/EPLP-051-water-human-right/Appendix%20II.html#fn145>. Accessed June 2009.

standards of service delivery, and plays a supervisory and regulatory role (though diffused) for the municipal bodies and DJB.

In the context of water services, this means not only that no water-related program or policy may unfairly discriminate against any group of historically disadvantaged people (for example, any water credit control measure must not be imposed only on poor communities), but also that any bias in favor of historically disadvantaged people will not amount to unfair discrimination and is acceptable. This mean, for example, that water tariffs for the same levels of consumption can be lower in poor communities than in wealthy communities.

Together, these legislative and policy imperatives suggest a dignified, equitable and administratively just approach to water services in which everyone has access to adequate, safe and affordable water and sanitation. However, as explored below, the reality on the ground is far more complex and, to varying degrees, problematic. It is evident that water services provision, levels of service, and administrative processes vary considerably across and within municipalities. Given the critical nature of water services, as well as the legal imperatives mentioned above, it is clear that some form of uniform regulation and enforcement is required in the water services sector to ensure equitable access, particularly regarding the extension of free basic water and sanitation.

### 3.8 Master Plans and WATSAN Services

*The Master Plan Delhi 2001 was published in the Gazette of India, 1st August 1990. Under the section titled infrastructure, the issue of "Water Supply" was addressed at length.*

The needed water supply was determined to be 80 GPCD/ 363 LPCD with the following breakdown:<sup>44</sup>

(i) Domestic	225	lcpd
(ii) Industrial, commercial, community (based on 45,000 liter / ha / day)	47	lcpd
(iii) Fire protection based on 1 % of total	4	lcpd
(iv) Gardening (based on 67,000 liter / ha / day)	35	lcpd
(v) Floating population and special users (i.e. embassies, large hotels)	52	lcpd

According to the plan, the minimum water supply in any residential area should be 135 liters (30 gallons) per capita per day. The projected population by 2001 AD was 128 lakhs, thus, the estimated water requirement was 4660 MLD (1024 MGD). A review of the Master Plan Delhi 1962, which forms **Annexure 7** of the 2001 plan, states, "The standard adopted by Master Plan, 50 gallons per capita per day for the city of Delhi as a whole was rather low, the standard is being revised to 80 gallons per capita per day."

In the latest master plan, Master Plan Delhi 2021, detailed attention is given to Water Integrated Management to cover crisis-ridden areas like water supply, demarcation of water supply based on its use, conservation of water resources, recycling of water and innovations in water drainage system. The estimated water requirements detailed in Master Plan 2021 are given in **Annexure 8**.

The Master Plan has split the water requirement in two parts: potable and non-potable as 35 and 45 GPCD respectively, with the proviso that "In the existing

<sup>44</sup> City Development Plan, Ministry of Urban Development, Central Government, 2006

areas till the arrangement of non potable water is made, potable water shall be supplied. For urban extensions and areas under development schemes, these norms are recommended with necessary provisions.”

### **3.8.1 DJB Vision: Putting the Poor First**

The Delhi Jal Board has developed a citizen’s charter outlining its obligatory functions. According to the charter, all consumers in unauthorized/ regularized colonies, approved colonies, resettlement colonies/ urban villages, rural villages can obtain a water connection for domestic/ commercial/ industrial purposes, as provided under the rules. Even as the Charter expresses a willingness to regularize illegal connections it in effect proposes to penalize consumers who have for lack of alternative illegally tapped the system by describing the enhanced penalty/ charges together with cumulative water charges for 3 years apart from facing the risk of disconnection of water connection.

Time periods for complaint redressal have been specified for leakages in pipes, contaminated water supply/ quality of water and failure of pumping system along with the accountability mechanism. However, few people are aware of the charter and its promises.

The Charter however has no commitment, and hence no accountability, to supply water to slum settlements. Increased judicial activism and political pressure has created an environment under which the agency is obligated to serve the poor first. However, contradictory messages have led to a state of confusion in the service agency about their obligations. Vrinda Grover, an advocate experienced in issues of women’s rights, describes this as a “Conflict of Rights.” Grover concludes that while the Right to Life remains the most powerful Constitutional tool in the hands of the people, its use must be tempered with caution and not be interpreted against the poor.<sup>45</sup>

### **3.8.2 Missions and Programmes**

**JNNURM (Jawaharlal Nehru National Urban Renewal Mission):** In November 2005, the Government of India launched a major urban reform and development initiative called the Jawaharlal National Urban Renewal Mission (JNNURM). The JNNURM aims to provide an incentive to 63 large urban areas to undertake institutional, structural and fiscal changes necessary for improved service delivery systems that are sustainable, address poverty and enhance local economic performance.

Basic Services for the Urban Poor (BSUP) is a mandatory urban poverty reform for all local bodies supported under JNNURM. Its goal is to; *“Provide basic services (including water supply and sanitation) to all poor including security of tenure, and improved housing at affordable prices and ensure delivery of social services of education, health and social security to poor people”.*

JNNURM has adopted a 7-point charter of basic entitlements and amenities – land tenure, affordable housing, water, sanitation, education, health and social security. Once implemented, the BSUP reform will ensure the following outcomes for the city:

<sup>45</sup> Review of Literature: WSS service to the Poor, CURE, 2006

- All urban poor, and in particular slum dwellers, will gain access to basic municipal services such as water supply, toilets, waste water drainage, solid waste management, power, roads, transport, etc.
- All urban poor settlements will be integrated and mainstreamed with municipal supply networks resulting in minimum threshold level services and sustainable improvements in the quality of life of the urban poor.
- Urban poor communities will have better access to land tenure and legal and affordable housing with in-house basic services that will allow them to live as legitimate citizens.
- Urban poor communities will have improved access to social services such as education, health and social programmes of the government. This will ensure better education, improved health, access to sustainable livelihoods and social security, which in turn would help reduce poverty.
- Urban poor will be able to voice their demands/grievances related to basic service provision. Their participation in political processes and city governance will also be enhanced.

Strategies for Water Supply and Sanitation under JNNURM are detailed in **Annexure 9**.

**Yamuna Action Plan (YAP):** The Original Phase of YAP activities in Delhi included a crematorium and two sewerage treatment plants (STPs). The amount approved for this phase is Rs. 196.209 crores. To reinforce these schemes, an extended phase amounting to Rs. 166.4 crores was approved. The largest component of the plan included the construction of 1146 Community Toilet Complexes (CTC's) for areas including rehabilitation colonies and slums, as well as the construction of Micro and Mini Sewage Plants and funding of a Public Participation and Awareness Programme.

In the end, only 956 Community Toilet Complexes were built due to the non-availability of land. The program officially ended in 2002. Many of the toilets constructed under YAP in slum areas now lie in a state of complete disrepair only eight years after being constructed. This is mainly due to the lack of general maintenance and upkeep.

### **3.9 Supply of Basic Services: Assumptions and Challenges**

Service provisions in informal settlements are generally of a lower standard than what would be deemed appropriate in more affluent communities. While the Government declares that, "water is a human right, and all, irrespective of socioeconomic levels, are entitled to receive water," the gaps that continue to exist suggest otherwise. A number of factors contribute to the ongoing service deficiencies. Some of these can be attributed to legal aspects of servicing unauthorized areas and slum settlements and others to more fundamental assumptions about people's citizenship, willingness and capability to demand and pay for improved services.

Several key assumptions and challenges that have emerged throughout the literature review are highlighted below.

### **3.8.1 Defining Water Vulnerability**

Access to water is a basic human right and all, irrespective of their right to live on a particular plot of land or their ability to pay for it, are entitled to receive clean and sufficient access to water. Attaining this access is closely linked to the provision of several other basic rights. Therefore, a definition of water vulnerability was developed from the above review of literature.

Water vulnerable households generally lack access to individual toilets, are provided poorly maintained community toilets at far distances from their homes which they use at high personal risk, or they resort to open defecation. Women and children constitute the most vulnerable groups. Water vulnerable households live in poorly drained settlements with inadequate wastewater disposal or solid waste collection systems and are, therefore, chiefly responsible for their own collection and disposal.

#### **Water Vulnerability**

Water vulnerability is seen as a household's lack of access to permanent shelter on land with permanent security of tenure, accessing less than the required quantity/quality of water supply through community sources at far distances, unconnected to waste water disposal systems, or who must make alternate personal arrangements in order to access water of a reliable quality. People deemed water vulnerable are those who are supplied water free of cost and therefore have low client power, lack information about their rights, and are unable to organize and make demands according to those rights.

### **3.8.2 Delinking Tenure and Services**

The lack of consistency in defining the poor, slums and unauthorized settlements, or in developing a specific understanding on water vulnerability has been chiefly responsible for the inequitable distribution of this important resource. The inconsistency has resulted in a cumbersome classification of settlements (unauthorized regularized colonies, designated slum areas, colonies in the 1071 list), each governed by a differential set of service norms. Besides compounding the confusion, this has reduced the efficacy of service delivery and management of water resources.

A simplified categorization for improving service delivery efficiency in the city's water supply and sanitation sector should be based on one overarching premise:

- Settlements with legal right to land
- Settlements without legal right to land.

All settlements without legal right to land, such as slums and slum designated areas, unauthorized colonies, both regularized and non-regularized, should have the right to paid water supply through household connections, without such supply necessarily giving them a legal right to the land itself. Whenever extending water networks to provide in-house connections is technically not feasible, alternate options may be explored in consultation with the people.

### **3.8.3 Towards Equitable Supply: Promoting Metered Connections**

When water is accepted as a "basic right" and a significant component of poverty reduction, standards for service delivery are less likely to be prejudiced by legal positions. Appropriate standards for services for the poor must be equivalent to those that are provided to the more affluent communities. However, sensitivities about the situation of the poor should be used for setting up of a menu of options to choose from.



Water standards for the poor should ideally be metered household connections. Alternatively, the poor could be offered group metered connections, paid supply through water reservoirs per settlement, or metered stand posts, as a starting point, with options to incrementally upgrade services as incomes rise.

In attention to raising revenues for the operator, providing paid water supply to the poor will eventually reduce their coping costs and enhance their income earning potential to help alleviate poverty. As paid clients, the poor are more likely to be heard and integrated into service provisions to increase transparency and accountability levels.

#### ***3.8.4 Creating Synergy between Water and Sanitation Services***

Multiple agencies are responsible for the provision of water and sanitation services to the poor, which has led to confusion over roles and responsibilities and reduced accountability. While the MCD Slum Wing is responsible for laying water infrastructure in slum settlements, DJB is accountable for its operation and maintenance, for which it receives funds from the Delhi Government. Since resources allocated are often only sufficient enough to cover repairs, the cost of supply has to be met by the DJB from its own scarce resources. As water supplied to the poor is free or non-revenue water, the poor are given a low priority of service delivery. Sanitation, including surface drainage, wastewater disposal and waste collection is the responsibility of the Slum Wing or the MCD. The two need not be separate, but rather should be tied together and linked to city sewerage for a comprehensive, cohesive approach. This combination would call for a dialogue between the two agencies with various mechanisms instituted to ensure synchrony in delivery between services.

#### ***3.8.5 Readiness to Pay, Willingness to Supply***

Projects across the country offer a number of ideas for how to address water and sanitation needs in poor areas. In Bangalore, the Bangalore Water Supply and Sanitation Board (BWSSB) has piped water supply into slums, simply overlooking the legal issue with significant revenue generation and reduction in non-revenue water for the Board. Slum residents' readiness to legally connect to the system must be connected to improved supplies. When residents see value additions (regular piped supply in or close to the house together with drains, clean and affordable toilets), it raises their confidence levels to actually pay for services.

Individual connections may initially increase water consumption and payments may initially be inconsistent. However, over time this will translate into a regular resource for the water authority. Water agencies would also benefit with a decrease in non-revenue water.

#### ***3.8.6 Political Economy of Water Supply and Sanitation Services***

The poor often face difficulty securing the resources needed to pay for proper, legal connections and to purchase the needed materials to bring piped connections inside their homes. Erroneously, this is often interpreted as a resistance to pay for these services. Providers also argue that local politicians encourage those who are connected to the system to stop paying for the water by promising it to them free of cost. As a result, the cost of connecting to the sanitation/sewerage system has a high initial payment, making a proper connection a low family priority.

In order to increase the ability of poor households to pay for connections, systems would need to be created that enable them to access credit at affordable rates, as well as allow paybacks in easy /small installments in accordance with their income. Lump sums of money would enable the poor to pay upfront for their



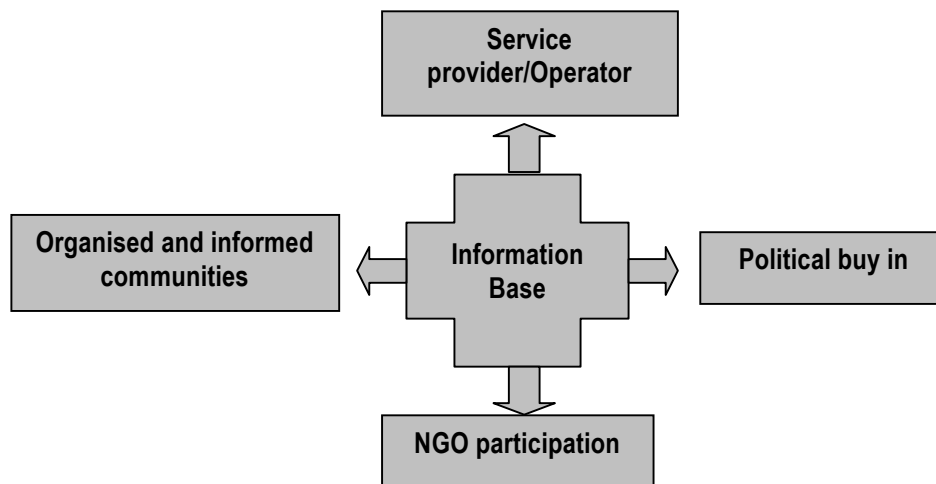
connections. Flexible collection systems would help the poor to pay user charges consistently and on time in a sustainable manner.

Partnerships with NGOs should be organized to bring in crucial value addition by helping adapt water and sanitation services to the specific demands of low-income communities. Communities could then begin to organize around issues of water and sanitation with capacities to better manage service provision within their neighborhoods.

Political leaders too, would need to be a part of the dialogue as their buy-in will be essential for a sustained cost recovery and roll out of the initiative. Community commitment and willingness-to-pay will in time create a win-win situation and positively influence service delivery efficiency.

### **3.8.7 Community-Service Provider Interface**

The poor in general have a very low client power. Their share in city's resources is far less than those more affluent. The poor are rarely included in service delivery planning. It is imperative that these communities are empowered to voice their concerns and raise issues as needed.



A functional water and sanitation system has four key stakeholders; organized and informed communities that are sufficiently empowered with knowledge and skills to negotiate; nongovernmental organizations that create a community-agency interface through their interactions with the community; political structures that invigorate public voice by advocating for the poor at appropriate forums; and a responsive administration supported by accurate and current information about the supply levels and who are enabled to take policy decisions. A single information base, such as a Community based information system (CBIS), should be created where stakeholders can share information and interact at all levels of planning and implementation. This central base will increase efficiency and accountability between all stakeholders.

### **3.8.8 Data Deficiencies and Information Loops**

Management of water resources has been affected by:

- a) An incongruence with regard to demand estimates, and
- b) Information on location of underserved populations and current nature of service levels

Delivery of services must be backed by reliable information that can be periodically updated. Community based information systems (CBIS) are capable

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of creating information about underserved populations and the state of supply infrastructure, as well as provide a wish list of demands that can pressure service agencies to improve service provision. Such systems create information loops that improve decision making transparency, allowing the poor to reflect their needs in city plans and be better informed about their rights.

Mechanisms also need to be created that allow for the flow of information from the street bureaucrats to the policy makers and vice-versa, to improve overall governance of service delivery and by reading into distribution policy.

## Status of Water and Sanitation Services in Delhi: An Assessment

### Methodology

The city survey was designed as a sample household survey to assess the access and quality of water and sanitation services in underserved areas in the community. The sample universe included all the underserved areas within the city.

#### Sampling

The study was conducted using a proportionate stratified random sampling technique.

#### Selection of the settlements

A two stage sampling plan was used for getting the appropriate sample for the study. The typologies of various low-income settlements in Delhi were developed as follows:

- ▶ Slum/JJ Clusters: Slum/JJ Clusters are illegal occupants or squatters on Public or Private Land (ibid). These are compact settlements with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions.
- ▶ Harijan bastis: Slums dominantly populated by *Harijans* are being considered as Harijan Basti in the study
- ▶ Regularized Colonies: unauthorized colonies that are regularized for provisioning of basic services and civic amenities are categorized as Regularised Colonies
- ▶ Non-Regularized colonies: unauthorized colonies that are not being regularized are categorized as Non-Regularised colonies.
- ▶ Urban Villages: As the frontier of Delhi expands, a large number of rural areas get wrapped into the city, and are designated as urban Villages.
- ▶ Rural Villages: The rural areas remaining at the city-state are referred to as rural villages.
- ▶ Resettlement Colonies: These comprise of JJ Cluster households that have been resettled from their original area.

It is found that in Delhi there are 820 Slums, 413 Harijan bastis, 44 resettlements colonies, 1017 non-regularized colonies, 567 Regularized colonies, 135 Urban villages and 219 Rural villages.

It was decided to select a 5% sample from across the different types of settlements. Of the total 3215 low-income (LI) settlements in the city, 150 settlements were selected through a proportionate stratified sampling on the following basis:

$$n_i = (N_i/N \times 100) \text{ of } 150$$

where

$n=150$ , sample size

$n_i$ : is the no. of  $i$ th type of settlement in the sample  
 $N_i$  is the  $i$ th type of settlement in the Population  
 $N=3215$ , total LI settlements

Based on the calculations, the number of settlements per category included in the final sample was:

$JJn_5 = (820/3215 \times 100)$  of 150 = 26% of 150 = 39  
 $HB n_6 = (413/3215 \times 100)$  of 150 = 13% of 150 = 19  
 $RCn_4 = (44/3215 \times 100)$  of 150 = 1% of 150 = 1  
 $U n_3 = (1017/3215 \times 100)$  of 150 = 32% of 150 = 48  
 $URn_2 = (567/3215 \times 100)$  of 150 = 18% of 150 = 27  
 $UVn_1 = (135/3215 \times 100)$  of 150 = 4% of 150 = 6  
 $RV n_7 = (219/3215 \times 100)$  of 150 = 7% of 150 = 10

<b>Table 4.1 : Coverage Area of the Baseline Study.</b>		
<b>TYPE OF SETTLEMENT</b>	<b>NO. OF SETTLEMENTS COVERED</b>	<b>NO. OF HOUSEHOLDS COVERED IN EACH SETTLEMENT TYPE</b>
Slum/JJ Cluster (Slum/JJCs)	39	390
Harijan Basti (HBs)	19	190
Resettlement Colony (RCs)	1	10
Non Regularized Colonies (UNRCs)	69	690
Regularized Colonies (URCs)	6	60
Urban Village (UVs)	6	60
Rural Village (RVs)	10	100
<b>TOTAL</b>	<b>150</b>	<b>1500</b>

Comprehensive lists for each type of settlement were prepared for selection of the actual settlements on a random basis. Random numbers were selected (two digit for Slum/JJ Clusters, Harijan bastis, Regularized Colonies, Non-Regularized colonies, Rural Villages and one digit for Urban Villages and Resettlement Colonies) for selection of the first settlement of its kind and the interval was unique for each of them; for slums it was 820/39; for Harijan bastis it was 413/19. In case of non-availability of a listed slum, the next consecutive slum was chosen; however, the interval was fixed. The problem of non-existence of a listed settlement was only faced for the JJ clusters.

The number of settlements and households covered in each type of settlement are presented in Table 1. The detailed list of settlements is attached as Annexure 2.1.1.

### **Selection of respondents**

For each of the selected settlements, it was planned to identify 10 HHs for the survey. The 10 households were selected randomly depending on the total number of HH in each type of settlements. For example, If a settlement has less than or equal to 100 households, then the interval is defined as No. of HHs/10 for a settlements having 100 HHs, every 10th house was surveyed starting from the left hand side of the enumerator. In case, it is settled along a road stretch, or railway line, and has only one lane, then every 10th HH is surveyed.

If a settlement has more than 100 HH then also the interval is selected as

mentioned before, and the survey started from the left hand side from its entrance.

Resettlement colonies have blocks. Thus in such a case, first the blocks are identified as No. of block/10. then the HHs are selected randomly from within each block.

Data was collected using a questionnaire. The questionnaire addresses large number of issues included but not limited to the location details of the settlement, sources of water supply and sanitation used, reason for accessing a specific form of services, satisfaction levels of users, socio economic profiles etc.

The preparation of questionnaire was followed by a pilot study to ascertain data availability and field work feasibility. These were translated into local languages for use in slums and with low-income communities. A team of about 20 field facilitators were engaged to complete the city survey. These facilitators were given detailed orientation on the questionnaire. They were sent for the pilot testing to have a greater understanding of the questionnaire as well as of the kind of responses they can expect. This exercise helped them sharpen their skills to conduct the questionnaire survey.

For further analysis and efficient management of data, the questionnaires were computerized.

## **Research Findings**

This section will map, in detail, the prevailing situation with regards to access to basic services relating to water and sanitation and other associated infrastructure facilities in Delhi's poor settlements. The Chapter has been divided into three sections: (i) general profile of settlements (ii) access to water supply in settlements (iii) access to sanitation facilities in the settlements.

Section 1 covers (a) coverage of settlements (b) locational profile of the settlements (c) ownership of settlement land (d) demographic profile of settlements (e) housing (f) income and expenditure (g) access to government schemes (h) health facilities (i) electricity.

Section 2 discusses Access to Water Supply services in settlements including a discussion on (a) source of water supply (b) collection, storage, treatment and water hygiene (c) water related health risks.

Section 3 looks at Access to Sanitation services in settlements covering a snapshot view on (a) toilets facilities (b) drainage (c) solid waste management and (d) health risks associated with various aspects of sanitation. The section also covers the infrastructure facilities in school.

## **General Profile of the Settlements**

### **Coverage of Settlements**

Rapid urbanization has led to one distinctive feature in Delhi — different types of settlements, each having its unique contextual features with regards to occupation pattern, standard of living and access to basic services. Keeping this in view, the study covers seven types of settlements – Slum and JJ clusters; Harijan Basti, Resettlement Colony, Non Regularized Colonies, Regularized

Colonies, Urban Villages and Rural Villages. A total of 150 settlements have been covered across these types with a total sample size of 1500 households.<sup>46</sup>

## Spatial Location

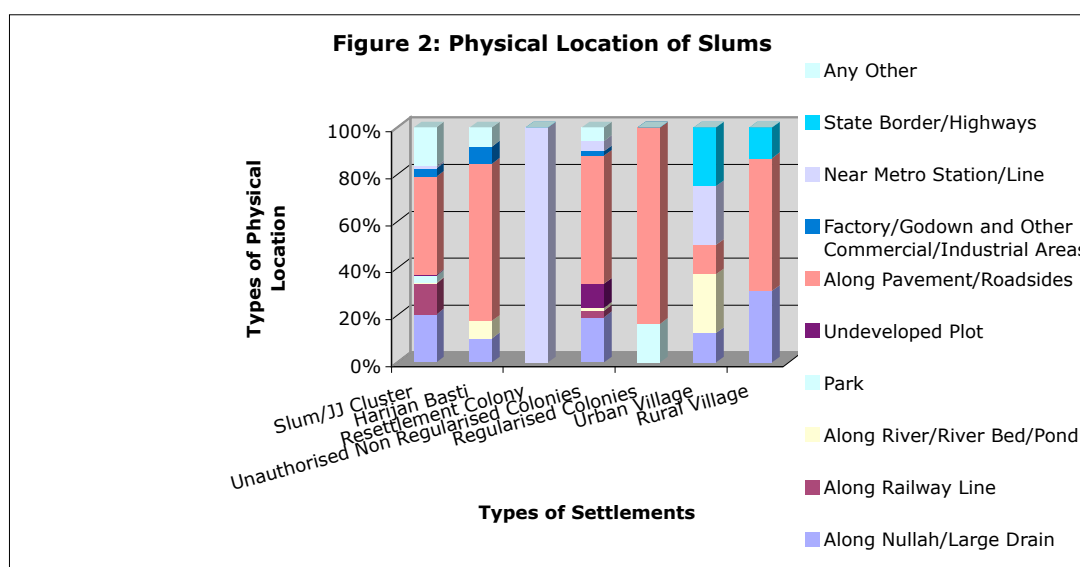
The development of all settlements have a basic precedent behind them which is dependent on the convenience the location offers in terms of (i) access to basic infrastructure including water, space for sanitation, connectivity etc (ii) access to income-generating activities. Thus the location of settlements can be most often associated with proximity to water body, proximity to transport corridors, proximity to industrial areas, availability of open land etc.

During the survey, it is found that around 40 percent are located along roadsides, around 14 percent are located near large drains and nullah or water bodies, 4 percent are located near railway lines, 3.6 percent are located near undeveloped plots while 2 percent are located near industrial and commercial hubs.

With the development of MRTS in the recent years, new settlements have developed around metro stations due to availability of jobs and better access to water and other facilities. Around 2.9 percent of the households surveyed falls under this category.

In order to further understand the spatial distribution, Figure 4.2 presents the same according to type of settlements.

- Most type of settlements, especially Rural Villages (21%) and Slum and JJ/Cluster (17%) are situated in close proximity to contaminated water sources like nullah/large drains.
- 17 percent of the Urban Villages and 5 percent of Harijan Bastis are located along river/river bed/pond, which in Delhi are mostly polluted.
- 11 percent of Slum/JJ Clusters are located along railway lines, which are ill-kept in terms of cleanliness and are often open dumping grounds.

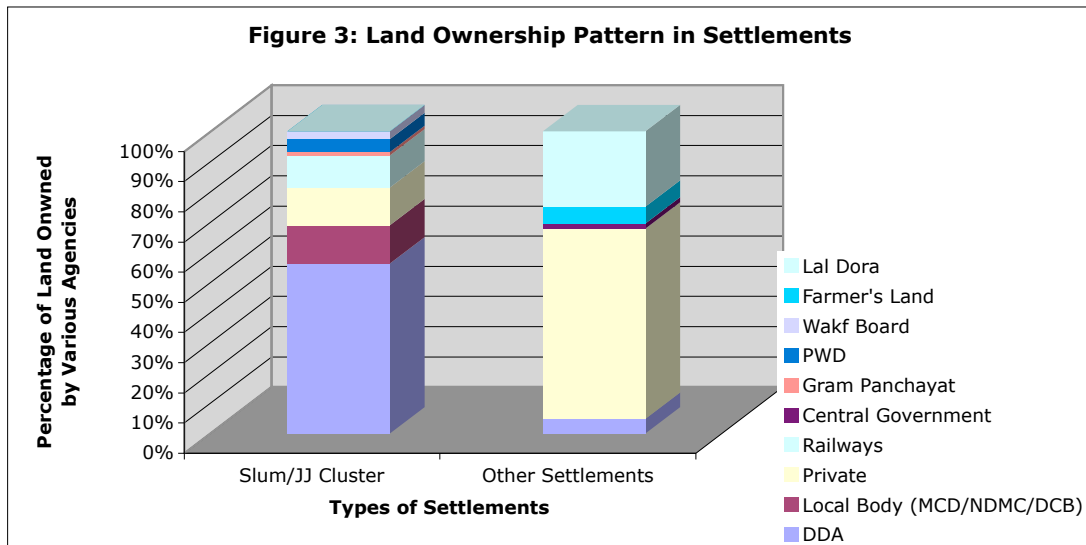


<sup>46</sup> The analysis for Resettlement Colony may not be very accurate as the sample size is relatively small.

## Tenability and Tenure

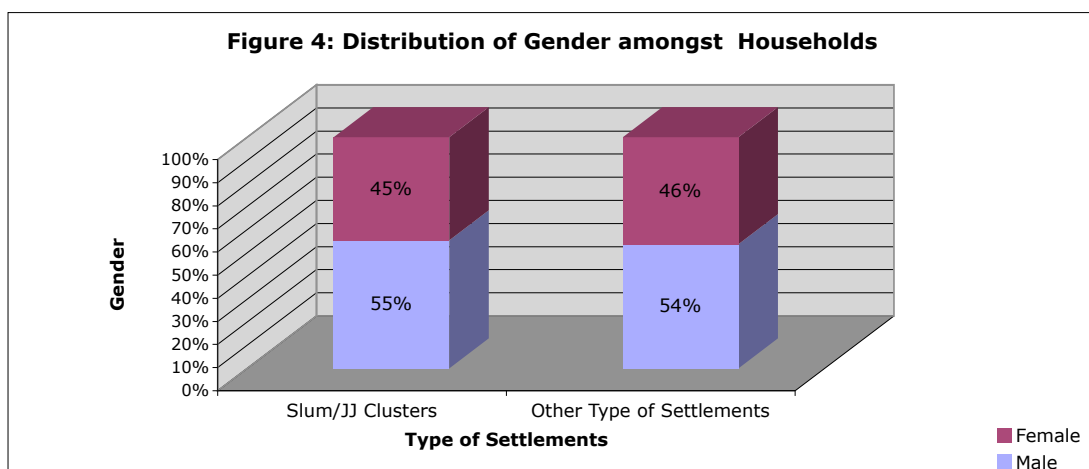
Slum/JJ clusters are predominantly residing on government land. Of this, 51 percent is owned by DDA and 11 percent by local bodies. 10 percent of the land belong belongs to Railways and 11 percent is private land.

In UNRC, 83 percent of the respondents did not respond to queries on the land ownership. The situation was similar in Urban and Rural Villages with over 30 percent of the respondents not stating their land ownership. However, of the households, which responded, the dominant owner in UNRC and Rural Villages is private, accounting for 14 and 39 percent of the land respectively. In Urban Villages, 48 percent of the land falls under Lal Dora and 17 percent of the land is private.

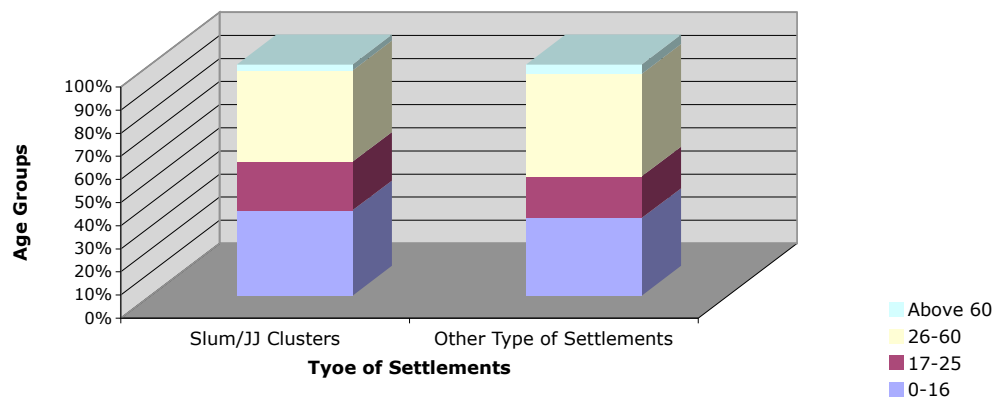
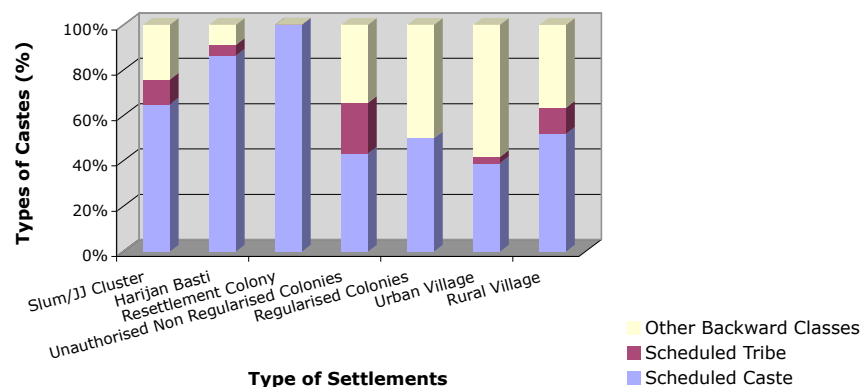


## Demographic Profile of the Settlements

The total population of 1500 household surveyed is 7721, where male/female ratio is 55:45. Around 40 percent of the population falls under the working age-group of 26-60 as evident from Figure 5. The average family size is 5.14. The dominant religion in all settlements is Hinduism.

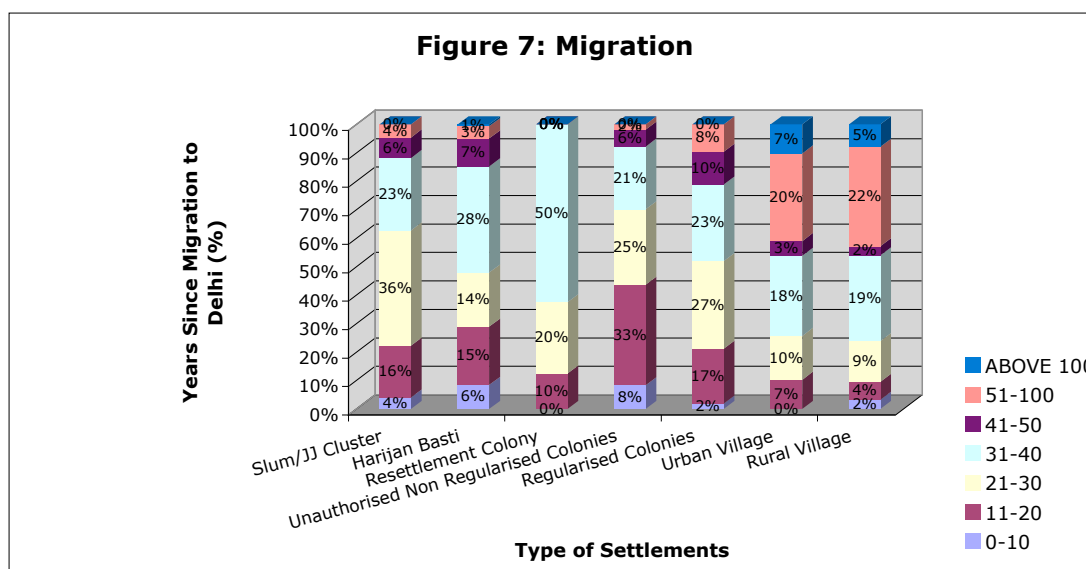




**Figure 5: Distribution of Age amongst Household Members****Figure 6 : Caste-Based Profile of Settlements**

In Slum/JJ Clusters 60 percent of the population migrated to Delhi in 1970-80's. Migration during this period in other settlements like Harijan Basti, UNRC and URC varies from 40-50 percent.

In the last ten years, the percentage of migrants in Slum/JJ Clusters, Harijan Basti and UNRC is 4 percent, 6 percent and 8 percent respectively. This indicates that migrants with some affordability prefer to live in better sites.



## Income and Expenditure

The average household income per month in Slums/JJ Cluster is low at Rs 6630 when compared with other type of settlements where the income ranges from Rs. 7700 - Rs. 13000, indicating a wide inequity in family earnings and affordability. UNRC has the highest average household income per month.

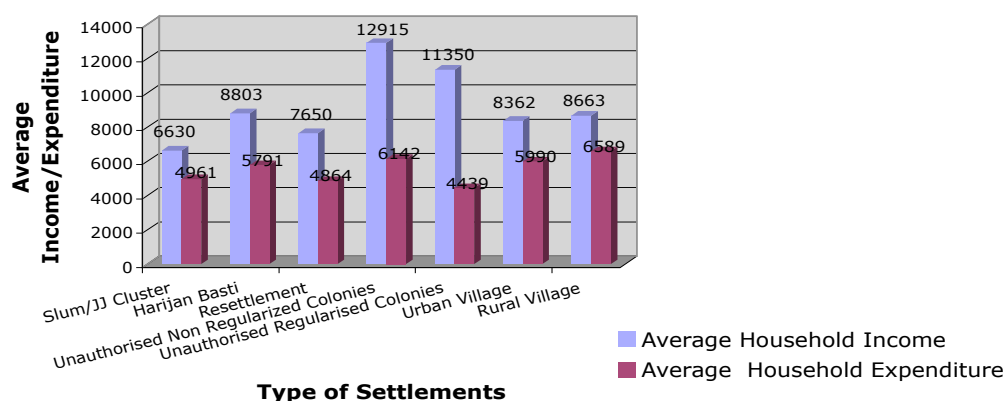
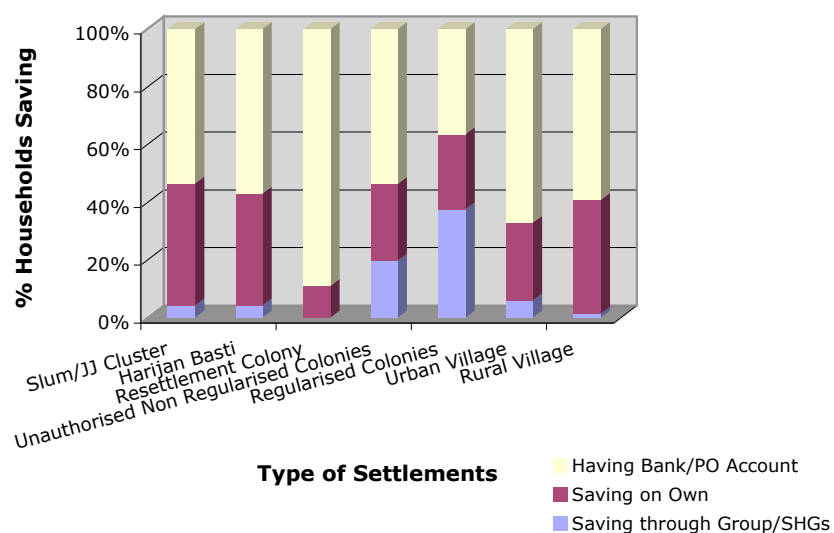
Expenditure on food, education, water, toilet use, electricity, medical expenses, fuel, debt, clothing and miscellaneous expenses have been included in the analysis to enable an understanding on the average monthly expenditures of a household. However, expenses on water and toilet use are the key heads to be delved into for this study.

1-2 percent of expenditure in all type of settlements is spent on procuring water. Slum/JJ Cluster, URC and Urban Villages also spend another 1-2 percent on toilet facilities. For poor families, this amounts to an average Rs264 per month.

## Savings

The gap between income and expenditure is narrow in Slum/JJ Cluster and widest amongst UNRC and URC. Households in UNRC and URC also save more as 27 percent of the households in UNRC and 60 percent in URC save through SHGs and other saving groups as compared to Slum/JJ Clusters where only 5 percent of the people are a member of any saving group.

However, access to bank/PO accounts is low in URC and Slum/JJ Cluster as compared to other settlements where 70-90 percent of households own a formal account.

**Figure 8: Average Household Income and Expenditure****Figure 9: Modes of Saving in Settlements**

### 6.5.1 APL/BPL Status

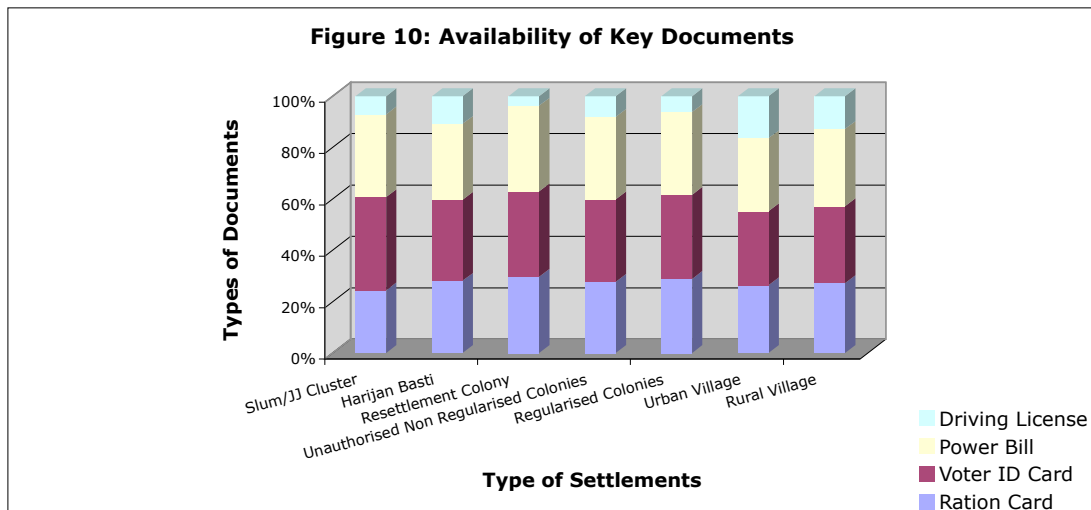
*As per Income:* As per Planning Commission, the poverty line for Delhi is evaluated at Rs. 542 per capita per month. Normally, income is understated, but in the case of settlements in Delhi, the income stated by the households is much above the poverty line threshold.

**Table 6.1: Average Family Income**

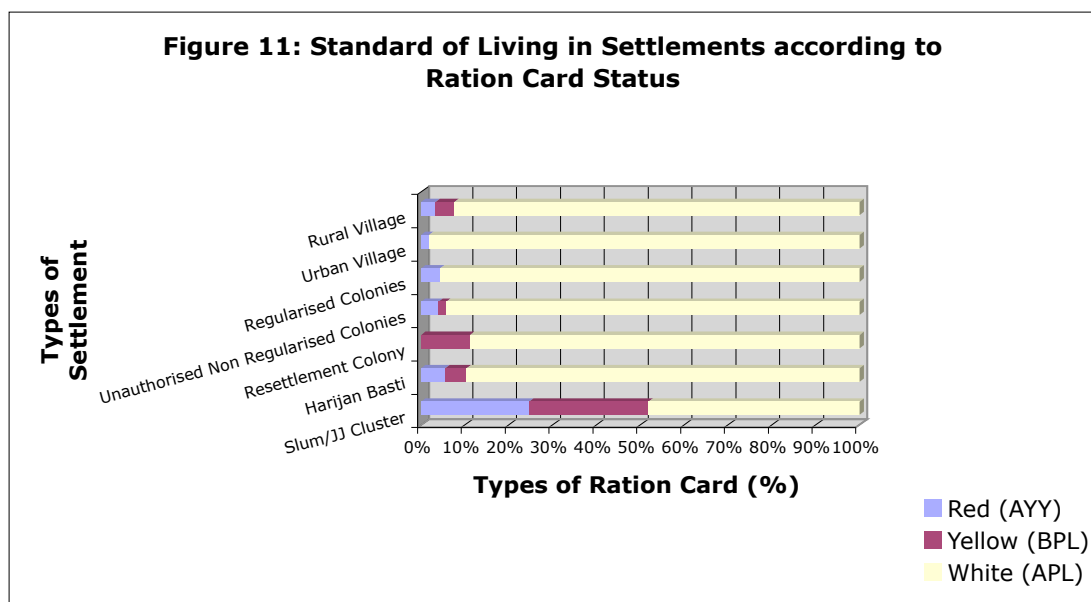
	Slum/JJ Cluster	Harijan Basti	Resettlement Colony	Unauthorised Non Regularised Colonies	Unauthorised Regularised Colonies	Urban Village	Rural Village
<b>Average Per Capita Income (at a family size of 5.14)</b>	1326	1761	1530	2583	2270	1672	1733

*As per Ration Card:* 62 percent of the households in Slum/JJ Cluster have a ration card while in all other settlements 80-85 percent of the households own a ration card. Despite reported incomes above poverty line, 51% households in Slum JJ cluster possess red/yellow ration cards whereas the same is as low as 6% in other settlements.

Other documents like power bill and driver's license, reflective of the social status of households were documented. The availability of these documents is lower in households' residing in Slum/JJ Cluster as compared to other settlements.



About half (48%) households in Slum/JJ Cluster are Above Poverty Line, while in all other settlements the percentage of Above Poverty Line households ranges from 77-92 percent. Below Poverty Line households in Slum/JJ Clusters are significantly higher at 52 percent as compared to 2-10 percent in all other settlements



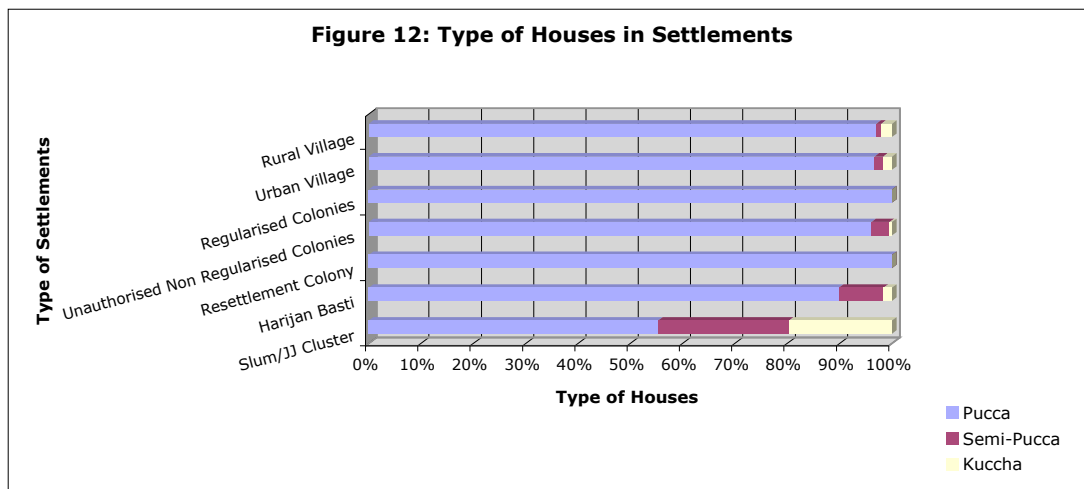
*As per Households perception:* While probing into the poverty status of people during data collection, majority of the respondents perceived themselves to be in the BPL category. This may be due to a possibility that the household

expenditures are high thus curtailing the capacity for saving.

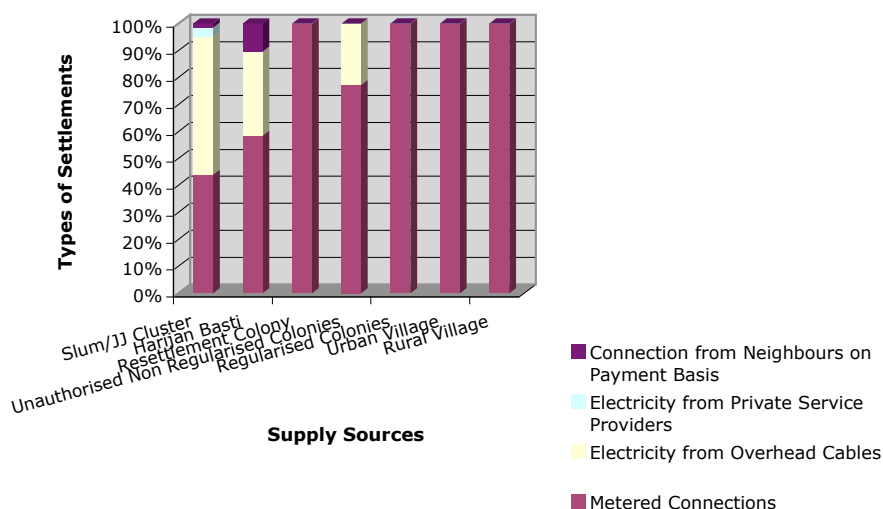
## Housing

55 percent of the households in Slum/JJ Cluster have pucca houses as compared to other settlements where 88-100 percent of the houses are pucca, denoting the standard of living. In all settlements over 90-100 percent of the houses are owned by the respondent and 82-100 percent have ownership papers of the house.

Predominantly, houses in all settlements are used only for residential purposes only. Insignificant number of households has reported commercial use of the property.

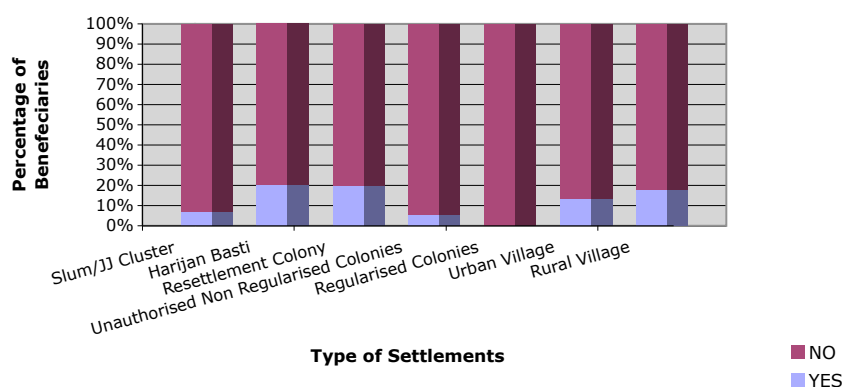


Apart from pucca houses, the settlements other than Slum/JJ cluster also reports almost 100% access to metered power connections in the homes. However, only 66 percent households in Slum/JJ Clusters have metered connections. Various respondents on verification, also responded in the affirmative to other sources of electricity like (a) connection from overhead cables (b) connection from neighbour and (c) connection from private service providers. Slum/JJ clusters, Harijan Basti and UNRC have reported 76, 50 and 29 percent dependence on overhead cables. Harijan Basti has also reported a 17 percent dependence on connections from neighbours on payment basis.

**Figure 14: Electricity Supply in Settlements**

## Government Schemes for the Urban Poor

Benefits from government schemes in all type of settlements have been very low. Only 1 percent of respondents in Slum/JJ Cluster and Harijan Basti have benefited from any low cost sanitation schemes. Respondents who agree to benefits of government scheme are mostly availing pension schemes. Only 1-2 percent of the households in Harijan Basti and UNRC have benefited from the *LADLI scheme* for girl child education.

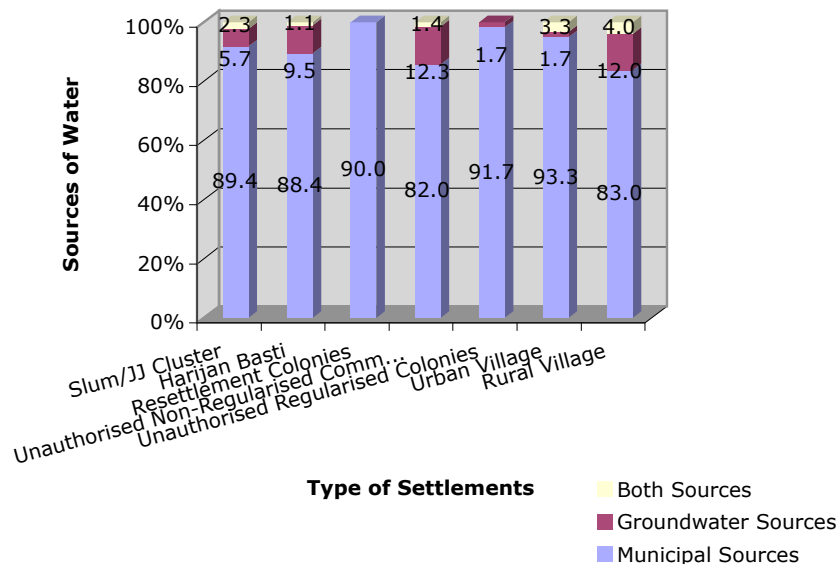
**Figure 13: Percentage of Households Benefitting from Government/ULB Schemes**

## Access to Water Supply

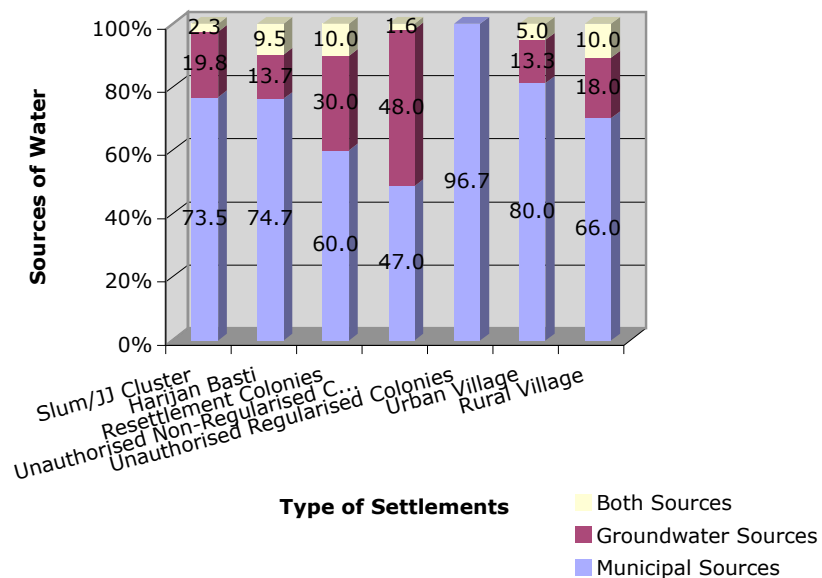
The population in poor settlements of Delhi resort to several sources to meet their water needs – tap in the house, community stand post, Tube well/Bore well, hand pumps, tankers, open well, local taps on roads and other public spaces, buying water etc. Despite the multiplicity of sources, the core supply source for

all these is either municipal supplies or groundwater. Figure 15 and 16 below depicts how Delhi's poor access water for drinking and cooking and other uses through these available sources.

**Figure 15 : Sources of Water Used for Drinking and Cooking**



**Figure 16: Sources of Water used for Other Purposes**



**Drinking and Cooking:** 80-90 percent of the households in all types of settlements resort to municipal sources of water for drinking and cooking. Dependence on groundwater sources in most settlements ranges from 6-12 percent, where UNRC and Rural Villages fall in the higher range. Both sources of water are not mutually exclusive. 1-3 percent of the households in all settlements except Resettlement Colony use both sources. In Resettlement Colony 10 percent of the households use both sources.



**Table 7.1 Dominant Water Supply sources**

Type of Settlement	Slum/JJC	HB	RCs	UNRCs	URCs	UV	RV
<b>Dominant Municipal Source for Drinking and Cooking</b>	Community Stand post	Tap in the House	Tap in the House	Tap in the House	Tap in the House	Tap in the House	Tap in the House
<b>Dominant Groundwater Source for Drinking and Cooking</b>	Public Hand pump	Tube well/Bore well	--	Tube well/Bore well	--	--	Tube well/Bore well

**Other Purposes:** As seen in the table below Municipal Sources are dominant in all type of settlements, except UNRC for drawing water for other domestic uses like bathing, washing, cleaning etc. In UNRC the dependence on groundwater sources marginally higher than municipal sources whereas in URC the households are 100 percent dependent on municipal sources. 10 percent of the households in Harijan Basti, Resettlement Colony and Rural Villages use both sources.

**Table 7.2 Dominant Municipal sources for other uses**

Type of Settlement	Slum/JJC	HB	RCs	UNRCs	URCs	UV	RV
<b>Dominant Municipal Source for Other Uses</b>	Community Stand post	Tap in the House	Tap in the House	Tap in the House	Tap in the House	Tap in the House	Tap in the House
<b>Dominant Groundwater Source for Other Uses</b>	Public Hand pump	Tube well/Bore well	Public Hand pump	Private Hand pump	--	Private Hand pump	Private Hand pump

In the following section, the report would further assess each source of water on reliability in terms of assuredness that a basic minimum quantity and quality of water will be available to households to meet the basic needs of consumption and hygiene. To assess reliability, each source of water has been screened on the following parameters:

- Timing, duration and frequency of supply: For the study, timing is defined as the time of the day when the water supply is received. Duration is defined as the number of hours of supply per day. Frequency of water supply has been assessed at two levels – daily and weekly. The frequency of supply is defined as the number of times a household receives water in a day/week.
- Quantity: Quantity has been defined as the number of 10 liter buckets a household is able to fill everyday from a particular source. It also captures the household's perception through a query on adequacy of water. This is to understand the gap between demand and supply.
- Quality: Quality of water supply has been assessed through subjective evaluation in terms of pressure of supply and the quality of water

received. Both the quality parameters have been measured on a scale of Good to Poor.

- Distance and time: This parameter has been used for all community sources like stand post, public Hand pump and tanker. The parameter will measure the distance traveled from home to reach the source of water. Time has been calculated at two levels – traveling time from home to source and time spent in collecting water at source.

Against each parameter the dominant replies of the respondents have been documented in a table format to provide a succinct picture of the prevailing situation, complemented by phrases on key observations. Detailed responses have been tabulated in the Annexures for reference.

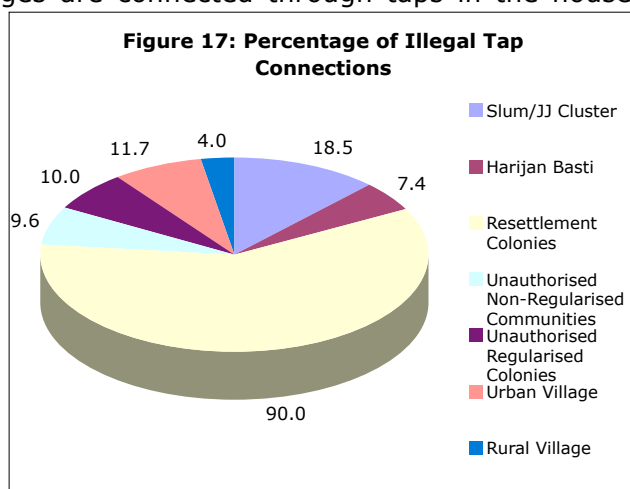
[For analysis, the report would include tap in the house, community stand post, and tanker supply (DJB and private) in municipal sources of water and Tube well/Bore well, Hand pump (both public and private) and open well in groundwater sources.]

## Municipal Sources of Water

### 7.1.1 Tap in the House

Tap in the house is a dominant municipal source in all type of settlements except Slum/JJ Cluster. 80-90 percent of the population in Harijan Basti, Resettlement Colony and Urban and Rural Villages are connected through taps in the house. Percentage of tap in the house is comparatively lower in URC and UNRC at 53 and 34 percent respectively. In Slum/JJ Cluster it is even lower than 30 percent.

However, households using tap in the house agree that there is a considerable number of illegal connections. In Resettlement Colony the percentage is as high as 90 percent, whereas in other type of settlements the percentage of illegal connections varies from 4-18 percent. A large percentage of respondents did not respond to the legal/illegal status of their connection especially in Slum/JJ Cluster (58%), UNRC (62%) and URC (62%), thus the total of the percentages in the pie chart does not add upto 100.



- Timing, Duration and Frequency:* It can be inferred from the tabulated analysis below that all type of settlements in Delhi are receiving water on a daily basis with a replenishment of water supplies twice a day. Also, most settlements are receiving water for at least upto 2 hours of duration at a convenient time of the day.

In Harijan Bastis, Rural Villages and Resettlement Colonies, 11-20 percent of the households have confirmed that taps are providing 24-hour water supply, thus showing potential areas for scaling up the services to better levels.

**Table 7.3: Water supply parameters – Tap in House**

Parameters	Slum/JJC	HB	RCs	UNRCs	URCs	UV	RV
<b>Timing</b>	All Day	Morning/Evening	No Fixed Time	Morning/Evening	Morning	Morning/Evening	No Fixed Time
<b>Duration</b>	24 hours	3-4 hours	0-2 hours	5-10 hours	3-4 hours	3-4 hours	0-2 hours
<b>Daily Frequency</b>	Twice a Day	Twice a Day	Twice a Day	Twice a Day	Twice a Day	Twice a Day	Twice a Day
<b>Weekly Frequency</b>	Daily	Daily	Daily	Daily	Daily	Daily	Daily

- b. *Quantity of Supply:* The demand side analysis of water supply in all types of settlements shows an encouraging trend, where majority of the households perceive that the current levels of water supply is adequate.

However the response to adequacy is contradicted by the supply-side responses to actual quantity available to households. Except, Resettlement Colony, majority of the households in all other type of settlements receives water upto 5 buckets (50 liters) per day<sup>47</sup> whereas the Master Plan of Delhi, 2001 recommends 265 liters per capita per day as the basic minimum requirement of water for cleaning and consumption.

**Table 7.4: Quantity of water supply – Tap in House**

Parameters	Slum/JJC	HB	RCs	UNRCs	URCs	UV	RV
<b>Quantity (no. of 10 liter buckets)</b>	0-5	0-5	41-50	0-5	0-5	0-5	0-5
<b>Adequacy</b>	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate

- c. *Quality of Supply:* Majority of the households have agreed to good pressure and quality of water supply. But the percentage of households, which feel that the pressure of water in tap supply is bad ranges from 20-40 percent. (refer Annexure 3.6)

Similarly, percentage of responses for good quality of water supply lingers around 50 percent in all types of settlements, except UNRC. This implies that the other half of the sample size rate the quality of water received in a range of average to very poor.

**Table 7.5 Water quality and pressure – Tap in House**

Parameters	Slum/JJC	HB	RCs	UNRCs	URCs	UV	RV
<b>Pressure</b>	Good	Good	Bad	Good	Good	Good	Good
<b>Quality</b>	Good	Good	Good	Good	Good	Good	Good

<sup>47</sup> The slab 0-5 measures number of 10 liters buckets filled per day by a household.

### 7.1.2 Community Stand post

Slum/JJ Clusters have a dependence of upto 60 percent on community stand posts, followed by URC at 30 percent and UNRC at 14 percent. The rest of the settlements have negligible or no dependence on community stand posts.<sup>48</sup>

Community stand post is mostly located within the settlement area in all the three settlements – Slum/JJ Clusters, URC and UNRC. 46 percent of the respondents in Slum/JJ Cluster said that their tensions like quarrelling for filling more water or filling water first during rush hours.

- a. *Timing, Duration and Frequency:* All settlements with significant dependence on community stand post are receiving water at least once, daily in the morning hours. The minimum duration in Slum/JJ Clusters is one hour while in UNRC and URC it is 3 hours and above going upto 24 hours in the case of UNRC. (Refer Annexure 3.7)

Table 7.6 Timing, duration and frequency of water supply – Community Standpost					
Parameters	Slum/JJC	HB	UNRCs	URCs	UV
<b>Timing</b>	Morning/Evening	All Day/No Fixed Time	Morning/Evening	Morning	Morning
<b>Duration</b>	3-4 hours	11-15 hours	3-4 hours	3-4 hours	3-4 hours
<b>Daily Frequency</b>	Twice a Day	Other	Once a Day	Twice a Day	Twice a Day
<b>Weekly Frequency</b>	Daily	Daily	Daily		Daily

- b. *Quantity of Supply:* Slum/JJ Clusters and URC have acknowledged that the water supply is adequate. This is because a large number of households are receiving upto 10 buckets (100 liters) of water per day. (Refer Annexure 3.7). In UNRC the supply is inadequate as nearly 50 percent of the respondents are receiving upto 5 buckets of water a day and another 30 percent fall in the 6-10 slab.

Table 7.7 Quantity and adequacy – Community Standpost					
Parameters	Slum/JJC	HB	UNRCs	URCs	UV
<b>Quantity (no. of 10 liter buckets)</b>	0-5	11-15	0-5	6-10	0-5
<b>Adequacy</b>	Adequate	Adequate	Inadequate	Adequate	Inadequate

- c. *Quality of Supply:* In Slum/JJ Clusters the quality aspects are questionable, as 46 percent of the households have claimed that the pressure is bad and around 47 percent of the households perceive quality of water is in the range of average to very poor. In UNRC and URC the percentages for quality aspects are encouraging.

<sup>48</sup> The parameter analysis for community stand post will only focus on the responses received from Slum/JJ Cluster, URC and UNRC as the other settlements have limited usage of the source.

<b>Table 7.8 Water quality and pressure – Community standpost</b>					
<b>Parameters</b>	<b>Slum/JJC</b>	<b>HB</b>	<b>UNRCs</b>	<b>URCs</b>	<b>UV</b>
<b>Pressure</b>	Good	Good	Good	Good	Bad
<b>Quality</b>	Good	Good	Good	Good	Average

- d. *Distance and Time:* With regard to the traveling time from home to community stand post an average time of upto 10 minutes apply to Slum/JJ Cluster and URC. However, in UNRC, nearly 35 percent of the respondents have specified a time period of 15-60 minutes.

The collection time of water is also high, especially in Slum/JJ Cluster and URC resulting in high time cost of water, given the small quantities that the households are able to fetch.

<b>Table 7.9 Water supply parameters – Community Standpost</b>					
<b>Parameters</b>	<b>Slum/JJC</b>	<b>HB</b>	<b>UNRCs</b>	<b>URCs</b>	<b>UV</b>
<b>Distance from Home to Source</b>	0-20 Meters	0-20 Meters	51-100 Meters	0-20 Meters	0-20 Meters
<b>Time Taken to Walk to the Public Source</b>	0-5 Min	0-5 Min	0-5 Min	0-5 Min	0-5 Min
<b>Time Taken to Collect Water at Source/Day</b>	51-60 Min	20-30 Min	21-30 Min	51-60 Min	

### 7.1.3 Tanker Supply

Tanker supply in the settlements is either through Delhi Jal Board (DJB) or private contractors, where latter is less prevalent. In both cases tanker supply is largely a community source, until and unless an individual calls for a tanker for special occasions like marriages etc.

Tanker supply is most prominent in UNRC with a 30 percent dependence ratio amongst all other sources of water (both municipal and groundwater sources). It is also used in URC and Harijan Basti.

Respondents in all three type of settlements have commonly reported that they take water from tanker every time it comes, indicating that its not an alternate/subsidiary source nor very effective in meeting water needs. Also, generally no payments are made for the tanker supply.

- a. *Timing, Duration and Frequency:* As the tabulated analysis below denotes, tanker supply in settlements dependent on it, is highly variable and intermittent. There are no fixed timings for the supply and the frequency of supply is low at two times a week.

<b>Table 7.10 Timing, duration and frequency of water supply – Tanker</b>			
<b>Parameters</b>	<b>HBs</b>	<b>UNRCs</b>	<b>URCs</b>
<b>Timing</b>	Morning/Evening	No Fixed Time	No Fixed Time
<b>Duration</b>	5-10 hours	0-2 hours	3-4 hours
<b>Weekly Frequency</b>	Daily	Twice a Week	Twice a Week

- b. *Quantity of Supply:* Since the supply frequency is low, quantity collected per trip is also low and inadequate to meet the needs of the households.

<b>Table 7.11 Quantity &amp; adequacy – Tanker</b>			
<b>Parameters</b>	<b>HBs</b>	<b>UNRCs</b>	<b>URCs</b>
<b>Quantity</b>	0-5	0-5	0-5
<b>Adequacy</b>	Adequate	Inadequate	Inadequate

- c. *Quality of Supply:* 88 percent of the respondents in UNRC and 100 per cent in URC have agreed that the water quality is good. The response for pressure of water is the similar.

<b>Table 7.12 water quality and Pressure – Tanker</b>			
<b>Parameters</b>	<b>HBs</b>	<b>UNRCs</b>	<b>URCs</b>
<b>Pressure</b>	Good/Bad	Good	Good
<b>Quality</b>	Very Poor	Good	Good

- e. *Distance and Time:* Most respondents in UNRC replied that the tanker comes to the same streets while in URC it stands at an other street. The Average time spent at the source for collecting water in all three settlements is around or over 30 minutes, where in UNRC, it sometimes also stretches beyond 2 hours. 68 percent of the households in UNRC are able to procure only upto 5 buckets and another 20 percent manage 5-10 buckets of water in this duration. Thus the time cost of water is extremely high in the case of tanker supply.

<b>Table 7.13 Distance and time taken to reach water source – Tanker</b>			
<b>Parameters</b>	<b>HBs</b>	<b>UNRCs</b>	<b>URCs</b>
<b>Distance from Home to Source</b>	21-50 meter	21-50 Meters	--
<b>Time taken to Collect Water Per Trip</b>	16-30 Min	31-60	16-30 Min

## Electricity and Water Supply

All types of settlements have reported nearly 95 percent access to electricity. Of these metered connections in all settlements, except Slum/JJ Clusters is reported above 95 percent. In Slum/JJ Clusters the count of metered connection stands at 66 percent.

60-70 percent households in Harijan Basti, Resettlement Colony, UNRC, Urban and Rural Villages have electric water motors. The percentage is comparatively low in Slum/JJ Cluster at 17 percent.

Although power supply affects household income and has health implications, but given the scope of this study it could not be elaborated further.

## Groundwater Sources

### 7.3.1 Tube well/Bore well

Access to water through Tube well/Bore well is prevalent in Rural Village (8%) UNRC (7%) and Harijan Basti (4%). A small section in Slum/JJ Cluster also draw water from this source. In Rural Village most of the Tube well/Bore well are private and provided by DJB, while in UNRC they are both private and public.

The depth at which groundwater is available is approximately 400 ft. in Rural Village and ranges from 100-150 ft. in UNRC.

Factors of timing, duration, frequency and quality are at the discretion of the households or dependent on the availability and use of electricity for drawing water through motor.

- a. *Quality of Supply:* The pressure at which the water is received is governed by the water motor being used. The quality of water varies in type of settlements, generally ranging from average to very poor, except for rural villages where 62 percent of the respondents perceive it to be good.

Table 7.14 Water quality and pressure – Tube well/Bore well				
Parameters	Slum/JJC	HBs	UNRC	RV
Pressure	Good	Good	Good	Good
Quality	Poor	Average	Very Poor	Good

### 7.3.2 Personal Hand pump

Personal Hand pump is being used in UNRC (4%), Rural Village (3%), URC and Urban Village (2%) and Slum/JJ Cluster (5%). It is mostly an individual source of supply. It is shared in the form that neighboring households draw some water from it on mutual understanding.

Like Tube well/Bore well, the factors of timing, duration, frequency, quantity etc do not pose a constraint as the individual is free to draw water as per need. Personal Hand pump is one of the most cost effective sources for a household given the fact that it has no electricity cost and is easy to maintain. However the environmental cost this source poses in terms of depletion of groundwater is considerable and often neglected.

- a. *Quality of Supply:* Households in URC and Urban Village are satisfied with the quality water. In other type of settlements the perception of water quality ranges from average to very poor, where almost 60 percent of the households in Slum/JJ Cluster and UNRC perceive it as poor/very poor. This may be attributable to the



depth at which the water is drawn – 10-60--. This generally the depth at which most pipe networks for sewerage system intercept, thus perpetrating seepage because of the high leakages in the system.

<b>Table 7.15 Water quality and pressure – Personal Hand pump</b>						
<b>Parameters</b>	<b>Slum/JJ Cluster</b>	<b>Harijan Basti</b>	<b>Unauthorized Non Regularized Colonies</b>	<b>Regularized Colonies</b>	<b>Urban Village</b>	<b>Rural Village</b>
<b>Pressure</b>	Good	Good	Good	Good	Good	Good
<b>Quality</b>	Poor	Poor	Poor	Good	Good	Average

### 7.3.3 Public Hand pump

Public Hand pumps are used by 3-4 percent households in Slums/JJ Clusters and Harijan Bastis but are not popular in other settlements. In Slum/JJ Clusters it is provided by MCD or DJB.

The source offers the convenience of 24 hour supply at no cost, in a shared arrangement within the community.

- a. *Quality of Supply:* The percentage of households in Slum/JJ Clusters perceiving the water quality as good is low at 15 percent.

<b>Table 7.16 Water quality and pressure – Public Hand pump</b>		
<b>Parameters</b>	<b>Slum/JJ Cluster</b>	<b>Harijan Basti</b>
<b>Pressure</b>	Good	Good
<b>Quality</b>	Poor	Good

- b. *Distance and Time:* The distance traveled by households in Harijan Basti to access water through public hand pump ranges from 50 meters to 1 km according to which the time taken to walk to the source ranges from 10 min-30 min. This time is topped by the time spent in collecting water at source, which is around 30 minutes. In sum, the time spent on accessing water through public Hand pump is high, even though these could be accessed through the day.

In the case of Slum/JJ Cluster the time spent in collection is high at 60 minutes, especially given that the quality of water is also rated as poor.

<b>Table 7.17 Water supply parameters – Public Hand pump</b>		
<b>Parameters</b>	<b>Slum/JJ Cluster</b>	<b>Harijan Basti</b>
<b>Distance from Home to Source</b>	21-50 meter	1 Km
<b>Time Taken to Walk to the Public Source</b>	0-5 Min	30 Min
<b>Time taken to collect water at source per day</b>	51-60/61-90 Min	21-30 Min

### 7.3.4 Open Well

An insignificant 1 percent of the households in Slum/JJ Cluster, Harijan Basti and UNRC use open well for drawing water.

## Purchasing Water

In Delhi and other cities of India, buying water for drinking and cooking has emerged as an option over the years, given the unreliability of municipal supplies, poor quality of water and rampant contamination of groundwater sources. However it is used more in the upper middle and middle income classes given the cost factor.

In the settlements surveyed for this study, a small percentage of households in most settlements buy water. Water is bought through informal sources supplying water in 'Mayur Cans'.

**Table 7.18 percentage of HH buying water**

Parameter	Slum/JJ Cluster	Harijan Basti	Unauthorized Non Regularized Colonies	Unauthorized Regularized Colonies	Urban Village
% of HH buying water	2.1%	2.1%	3.6%	1.7%	1.7%

## Collection, Storage, Treatment and Water Hygiene

This section will assess some of the specific parameters related to collection, storage and treatment of water with water hygiene as the common thread of analysis. The research questionnaire has been designed to collect information mainly on the behavioral practices relating to collection, storage and treatment to understand their linkage with health and hygiene with a gender perspective in mind. Thus to maintain focus, quantitative information on collection storage and treatment is limited.

It should be noted that the responses received for this section are lesser in number as compared to the previous sections. However, the data has been used in percentages to enable cross tabs with other parameters and reveals interesting anomalies with regards to linkages between gender, behaviour, health and illness.

### 7.5.1 Collection

In all types of settlements women play a crucial role in collection of water. It has been observed that in settlements having larger dependence on community sources of water like community stand post, public Hand pump or tanker supply, the role of men in collecting water is enhanced. For instance in Slum/JJ Cluster where community stand post is the dominant source of supply, the percentage of men involved in collection of water is high. The case of UNRC and URC is similar where tanker supply is prevalent.

**Table 7.19 Water collection**

<b>Parameter</b>	<b>Slum/ JJC</b>	<b>HB</b>	<b>RC</b>	<b>UNRC</b>	<b>URC</b>	<b>UV</b>	<b>RV</b>
<b>Responsibility for Water Collection</b>	Women	Men/ Women	Women	Women	Men/ Women	Men/ Women	Men/ Women

The collection time is also analogous to the source of water. Although in all settlements the dominant reply for time spent on collection is less than one hour but percentages for more than one hour are higher in case of UNRC (22%) and Slum/JJ Cluster (10%) where community sources like tanker supply and community stand post are widespread.



### 7.5.2 Treatment

Choice of treatment facilities in a household is determined by factors like quality of water from source, education and hygiene awareness (especially amongst women) and cost of treatment.

Although municipal sources (the dominant source in all settlements) are theoretically considered a reliable source in terms of quality, there are various reports of water contamination in Delhi. In such a scenario, settlements like Slum/JJ Cluster and UNRC where community stand post and tanker supply are used, only 15-20 percent of the households treat water. The situation is same in Urban and Rural Villages. The percentage is slightly higher at 28 in Harijan Basti followed by URC at 40 percent. Resettlement Colony has the highest percentage of households treating water at 60 percent.

The limited number of households, which responded to the query on ways of treating water, uses the following types of water treatments – boiling, chlorination, filtration and sedimentation. Methods of filtration vary from electric water filters to tap filters or simple filtration through muslin cloth, although the former is widely used as evident from the tabulated analysis below.

In settlements like Slum/JJ Cluster and Resettlement Colony where female illiteracy levels are high at 21 and 50 percent respectively, use primitive methods

of treatments like sedimentation. However, in the case of URC, there emerges an interesting anomaly - female illiteracy is as high as 47 percent and females educated till senior secondary level are highest amongst all settlements at 35 percent and the dominant treatment method is electric water filter.

**Table 7.20 Water Treatment Methodology**

Parameter	Slum/ JJC	HB	RC	UNRC	URC	UV	RV
<b>Method of treatment</b>	Sedimentation	Electric Water Filter	Sedimentation	Electric Water Filter	Electric Water Filter	Electric Water Filter	Electric Water Filter

### 7.5.3 Storage

The most common storage containers used in all types of settlements are pots, drum, plastic bottle, buckets, cans etc. More than 80 percent of the households cover these containers.

Since most of the houses are pucca, 70-90 percent of the respondents in all types of settlements also agreed that they use large overhead plastic tanks for storage. All these sources are relatively safe storage containers if covered and maintained properly with regular cleaning.

Some households in Slum/JJ Cluster and UNRC are using pits dug in the ground outside the house to store water. This is an unsafe storage method as the walls of storage container is most often loose mud, which makes it difficult to clean the container often, and is a constant source of water contamination. As evident in the section above, the source of water used impacts storage as well. Due to dependence on community sources, reliability of water is not assured which motivates households to resort to as many sources of storing water as possible within the given income. Pits, being a cost effective technique, easily serves as an additional storage source to stock more water.

Another behavioral aspect related to storage of water is – how is the water taken from the storage container for end consumption, particularly for drinking and cooking because of its linkage to hygiene, health and illness.

Households have responded that they use the following ways to take water – through ladle, tumbler, tap and direct pouring from container. Of these the use of tumbler is most unsafe because of the contact with hands during dipping. Instances of households using tumbler has been found in Slum/JJ Cluster, Harijan Basti, UNRC and URC.

**Table 7.21 Methods of taking out water from Water Container**

Parameter	Slum/ JJC	HB	RC	UNRC	URC	UV	RV
<b>How is water taken from Storage Container</b>	Through Ladle	Through Ladle	Through Ladle/Pouring	Through Ladle	Through Ladle	Through Ladle	Through Ladle

## 7.6 Water Supply and Health Risks

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**7.6.1 Physical Location of Slums and Health Risks**

Settlements like Slum/JJ Cluster, Urban and Rural Village reporting 30-40 percent of illnesses in the last 30 days are mostly situated along high health risk vicinities along nullah/large drain, river/river bed/ponds and railway line.

UNRC and URC have reported 20-25 percent illness where the key risk for the former is arising from exposure to nullah/large drains.



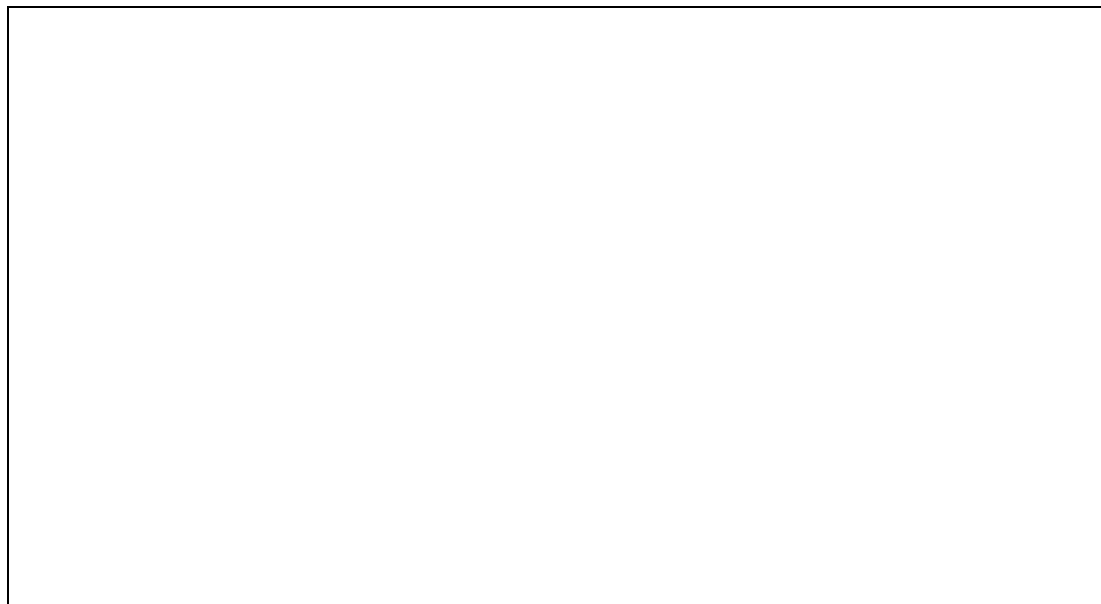
Acute Respiratory Infection (ARI)/Cold and Cough/Fever is the most prevalent illness amongst all settlements where settlements situated along nullah/large drains have reported the highest percentages.

Incidence of Typhoid and Malaria are visible in Slum/JJ Cluster, Harijan Basti UNRC and Urban Village, attributable to exposure to contaminated water with feces because of nullah/large drains.



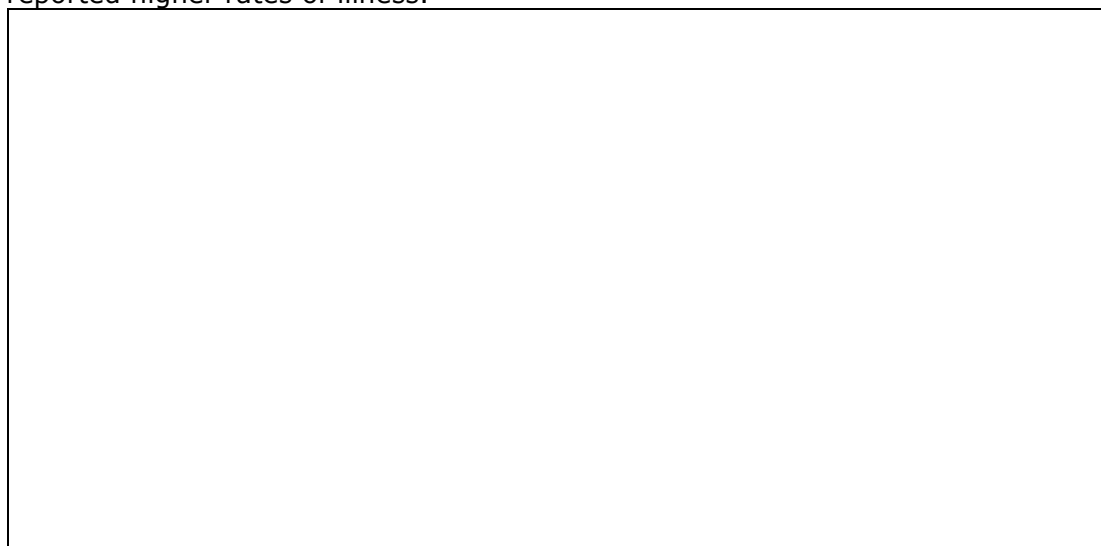
### 7.6.2 Source of Water for Drinking and Cooking and Health Risks

The high incidence of diarrhea, dysentery and gastroenteritis in UNRC and URC may be attributed to dependence on relatively unsafe sources of water for drinking and cooking like community stand post and DJB Tanker. In Slum/JJ Clusters the dependence on community stand post is even higher than UNRC and URC at 60 percent but cases of diarrhea, dysentery and gastroenteritis are lower.



### 7.6.3 Treatment of Water and Health Risks

Figure 22 highlights the fact that settlements, which do not treat water, have reported higher rates of illness.



70 percent of the households in Slum/JJ Cluster and Urban and Rural Village do not treat water and have thus reported highest rates of illness of above 30 percent

#### 7.6.4 Storage of Water and Health Risks

The implications of storage devices on health are well documented in water and sanitation literature and are an established fact. However, due to limited responses on the usage of pit, it would be premature to analyze the impact of pit storage on the health of the respondents in this study.

#### 7.6.5 Health Facilities

Of the respondents, which reported that the patients were taken for treatment, 60-70 percent depend on government facilities except for residents in UNRC where private doctors are more prevalent.

Government Health Facilities: 70-80 percent of the respondents in Resettlement Colony and Rural Village confirmed that there are government health institutions in or near their settlements. 25-50 percent respondents have access to government health institutions in all other settlements except URC where the coverage reported is less than 5 percent.

Private Health Facilities: Around 35 percent of the respondents in UNRC and Rural Villages confirmed that there are private clinics in their vicinity. Rest of the settlements reported a 10-20 percent presence of private clinics.

### 7.7 Preferred Water Service

Households from Slum/JJ Cluster and UNRC have been forthcoming to state their preferences for alternative sources of water supply. This stems from the fact that a large part of the households in these settlements have to resort to community sources of water supply like stand posts and tankers, which are time-intensive and inconvenient.

72 percent of the households in UNRC and 53 percent of the households in Slum/JJ Cluster have stated tap in the house as their preferred option for water supply.

<b>Table 7.22 Preferred choice of water supply</b>				
<b>Parameter</b>	<b>Slum/ JJs</b>	<b>RCs</b>	<b>UNRCs</b>	<b>URCs</b>
<b>% of HH having access to Tap in the House</b>	29%	90%	34%	53%
<b>% of HH stating Tap in the House as their preferred choice of water supply</b>	53%	100%	72%	30%
<b>Willingness to Pay for tap connection (in Rs)</b>	560.00	180.00	1430.00	NA
<b>% of HH needing access to credit facilities for buying a tap connection</b>	19%	40%	5.7%	NA
<b>Willingness to Pay for Monthly Water Charges</b>	34.00	40.00	49.00	71

As per the water tariffs of DJB for domestic category, the average monthly bill of a household consuming a minimum of 20 kiloliter of water per month works out to be Rs 68, where Rs 40 is the monthly service charge and Rs 28 is the water tariff according to the prescribed increasing block tariff rates. In comparison to the monthly water charges, most settlements have shown willingness to pay up to at least 50 percent of the monthly water bill. It should also be noted that the water tariffs for domestic category do not offer any special rates for poor settlements, highlighting the fact that the subsidies are having limited benefit for the poor - neither the subsidies received by DJB on capital investment for



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increasing network coverage are improving access to piped supply for poor nor the tariff structure is offering incentives to poor. In such a scenario, if subsidized tariffs are offered to the poor, not only will they be able to afford the monthly bill for a tap connection, it will also increase revenue source for DJB through an enhanced customer base.

However, the issue of affordability of tap connection is not only confined to subsidized tariff rates but is also linked to the initial connection charge. In case of Delhi, the water connection charges are low and DJB also offers an option of installment payment for poor settlements. But often the cumbersome paperwork and time consumed in doing the rounds of the offices for processing the application discourages households. Also the associated costs of road cutting and engineering services etc increase the initial burden along with the speed money, which is commonly demanded.

Despite the above facts, 35 percent of the respondents in Slum/JJ Cluster, 60 percent in Resettlement Colony, 45 percent in UNRC and 17 percent in URC do not need credit to buy a tap connection. Thus affordability is not really an issue. If willingness to pay is tactfully matched with subsidy to work out a comprehensive plan for increasing the network of individual tap connections to the poor, easy access to water for all will be a possibility having positive impacts on other economic indicators of income, expenditure, productivity and health.

## The Hows and Whys of Water Connection Charges

### A BARRIER TO CONNECTING PEOPLE

A widely used benchmark for measuring affordability is that the monthly water and sanitation bill does not exceed 5% of the average household disposable income. However, this does not account for the initial cost of a water connection that is sometimes in the range of \$100 and above, often equivalent to 100% and more of urban poor households' monthly income.

Poor households in many places either are not able to afford the upfront payment of the full connection charge or to comply with additional administrative requirements, most notably a land title. Prohibitive connection charges present a real barrier and are being blamed for more people—particularly the poor—not being connected to piped water systems...

### ANATOMY OF A CONNECTION FEE

Connection charges are usually based on the size of the connection (i.e., the water meter); user category (e.g., domestic, industry); location of the property (i.e., within/outside city limits); and distance of the property to the nearest water main. Connection charges usually include a basic connection fee plus various add-on charges for physical facilities, labor, administrative fees, and other costs. Table 1 presents typical water connection fee components.

**Table 1: Water Connection Fee Components**

Physical Facilities	Labor	Administrative Fees
<ul style="list-style-type: none"> <li>Ferrules/main tapping tees</li> <li>Pipe from water main to individual meter</li> <li>Meter, and Stop taps and appurtenances</li> </ul>	<ul style="list-style-type: none"> <li>Pre-installation inspection</li> <li>Road cutting</li> <li>Connection work</li> <li>Plumbing</li> <li>Installation inspection</li> </ul>	<ul style="list-style-type: none"> <li>Application fee</li> <li>Availability fee</li> <li>Plumbing permits</li> <li>Deposit against future charges</li> </ul>

Source: Cranfield University. 2006. Charging to Enter the Water Shop.

A 2007 ADB study of 20 water utilities in India reveals a similarly wide range in the level of connection fees—Ahmedabad reported the least expensive at \$2.40, while Vijayawada had the highest at \$132. The average connection fee was \$38... In a 2001 ADB study of 18 water utilities in Asia, New Delhi had the lowest connection fee at \$2, while Osaka had the highest at \$1,506. It may be noted that while a \$2-connection fee logically should not stop a poor household from getting connected, this may hide a utility's inability to extend the distribution lines, in effect preventing access to the system by new customers.

In addition to the formal costs mentioned, connection charges also involve informal costs—such as the opportunity costs of the time spent in visits to apply for a water connection or the giving of "tips" or "speed money" to facilitate successful applications.

Source: Asian Development Bank (<http://www.adb.org/Water/Knowledge-Center/connection-charges/how-why.asp#TOP>)

## Access to Sanitation Services in Settlements

### Toilet Facilities

80-100 percent of the households in all types of settlements, except Slum/JJ Cluster use private toilets. 28 percent of the households use private toilet in Slum/JJ Clusters.

Community toilets are dominantly used only in Slum/JJ Cluster where nearly 60 percent of the households are dependent on it.

Percentage of people defecating in the open hover around 12 percent in Rural Villages, Harijan Basti, Resettlement Colony and Slum/JJ Cluster.

Table 8.1 Toilet facilities used							
Parameter	Slum/ JJC	HBs	RCs	UNRCs	URCs	UVs	RVs
<b>Toilet Facility Used</b>	Communit y Toilet (62%)	Private Toilet (88%)	Private Toilet (90%)	Private Toilet (100%)	Private Toilet (100%)	Private Toilet (98%)	Private Toilet (87%)

#### 8.1.1 Private Toilets

Majority of the toilets in all settlements are connected to sewer. However, in case of Slum JJs the percentage of private toilets connected to a septic tank is also significantly high at 32%. In URC, 42 percent of households use small pit inside the house as toilet. Other options like connection to septic tank, pour flush pit latrines, pour flush latrines connected to surface drain constitute a negligible percentage.

Further, the private toilets have been assessed on parameters of water supply, usage and cleanliness to ascertain the impact on health in the subsequent sections.

*Water Supply:* Of the households, which have reported the use of private toilet, about 66 percent have taps in the toilet, with two exceptions. One is the Resettlement Colony where the percentage is low at 20 percent and the other is the Slum/JJCs where it is as low as 1%.

*Usage:* Private toilets are being used all the time by 80-90 percent of the family members; men women alike. There are minor instances in Slum/JJ Cluster and Urban Village when the toilet is used for defecation only.

Data on number of male and female non-users of the toilet was also probed during the field research. Since, the percentage of toilet usage is already high, there have been no significant observations on gender perceptions towards use of toilet. Male and females alike use toilet all the time.

*Cleanliness:* Although the study probed – ‘if the toilet is dry latrine/without flush, who cleans it?’, the respondents have replied generically on who is responsible for cleaning the toilet, irrespective of dry latrine toilets.

Women of the house are largely responsible for maintaining cleanliness. In some cases private sweepers are also hired. Government sweepers are not responsible for the upkeep of private toilets.

**Table 8.2 Cleaning of Toilet**

Parameter	Slum/JJ C	HBs	RCs	UNRCs	URCs	UVs	RVs
<b>Who Cleans the Toilet</b>	Women Of The House	Women Of The House	Women Of The House	Women Of The House	Private Sweeper Male	Private Sweeper Male	Women Of The House

### 8.1.2 Community Toilets

Since the use community toilets in settlements other than Slum/JJ Cluster is very limited, the analysis of community toilets on parameters like water supply, facilities, usage, cleanliness etc will be entirely dependent on the responses received from Slum/JJ Cluster.

62 percent of the households use community toilets regularly. However the respondents have reported the following types of problems:

- Water Supply in Toilets: 13 percent have reported that the water supply is insufficient. Common problems relating to water supply are –
  - a. No or intermittent water supply
  - b. No or non-working water motor
  - c. Absence of water storage tanks and dependence on Hand pump because of which water has to be carried. Many times the hand pumps are also not functional. 52 percent of the respondents carry water from outside. 19 percent carry water from home.
  - d. Broken taps
- Electricity: 20 percent have reported that there is no electricity. Problems like absent or non-functional bulbs; insufficient lighting are also there.
- Cleanliness: 75 percent of respondents have reported that the toilets are dirty. 27 percent have reported overflowing septic tanks. Flushes are often non-functional. Although 74 percent of the respondents have said that the toilets are cleaned once/twice a day but technical problems such as non-functional toilets, overflowing septic tanks and hygiene behaviour of the users lead to unsanitary conditions.
- Safety: 56 percent of the respondents feel that the community toilets are not safe. Broken doors, lack/insufficiency of lighting, eve-teasing, distance from home etc make them unsafe for use especially during evening and night hours.
- Waiting Time: 91 percent of the respondents have to wait upto 10 minutes during peak hours. 22 percent of the respondents have a waiting time of 11-30 minutes and around 5 percent have a waiting time of more than 30 minutes, stretching upto one hour.
- Handwashing: Although respondents have agreed that there are basins for

washing hands but availability of water is limited. Also 57 percent of the respondents have said that soap is not provided for washing hands.

There are additional facilities like bathing units and units for washing clothes in the community toilet, but data procured on these facilities is sketchy and cannot be used for analysis.

**Even DJB does not know how dirty is Yamuna  
(Hindustan Times-22 June 2009)**

How much sewage is flowing into the Yamuna in Delhi to make it the dirtiest river in the country? The Delhi Jal Board (DJB), responsible for treating the sewage so they don't pollute the river, has conceded that it does not know the answer.

A few days ago, an RTI application had asked the DJB how much million-litres per day (MLD) of sewage flows into the river to make it polluted. "The answer is not available with us," was the reply.

What's more, RTI replies also revealed that the DJB also does not have even an estimate of the amount of sewage generated in the urban villages and unauthorized colonies, where sewer network has not been laid.

These urban clusters have for long been considered the biggest stumbling block for any exercise to clean the river because of the amount of sewage they discharge.

And minus the data, the upcoming Interception Sewer network of the DJB -- Rs 1,800 crore project -- touted as the last ditch effort to clean Delhi's river, could turn out to be a dud.

"It all seems like a lot of half baked data," said Vinod Jain, an environmental activist who has dragged the State to the high court to force it to clean the river, restore the drying water bodies and stop construction on riverbed.

"This means, the basis of all the programmes to augment sewage treatment capacity and seek funding to clean the river is pure guesswork," he said.

Guesswork it is indeed. As per a conventional rule, the DJB "assumes" that around 70-80 percent of the total water demand in the city turns into sewage and flows into Yamuna, said DJB chief executive officer Ramesh Negi.

"Delhi's water demand is around 700-800 million gallons per day (MGD). Our sewage treatment plants have a combined capacity to treat around 512 MGD. And we are in the process of adding another 100 MGD to the sewage treatment capacity," he said. "And this arrangement is made by working out the conventional rule of estimation." Yamuna cleanup in Delhi has been a victim of wrong government estimation in the past.

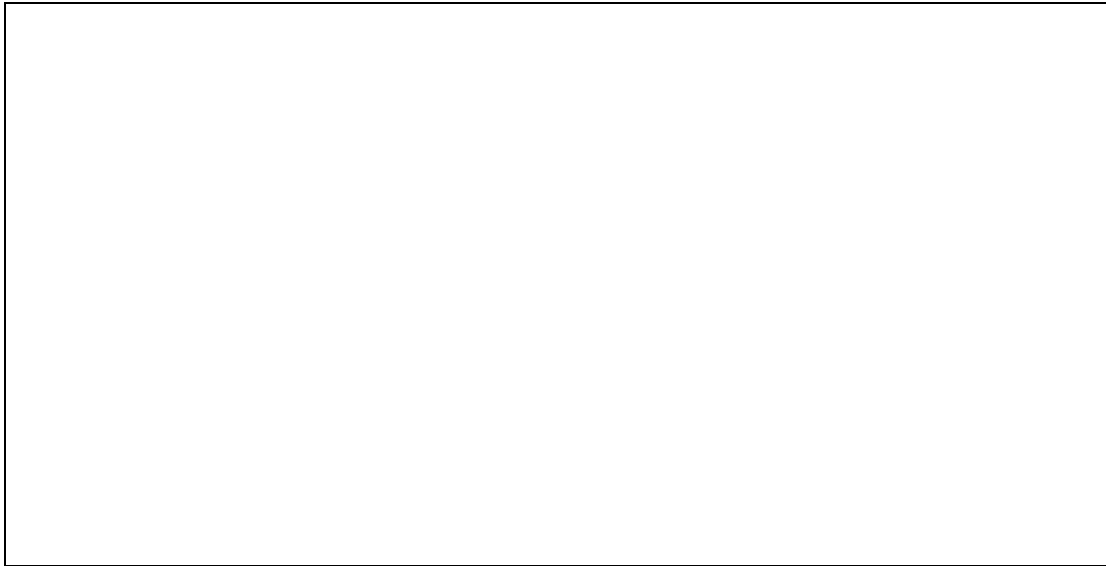
In the 1990s, Delhi had installed a number of sewage treatment plants (STP) as river cleanup process. But money went down the drain as it was found that the STPs could not function optimally because most of the city's sewage could not be channeled into them.

The Interceptor Sewer Network is a similar, mammoth plan to connect all the sewage with a central sewage carrying stream that would channel it to STPs. But minus the data, the project's viability is in question.

## 8.2 Drainage

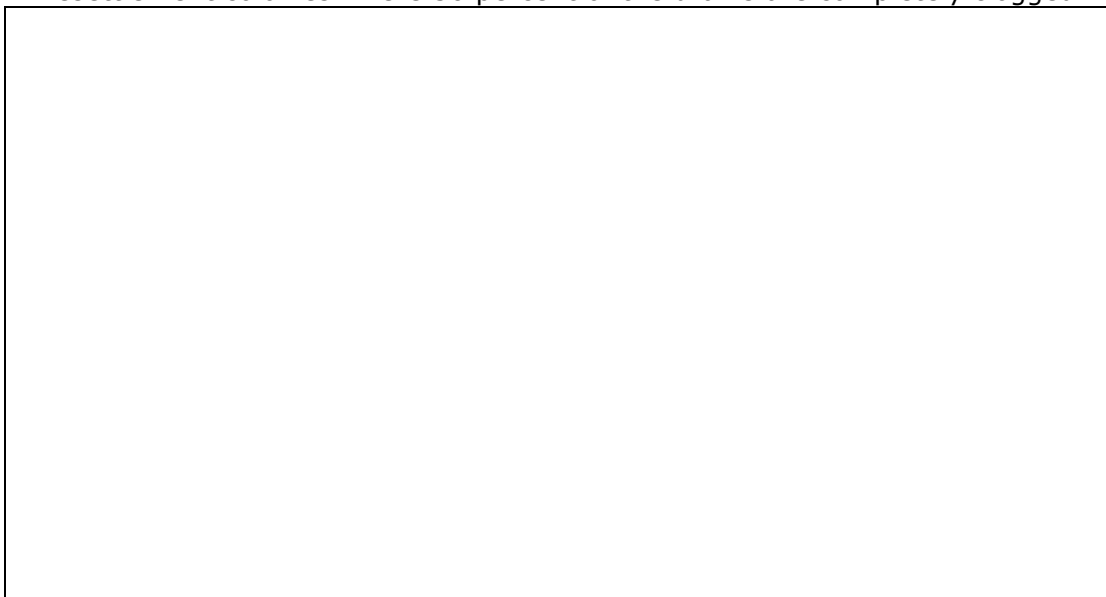
Drainage system in all settlements is largely pucca but open. 60-80 percent of the pucca drains are open in all settlements except Harijan Bastis where 30 percent of the network is covered.

Urban Villages have a high percentage of informal drains at 28 percent followed by UNRCs (19%) and Harijan Bastis and Slum/JJCs (16%).



### 8.2.1 Pucca Drains

The gradient of the drains is poorly made, especially in Resettlement Colonies, Urban Villages, Slum/JJ Clusters and Harijan Bastis. Thus drains are either clogged with water at several places or completely clogged. The situation is worst in Resettlement colonies where 50 percent of the drains are completely clogged.



30-40 percent of the respondents in all settlements agree that the drains are

cleaned only occasionally. In Resettlement Colonies another 40 percent of the respondents say that the drains are cleaned rarely. On inquiring about 'who cleans the drains?', maximum respondents in all settlements ascribe the responsibility to MCD.



### **8.2.2 Kuccha and Informal Drains**

The kuccha and informal drains are connected to either bigger drains or sewer. In Resettlement Colonies and Urban Villages, around 10 percent of these drains outfall in open plot/field/land. The rest of the water spills on road/streets or is directed into big pits.

The wastewater from home generally falls into street drains. In UNRCs, which are situated near open plots, 15 percent of the respondents agreed that the water is directed to these plots.

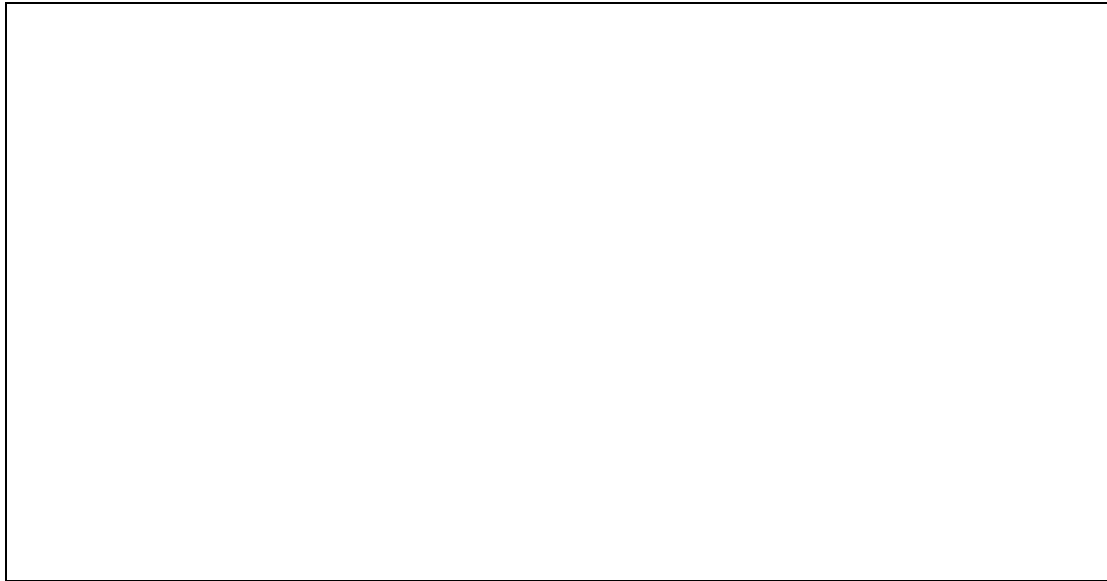
Around 5 percent of the households in Slum/JJ Clusters and UNRCs have a pit in front of the house to collect wastewater flowing from home. Enquiries on 'who cleans the pit?' did not attract many responses from households.

## **8.3 Solid Waste Management**

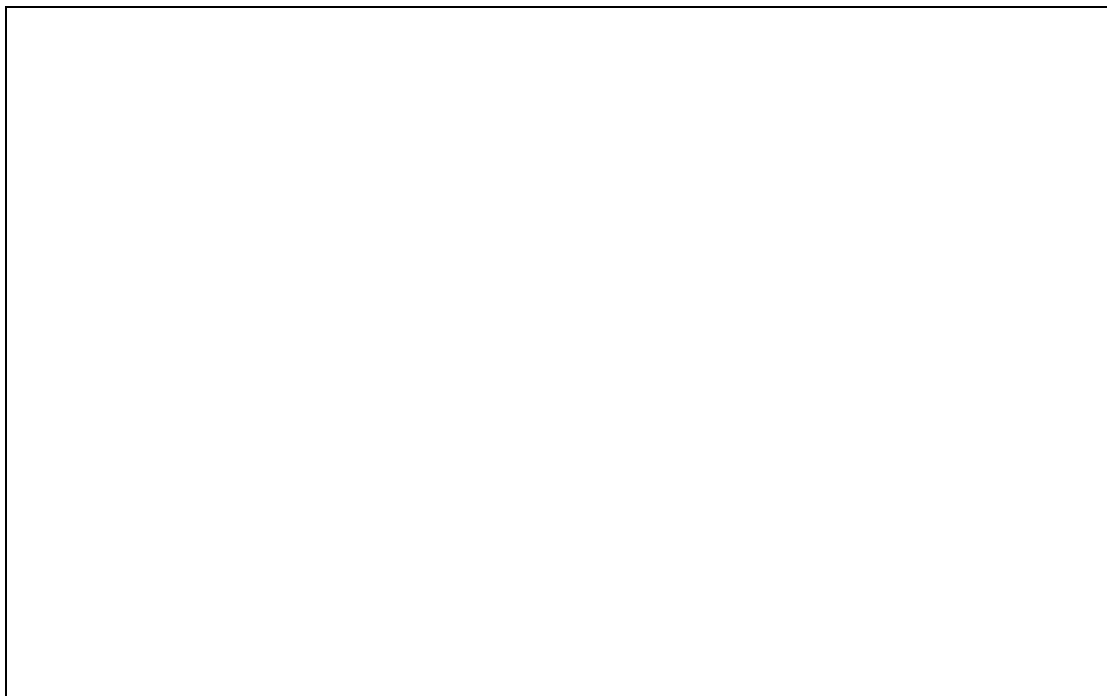
Although solid waste management, from collection, transportation to disposal is a mandatory function of local bodies, majority of the households in all settlements dispose the waste on their own or pay private sweepers to collect it.

Private sweepers are generally paid money or in kind with food, clothes etc. Some households pay it on a monthly basis whereas some only pay occasionally on festivals.





A large part of the waste is disposed on open plots/streets/land. The situation is worst in UNRC where almost 90 percent of the waste is disposed in the open followed by Resettlement Colony (70%) and URC (65%) and Rural Village (61%). In Slum/JJ Cluster and Urban Village above 50 percent of the respondents dispose waste in Dhallao. Both these settlements have also reported a high percentage of self disposal of waste. Households have also reported disposal of waste in drains, parks and pits.



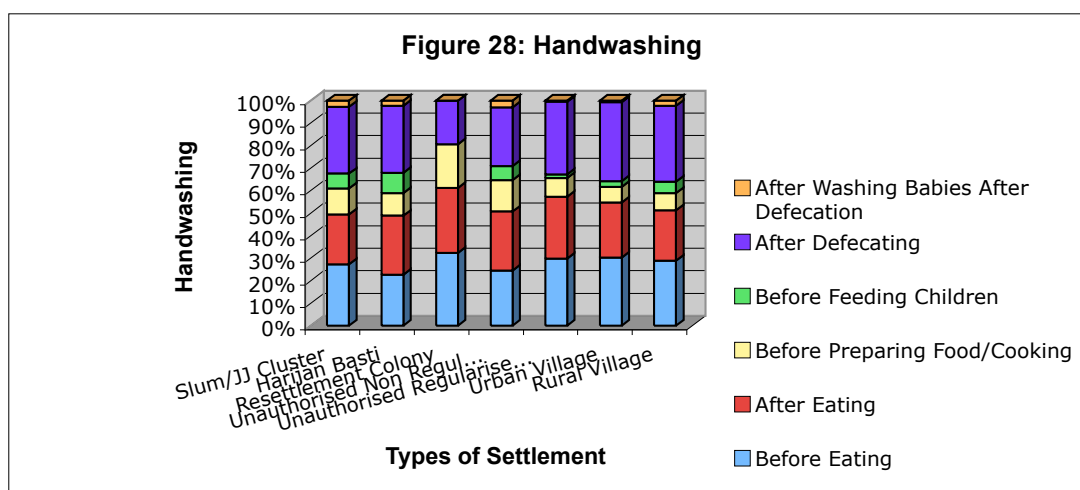
Satisfaction levels with solid waste management vary across settlements although majority of the households in all settlements are satisfied. Satisfaction levels are high at 80 percent in Urban and Rural Village; 50-65 percent in Slum/JJ Cluster, Harijan Basti and UNRC; and 40 percent in Resettlement Colony and URC.

## 8.4 Sanitation and Health Risks

### 8.4.1 Hand washing and Health Risks

90-100 percent of the respondents wash hands after defecation in all settlements, except Resettlement Colonies where the percentage is low at 60 percent. 90 percent of the respondents use soap to wash hands in all settlements including Slum/JJ Cluster where use of community toilet is prevalent and respondents retorted that soap is not available in community toilets.

The general hand washing behaviour is showing varied trends where 80-100 of respondents wash hands before eating in most settlements; 65-80 percent of the respondents wash hands after eating; 20-40 percent wash hands before preparing food/cooking. The percentage is slightly better in Resettlement Colony and UNRC. A very low percentage wash hands before feeding children.



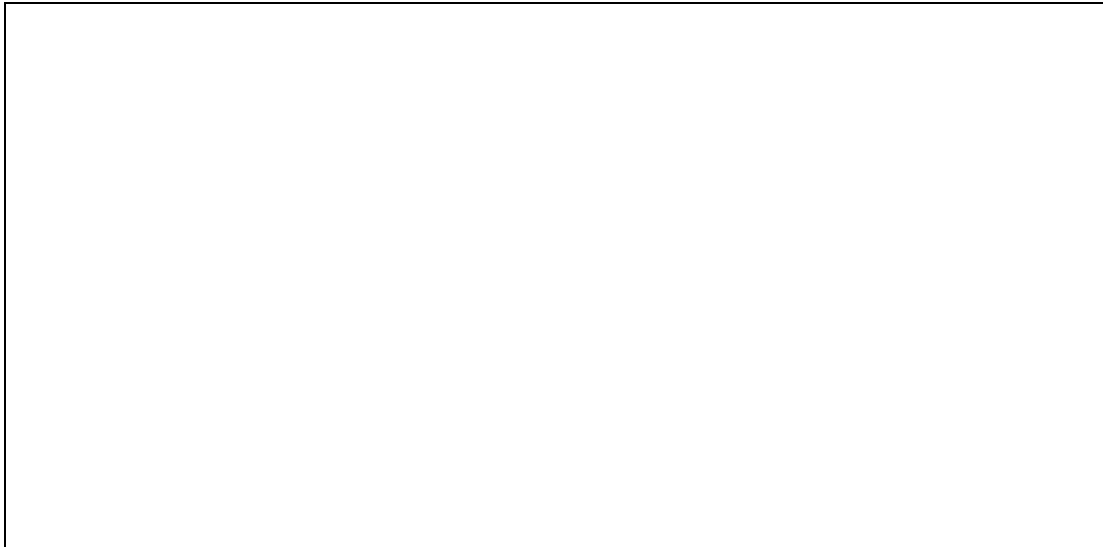
Hand washing behaviour has a direct link to the health status and the illness pattern. However the data collected for this report may not be able to substantiate the same due to various limitations. However in the case of Resettlement Colony, a pattern is visible where the percentage of respondents washing hands after defecation is lowest at 60 percent and the reports of Diarrhea, Dysentery and Gastroenteritis is highest at 33 percent. However, contradictions do exist, where Resettlement Colony also has the highest percentage of respondents washing hands before preparing food/cooking.

### 8.4.2 Drainage System and Health Risks

Incidence of illness is highest in Urban and Rural Villages at 38 percent, where 60 and 80 percent of the pucca drains are open, which are largely clogged. Also Urban Villages has the highest percentage of kuccha/informal drains at 30 percent.

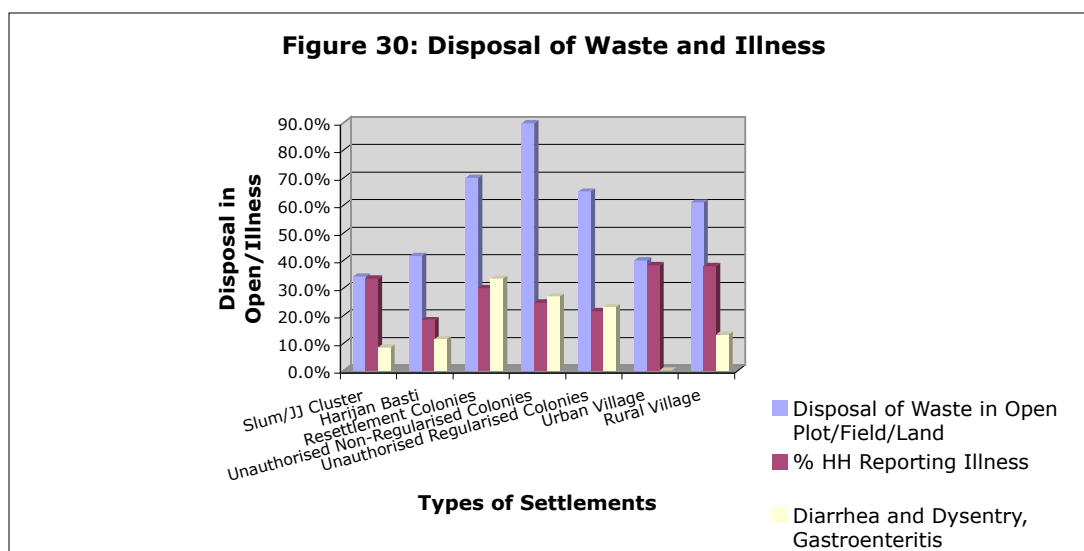
In Slum/JJ Cluster, 33 percent of the respondents have reported illness. Drainage system is in a similar condition, where 63 percent of the drain network is pucca but open and 11 percent is kuccha/informal. 57 percent of the respondents agree that drains are partially/completely clogged and wastewater is spilled on streets and roads.

The condition of drainage in other colonies is also not very encouraging but where the percentage of clogged drains is lower, as in the case of UNRC and Harijan Basti, reports of illness are slightly lower. It cannot be simplistically interpreted that illness is only a function of drainage conditions. Where the figures do not show a coherent trend in one section, other factors need to be probed. For instance, illness in Resettlement Colony is lower than Urban and Rural village and slum/JJ Cluster but the drainage system is in a worse condition. The reasons for illness in Resettlement Colony have been investigated in the previous section where hand washing habits were incorrect.



#### **8.4.3 Solid Waste Management and Health Risks**

Settlements, which have high percentage of disposal in the open like UNRC, Resettlement Colony, URC and Rural Village are showing trends of diseases which are spread generally spread through contamination of food or water by feces through exposure to flies, mosquitoes and other bacteria and viruses. For instance the incidence of Diarrhea, Dysentery and Gastroenteritis is high at 25-35 percent in Resettlement Colony, UNRC and URC. 9 percent respondents in UNRC, which has the highest percentage of open disposal, have reported highest percentage of Typhoid and Jaundice.



#### 8.4.4 Facilities at School and Health Risks

Since child health is an integral part of the subject on water and sanitation, this research study has also tried to collect information on facilities for water supply and toilet in schools in the various settlements. Although limited responses have been received but on aggregation some trends can be interpreted.

Majority of the households have agreed that there are water supply and toilet facilities in the school, which are not perceived to be good. The key problems narrated by the respondents with regards to water supply are:

- Dirty and salty water
- Dirty water tanks
- Non functional taps
- Inadequate supply when compared to the number of children

Common problem with toilet facilities can be summed up as below:

- Dirty and ill maintained toilets
- Stagnant water in toilets
- Broken seats/windows/doors

Contrary to the above problems, 45-60 percent of the respondents replied that their children have not missed school due to sickness. However, concentration of types of illness amongst children in each settlement is highly skewed towards ARI, Cold and Cough and Fever, which are an outcome of spread of virus and bacteria in dirty environments.

**Table 8.3 Dominant Illnesses**

Parameter	Slum/ JJs	HBs	RCs	UNRCs	URCs	UVs	RVs
<b>Dominant Illness</b>	ARI, Cold and Cough, Fever	ARI, Cold and Cough, Fever/Diarrhea, Dysentery and Gastroenteritis	Jaundice	ARI, Cold and Cough, Fever/Diarrhea, Dysentery and Gastroenteritis	ARI, Cold and Cough, Fever	ARI, Cold and Cough, Fever	ARI, Cold and Cough, Fever

## 9. Conclusions

The research findings are concluded in the Table 2 below highlighting the status of infrastructure facilities in the settlements.

**Table 9.1: Summary of Infrastructure Facilities in Settlements**

Status of Infrastructure (in %)	Slum/JJ Cluster	Harijan Basti	Resettlement Colony	Unauthorized Non Regularized Colonies	Unauthorized Regularized Colonies	Urban Village	Rural Village
<b>Water Supply (for drinking and cooking purposes)</b>							
Access to Municipal Sources of Water	89%	88%	90%	82%	92%	93%	83%
Access to Tap Connections	29	82	90	34	53	93	86
Above 20 liter of Quantity Received Per Day	12	19	50	8	0	23	28
Adequate Water supply	52	58	40	80	98	63	65
Average to Good Quality of Water	76	83	60	79	98	85	84
Good Pressure	52	58	40	80	98	63	65
<b>Toilet Facility</b>							
Access to Private Toilets	33	88	90	100	100	98	87
Access to Community Toilets	59	2				2	
<b>Drains</b>							
Covered Pucca Drains	12	28		9	10	5	8
Open Pucca Drains	63	45	70	59	75	60	80
Kuccha/Informal Drains	11	19	10	24	5	30	
Semi-Clogged or Choked Drains	57	47	70	40	53	62	45
<b>Solid Waste Management</b>							
Disposal at Dhallaao	65	41	50	20	32	47	52
Disposal in Open	8	17	40	13	7	20	26
Satisfied Households with Solid Waste Management in	66	54	40	51	38	83	86

the Settlement							
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Other observations, which have emerged from the research findings documented above, can be summed as below:

- The establishment and growth of slums and other low-income settlements is strongly correlated to the convenience that the location offers in terms of access to infrastructure including roads, water supply, space for toilet etc.
- Most type of settlements are situated in close proximity to contaminated water sources like nullah/large drains and river/ponds which is posing greater health risks as evident from the statistics collected on illness and prevalent diseases.
- It is evident from the analysis, the recent migrants with some affordability, specifically in the past decade; prefer to live in better sites (Harijan Basti, UNRC) than slums.
- Although settlements are situated close to contaminated water sources but households depend largely on municipal sources of water like tap connection or community stand post for drinking and cooking purposes. This is much against the myth that the urban poor depend mostly on groundwater sources for their water needs.

Neither are nullahs/drains and other open spaces around the settlements used extensively for toilet purposes. Private toilets in households are a prevalent trend in most settlements. In Slum/JJ Clusters, community toilets are used. Open defecation is an uncommon practice, which negates another myth often associated with the urban poor.

- Majority of the respondents in all settlements are receiving 'adequate' water at comfortable hours of morning and evening. However, the quality of water, as perceived by the respondents, is doubtful and water is mostly treated through modern techniques like electric filters.
- Slum/JJ Clusters have least access to tap connections and are dependent on community stand post thus paying a higher cost for procurement of water in terms of time spent, inconvenience beared in collection of water and disease burden because of the low quality of water. The situation is similar in UNRC where tanker supply is used and the quality of water is further compromised.

Slum/JJ Clusters are also using community toilets, unlike other settlements, which use private toilets. Community toilets are ill-maintained and offer unhygienic conditions due to limited water supply, insufficient electricity and lack of regular cleanliness. Respondents are further discouraged to use the facility because of factors like distance from home, safety, and the inconvenience of long waiting hours.

- Drainage system in all settlements is largely pucca but open with ill-made gradient. Connection of drains to the city sewerage system is doubtful in most cases. Clogging of drains due to poor maintenance further aggravates the problem. In sum, most of the wastewater from pucca/kuccha/informal drains spills in the streets or other open spaces/areas/plots thus proliferating the health risks.

- Solid waste management is equally poor in all settlements with regards to collection, transportation and disposal, with most of the respondents confirming the lag of municipal authorities in delivering services.
- The research reiterates that the incidence of illness is positively related to the kind and condition of basic infrastructure facilities available to households. Corollaries to health are clearly visible with the following factors:
  - a. Physical location of Settlement: Settlements located near nullahs/drains, river/ponds are facing higher disease burden.
  - b. Source of water used: Settlements like Slum/JJ Clusters and UNRC, dependent on relatively unsafe sources of water for drinking and cooking like community stand post and DJB Tanker have higher incidence of diarrhea, dysentery and gastroenteritis
  - c. Consciousness towards treatment of water before consumption: Households which treat water before consumption face lesser disease burden
  - d. Drainage: Settlements having open, kuchha and informal drains resulting in spilling of wastewater in the open have higher health risks.
  - e. Solid Waste Management: Viral diseases like ARI, Cold and Cough and Fever are common in settlements where open disposal is rampant.

Thus the research study provides satisfactory evidence that inadequate infrastructure has burdened households with numerous coping costs including investments in alternative arrangements and associated costs of manpower, engineering, equipments, operation and maintenance; time value of money; increased health risks and medical expenses etc. Because of a long legacy of poor infrastructure provision, many of the coping costs are assumed as routine and thus remain as hidden costs. For instance, many a times regular bouts of gastroenteritis are not recognised as an outcome of poor quality of water but the medical expenses incurred and loss of workdays is a coping cost. Thus coping costs are a huge burden, which citizens endure on an everyday basis in a recognisable or non-recognisable form.

For the settlements surveyed, coping costs in themselves are a burden and given the low-income of the households, they further aggravate the vicious circle of poverty and the overall city economic development.

## **10. Recommendations**

Government and various development schemes targeted at the poor have tried to reduce coping costs by increasing the coverage of infrastructure through subsidies in capital investment and subsidising tariffs to encourage consumers to take advantage of the laid infrastructure. However, these subsidies are often poorly targeted and do not benefit the poor. Thus the recommendations given below try to address these gaps with the objective of reducing the coping costs for the poor.

### **10.1 For Improving Water Supply Services**

All settlements without legal right to land should have the right to paid water supply through household connections, without such supply giving them a legal right over land. Water standards for the poor should ideally be metered



household connections. Alternatively, the poor could be offered group metered connections, paid supply through water reservoirs in each settlement, metered stand posts etc. as a start with options to incrementally upgrade services with rises in incomes.

#### **10.1.1 Reducing dependence on Community Stand posts and Tanker Supply:**

Water provided through community stand posts and tanker supply is free of cost for the benefit of the poor. Policymakers and researchers have long debated the efficacy of free provision of water supply because of the following reasons:

- a. High coping costs of these sources as elaborated in the sections above.
- b. Drain on the finances of the water service provider, which disables it to undertake further investments for increasing coverage and upgradation of existing network.
- c. Free provision discourages poor families from taking house connections even if they are affordable.

The settlements surveyed have also stated 'tap in the house' as a preferred source of water supply complemented by a willingness to pay for one time connection charge as well as monthly charges. Most households have also stated that they do not need access to credit for buying a water connection.

In such a scenario, where the poor are willing to contribute a basic minimum sum for access to tap connections, the water service provider –DJB should capitalise on the opportunity supported by government schemes like Jawaharlal Nehru National Urban Renewal Mission (JNNURM), which prescribes access to infrastructure under its Basic Service for the Urban Poor (BSUP) component. With the advantage of central funding, free connections can be provided to the urban poor who are not already connected to piped water supply and basic minimum monthly tariffs can be charged.

The ramifications of such an effort would be multi-fold:

1. Poor will have access to tap connections thus reducing coping costs.
2. Enhanced network coverage and revenue stream for DJB with addition of new customers. This will also restrict illegal connections, which are a major cause of unaccounted for water and is a drain of potential revenue streams.
3. Reduction in wastage of water through community sources resulting in resource conservation. However this is possible on the premise that tariffs for a tap connection are fixed at levels which discourage wastage of water.
4. Progressive city economic development with an improvement in human development indicators.

#### **10.1.2 Water Tariff Reform**

Although DJB has an increasing block tariff structure to ensure equity in water pricing as per consumption with a resource conservation angle, but it should also be noted that the water tariffs for domestic category do not offer any special rates for poor settlements. This highlights the fact that the rich and the poor are alike taking advantage of the subsidies given per unit of water. Since a large portion of the poor are not connected to tap network, they are not even taking advantage of the tariff subsidy and rather succumbing to the coping costs of

using community stand posts, tankers and other groundwater sources.

In such a scenario, if subsidized tariffs are offered to the poor, not only will they be able to afford the monthly bill for a tap connection, it will also increase revenue source for DJB through an enhanced customer base.

## **10.2 For Improving Sanitation Services**

### **10.2.1 Promoting Community Low/No Cost Private Toilets with Hygiene Awareness**

Since most of the respondents have confirmed that they have accrued no benefits from government schemes for low cost sanitation, and given the state of community toilets, it is necessary to find immediate solutions in the interest of public health. It is imperative that implementation of schemes need to be closely monitored at all levels of government to ensure that benefits of government investments reach the intended beneficiaries. However, given the close link of toilet maintenance with health risks, it would be advantageous to induce a sense of ownership towards the toilet facility for better maintenance and enhance user knowledge on hygiene techniques.

Since, the general income levels in all settlements is above poverty line, small savings can be mobilized from community to build low/no cost private toilets. Where land is a constraint, shared toilet facilities between lesser numbers of households can also be promoted to shift from multi-unit community toilets which are under local bodies and often difficult to maintain because of the lack of ownership and mismanagement in civic bodies.

The involvement of community has to be at two levels: (i) need assessment and construction of toilet (ii) operation and maintenance of toilets. Community mobilization, construction of toilets, setting arrangements for O&M, promoting hygiene awareness can be undertaken by local NGO's and CBO's through funding under existing and upcoming sanitation schemes being administered by the local body through central and state funded programmes.

### **10.2.2 Promoting Public Private Partnership in Solid Waste Management**

The solid waste management system in Delhi is based on Dhallaos as the key collection unit for final treatment and disposal. Segregation of waste is an upcoming concept in Delhi and prevalent in low-income settlements due to limited awareness amongst residents and slag implementation of the local body.

Since, households are responsible for taking the household waste till the Dhallao, either personally or through door-to door collection (generally arranged through private sweepers), community participation is important to bring about behaviour change in disposal of waste and create awareness on health risks associated with improper disposal of waste in the open.

Given the institutional arrangement for solid waste management in Delhi, a consortium approach needs to be promoted, platforms are created for interactive dialogue between the local body, private service provider responsible for collection and disposal and the community. The role of community in this arrangement is limited to ensuring proper collection and segregation of waste within household and its disposal till the Dhallao. Also awareness generation will empower community to act as a monitoring agency for the private service

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provider and local body to provide timely and efficient services.

### **10.2.3 Rehabilitation of Drainage Network under JNNURM**

The drainage network in slums needs to be revamped through a concerted capital investment plan for building new network and rehabilitating the existing networks.