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A Demand-Gap Assessment of Sanitation in Chennai Slums

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ABSTRACT; *The urban population in Chennai City is expected to increase tremendously by 2030. Currently, a sizable proportion of the population in most urban area lives in slum areas. The increasing slum population in urban areas are seen an indication of worsening living conditions and increasing poverty in urban areas. The increasing concentration of population in slums and urban poverty has elicited a strong interest in urban health conditions in general and the health of slum dwellers and the urban poor in particular. The present study provides spatial-information on an extent of poverty by slum/non-slum residence according to the census; demographic and socio-economic characteristics of slum/non-slum residents and the urban poor; Household living conditions; sanitation for the Chennai City. The perceptional study has also been adopted for the future planning of urban living conditions.*

KEY WORDS: *Urban population, Slum population, non-slum population, urban poverty, urban health.*

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I. INTRODUCTION

Rapid urban growth resulted into mushroom growth of slums of varying sizes in the towns. Undoubtedly, slums have become the most vulnerable and blighted areas of towns/cities. There appears to be no improvement in their basic level of living, despite several decades of programmes for the environmental improvement and for providing better quality of life. The spread of slums leads to multitude of problems, and the main problem is poverty. Towards understanding the slum and poverty, and their consequences on urban economy, it is essential to assess and analyze the socio-economic dimensions of slum dwellers; and this analysis will help to reach an efficient urban planning and development strategies for urban health. Improving the quality of life and slum dwellers is the most demanding task of the present urban planning and development on point of health background.

'Cities without slums' are one of the major goals of urban planning. Clearance or upgrading slums is not a problem of individual urban settlement, but it is a national problem. Improvement of the environmental situation, education standards, civic conditions, housing, and health is very important to bring up the slums to the general standard of the towns. Analyzing the site and situation of slums as well as their spatio-socio-economic dialectics is of paramount importance to improve the urban poor/urban health. It is in this perspective, the present paper attempts to assess the levels of socio-economic development of slum households, taking the case of Chennai City in Tamil Nadu. This diagnostic study will help to evolve measures to improve the quality of life of slum dwellers.

Urbanization and Migration

A century of industrialization and technical advancement has brought in rapid urbanization. The proportion of urban population in India has gone up from 11 percent in 1901 to 18 percent in 1951 and to 32 percent in 2001.

Economic Development and Urban Poverty

The insufficient employment opportunities and inadequate income among a considerable segment of urban population in India has given rise to urban poverty[1]. Particularly in big cities, the slums are rapidly proliferating, which eloquently symbolizes the disturbing magnitude of urban poverty. Therefore, urban poverty in Indian scenario is reflected not only in lack of productive employment, but also inadequate living conditions and degraded environment[2].Urban populations have both higher needs and demands for services and infrastructure. Urban population growth has been fuelled by prospects of higher incomes and also contributes to

[1] Brian C. Aldrich and Ravinder S. Sandhu, Housing for the Urban Poor, New Delhi, Sage Publications, 1995
[2] C. H. HanumanthaRao, 'Agricultural Growth, Sustainability and Poverty Alleviation', Economic and Political Weekly, Vol. XXXIII, Nos. 29 and 30, 1998

the growth process at large. It is unfortunate to notice that the cities failed to deliver the promise of a better quality of life to the expectations. The quality of basic services remained poor resulting deterioration in the physical environment and quality of life by the widening gap between demand and supply of essential services and infrastructure. The urban poor lack adequate access to services like water supply, sewerage, low-cost housing, education and public health. Thus the urban poor in general and the population living in the slum settlements in particular have been affected most adversely by urban service deficiencies. For the present study, various approaches have been adopted to address the problems of urban poor which helps to narrowing the gap between the demand and supply of urban services in low-income communities.

The of the Tamil Nadu Slum Clearance Board (TNSCB) had conducted that the socio-economic survey of slum areas in Chennai City to taken up various measures to improve the living conditions of the urban poor living in the slums and also has rehabilitated urban poor living in the river margins and objectionable places. To improve the living conditions of the urban poor living in the slums.

The slum residents lack the most basic municipal services, such as water supply, sanitation, and waste collection and thus are exposed to disease, crime and natural disasters. They also lack schools, clinics, as well as places for the community to meet and socialize. Each of these failures adds to the toll on people already deeply burdened by poverty and constrains the enormous opportunity for urban development as well as urban health offers. It is also clear that the disparities between the haves and the have-nots are increasing. The lack of basic environmental services in rapidly growing, dense urban and peri-urban settlements have resulted in public health and safety hazards.

Slums - Nature & Characteristics

Following are some of the key characteristics and nature of slums existent around the world:

- Slums are neglected parts of cities where housing and living conditions are appallingly poor. Slums range from high density, squalid central city tenements to spontaneous squatter settlements without legal recognition or rights, sprawling at the edge of cities. Some are more than fifty years old; some are land invasions just underway. Slums have various names, Favelas, Kampungs, Bidonvilles, Tugurios; yet share the same miserable living conditions.
- Slums do not have basic municipal services like water, sanitation, waste collection, storm drainage, street lighting, paved footpaths, roads for emergency access schools and clinics within easy reach, safe areas for children to play places for the community to meet and socialize.
- Slums are worsening - while the average age of city population is increasing, the average age of slum dwellers is decreasing, so youths and children suffer most visible disparities between slums and better-off neighborhoods increase the social tensions in poorer areas unplanned growth of settlements makes conventional service provision complicated and costly.

Initiatives and Trends in Slum Upgrading

The alternative to moving people or replacing their homes is upgrading. For example, water reticulation, sanitation, garbage collection, storm drainage and security lighting, up to an appropriate, basic standard. It also involves the improvement of footpaths and streets, playgrounds and community facilities, which are leads automatically for urban health.

Slum upgradingconsists of physical, social, economic, organizational and environmental improvements undertaken cooperatively and locally among citizens, community groups, businesses and local authorities.

A successful upgrading program is more than infrastructure. As a whole, the slum upgrading has two significant advantages, viz.

a) it is not only an affordable alternative to clearance and relocation (which cost more than 10 times more as upgrading), but it minimizes as well the disturbance to the social and economic life of the community, and

b) the results of upgrading are highly visible, immediate and make a significant difference in the quality of life of the urban poor. Upgrading of slums and settlements is a viable and effective way to help the urban poor solve their need for shelter and a clean, safe and healthy living environment.

II. AIM AND OBJECTIVE OF THE STUDY

AIM: The aim of the study, to study about the urban health which influences by the slum development in Chennai City.

Objectives:

- to show the distribution of slums in Chennai City.
- to show the categories of slums in Chennai City.
- to show the existing facilities or infrastructure for Slums in Chennai City.
- to show the demand and gap of infrastructures for slums Chennai City.
- to show the sanitation need for Chennai City.

1. Profile Of Chennai City

Chennai Urban Agglomeration (CUA) is spread over an area of 571.93 sq. km and the Chennai Metropolitan Area (CMA) is spread over an area of about 1177 sq. km. Chennai City, which covers an area of about 174 sq. km accounts for major portion of the CMA. The CMA is bounded in the North by MinjurPanchayat Union, in the South by Sholinganallur Town Panchayat, in the West by TiruvallurPanchayat Union, and in the East by Bay of Bengal.

Chennai City is located on the coromandel (eastern) coast in South India, with Latitudes of 13^{o} 4' North and Longitude of 80^{o} 15' East. It is found at the north-eastern tip of the State of Tamil Nadu and is the Capital City of the State. The City of Chennai is the 38^{th} largest city in rhe world and the fourth largest city in the Country and has a long shoreline bordering the Bay of Bengal. Chennai City has a rare distinction of having a large harbor, the world's second longest beach (Marina Beach) and one of the oldest libaries (Connemara Public Library, founded during 1980). This library is one of the four National Depository Libraries, which receive a copy of all books, newspapers and periodicals published in India free of charge. Chennai City is one of the four metropolitan cities of India and is well connected with most of the cities in the country by road, rail and air. Following are some of the salient features of the city:

Chennai is a blend of historic and modern, traditional and advanced urban agglomeration, mingled in an unique way. The growth of Chennai into one of the major cities in India is attributed to its uniqueness in geographical location at the seaboard of the palar delta. The main factors, which account for its growth, are the extent of its hinterland, its easy accessibility from the sea route along with accelerated development of railways. Chennai has developed as the largest commercial and industrial center in South India, with an extensive network of transportation facilities including the largest seaport in South India, an international airport, well-laid roads and rail facilities.

Demographic Characteristics

Population Growth:

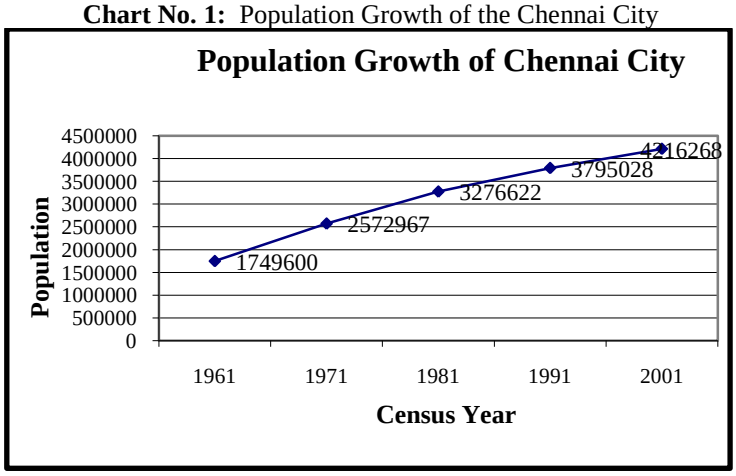
Chennai City had a population of 4.22 million in 2001, accounting for 15.48 percent of State's urban population of 27.24 million. Other major agglomerations in the States are Coimbatore (3.39 percent), Madurai (3.39 percent), Trichy (2.74 percent) and Salem (2.54 percent). The growth pattern of the Chennai City is illustrated in the following table:

Table No. 1: Population Growth of Chennai City

Census Year	**Area (sq. km)**	Population	**Decennial Variation (%)**
1961	120.83	1749600	--
1971	120.83	2572967	47.06
1981	170.00	3276622	27.35
1991	170.00	3795028	15.82
2001	174.00	4216268	11.10

Source: Census of India; 1961-2001

Chart No. 1: Population Growth of the Chennai City



Source: Census of India; 1961-2001

From the above table no. 1 and the chart no. 1 below, it was also observed that there has been a sharp decline in the growth rate of the Chennai City during the decade 1981-1991, which may be attributed to the effective population control measures of the State Government. Similar trends have been observed during the

decade 1991-2001 also.

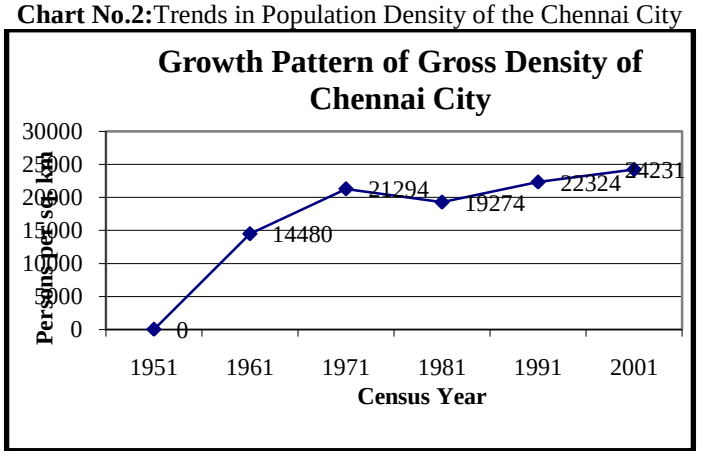
Population Density:
The population density of the Chennai City was worked out at about 24,231 persons per sq. km as per the 2001 census, as given in the table below:

Table No. 2: Population Density of Chennai City

Census Year	Population	Area (sq. km)	Gross Density (Persons per sq. km)
1961	1749600	120.83	14480
1971	2572967	120.83	21294
1981	3276622	170.00	19274
1991	3795028	170.00	22324
2001	4216268	174.00	24231

Source: Census of India; 1961-2001

Chart No.2: Trends in Population Density of the Chennai City



Source: Census of India; 1961-2001

The above table no. 2 reveals the trend of density (Chart no. 2). It was noted that the gross density of the CMA has been increasing from a mere 1813 persons per sq. km in 1961 to 5982 persons per sq. km in 2001 as per the respective Census figures.

Physical And Socio-Economic Characteristics
Physical Characteristics
Topography: Chennai is situated in a relatively plain terrain. The city is located at about 16 m above mean sea level, bounded by the Bay of Bengal on its northern side. Two major rivers, viz. Cooum and Adyar flow through the city and both do not have natural flow for several months of the year. These rivers were also found conveying flood discharge into sea during monsoon season. The Buckingham Canal runs through the city from north to south parallel to the seacoast at about 1-2 km away from the coast. The canal links the two rivers. In addition, there are three major drains viz. Captain Cotton Canal, OtteriNullah and Mambalam Drain for discharge of storm water into watercourses. OtteriNullah and Cotton Canal discharge into North Buckingham Canal while Mambalam Canal discharge into Adyar River. These waterways are flood carriers and have flow for about two months in a year in monsoon. The flow in these water courses during the non-monsoon period is from discharge of treated and untreated domestic waste water and trade effluent through several outfalls, leaving these water courses as storage basins of wastewater. This has created significant problem for flood protection system, storm water drainage network and associated public health and environmental problems in Chennai City.
Climate: Chennai City enjoys a tropical maritime monsoon type climate. Mean annual temperature is about 30^{o} C with very little seasonal variation or diurnal temperature variation and temperature soar highest in the month of May (between 40^{o} C and 45^{o} C).

Socio-Economic Characteristics

The following table no. 3 provides information on the workforce composition within the city:

Table No.3: Workforce Composition within Chennai City - Main Workers

Sector	Numbers	Percentage to Total Workers	Percentage to Total Population
Primary - Cultivators and Agricultural Labors	1503	0.11	0.04
Secondary - Household Industries, Manufacturing, Services and Repair	22108	1.53	0.52
Territory - Trade and Commerce, Transport and Service Sector	1417771	98.36	33.63
Total	**1441382**	**100.00**	**34.19**

Source: Census of India 2001, Government of Tamil Nadu

The workers participation rate of the city (within the Municipal Corporation limits) was about 34.19 percent of the total population as per the 2001 Census, comprising of 98.36 percent of total workers in tertiary sector, followed by about 1.53 percent in secondary sector.

Essential Services And Facilities

Water Supply:

Water was taken from the Kortalaiyar River to storage in Cholavaram and Redhills Lakes. Further developments, which took place after 1907 included the construction of an outlet tower and roughing filters at Redhills, an underground conduit to convey water to the city and slow-sand filters at Kilpauk.

Sources of Water Supply

- **Surface Water Sources:** Main source of water supply to the city is from three lakes, viz. Redhills, Cholavaram&Poondi, having an aggregate storage capacity of 175 million cu. m. Since January 2000, Chembarambakkam is also used as a supplementary source after meeting the needs of the registered ayacut.
- **Ground Water Sources:** About 7 Well Fields accommodating about 74 deep bore wells, viz. (i) Poondi; (ii) Tamaraipakkam; (iii) Flood Plains; (iv) Kannigaipair; (v) Panjetty; (vi) Minjur; and (vii) Southern Coastal Aquifer.

Distribution Supply System

Water is treated at three treatment plants (Redhills, Kilpauk& KK Nagar).

Sewerage and Sanitation

The sewage collected from the city is conveyed through various pumping stations to the sewerage treatment plants located at Kodungaiyur, Koyambedu, Nesapakkam and Perungudi for treatment and disposal. Preventive maintenance works in sewer are being carried out by using mechanical equipments such as Jet Rodding & Bucket Cleaning Machines to keep sewers free from blocks.

Solid Waste Management

- The solid waste generation of the city was enormous, with a generation of about 3200 MT per day, which worked out to about daily per capita waste generation of about 725 grams.

Roads and Other Road Infrastructure

Road network of Chennai City is dominated by a radial pattern converging at George Town, which forms the Central Business District (CBD) of the entire Chennai Metropolitan Area. Road transport is the dominant mode of transportation of the city, both for moving goods and passengers, assuming a pivotal role in development of the city. The administrative jurisdiction of the Chennai Municipal Corporation had about 140 km of National Highways. Further, the city had about 158 bridges, 40 culverts, 15 subways and 9 over bridges to add on to the city road infrastructure.

Streetlights

Streetlight is one of the essential obligatory services of the Chennai Municipal Corporation. About 99 percent of the fixtures were of high power type, comprising of 108912 sodium vapor lamps, 2194 mercury lamps and 59 high mast lamps.

III. METHODOLOGY

Non-Spatial data:

The field survey had been conducted by Tamil Nadu Slum Clearance Board (TNSCB) for Chennai City. The data acquisition has been revealed and retrieved from TNSCB with relevantly for the present study. The data fully deals about socio-economic factors of the samples people of slums about 242 units out of 1473. The data has been covered for the different categories of samples people of slums in Chennai City.

Data Classification:

The total number of undeveloped slums and corresponding number of slum families in Chennai Metropolitan Area is estimated to be 444 and 10,141 respectively, out of which 242 number of such slums fall within the Chennai City Corporation Area while the remaining 202 fall under the rest of the other Metropolitan area (i.e. Municipalities, upgraded ULBs (erstwhile Town Panchayats) and the Village Panchayats).

In Chennai Corporation Area a total of 1473 slums were covered out of which 242 slums were identified as undeveloped slums. It was observed that there were 71840 slum families located in these slums. Further 122 slums have been categorized as slums located in objectionable areas, which include all slums including those owned by the private parties and 120 slums have been categorized as slums located on unobjectionable areas.

Spatial Data:

The Non-spatial data which has been collected from TNSCB has been transferred as Spatial data for the study area (Chennai City) with correlated to the objective of the present study.

2. Profile Of Slums In Chennai City

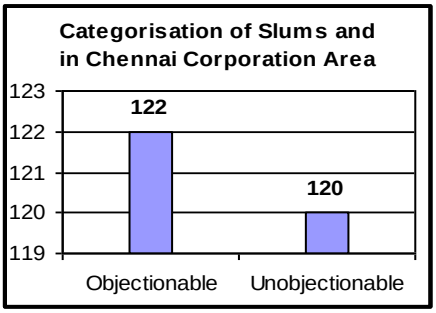
Categorization Of Slums:

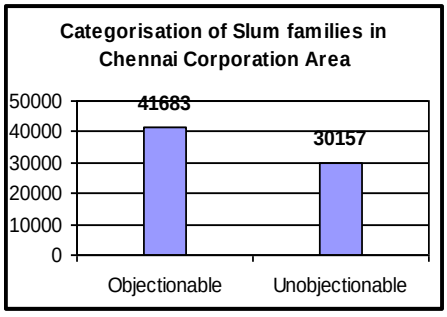
As per the TNSCB, the slums have beencategorized in to the following three categories:

- Slums in Objectionable Areas

These are slums located/formed in land like river/canal margins, ROW of roads, catchment of drains, greenbelts, etc., which do not confirm to the land use assigned in the approved Master Plan.

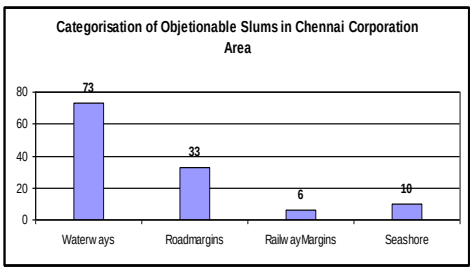
Chart No. 3: Categorisation of Slums and Slum families in Chennai Corporation Area





Out of the 242 slums within the Chennai Corporation Area, 122 slums were classified as under Objectionable Slums and 120 slums as unobjectionable slums. Out of these 122 Objectionable slums 33 slums were found along the Road Margins, 6 slums along the Railway margins, 73 slums along Waterways and 10 along the Seashore. The total families in objectionable category of slums was about 41683 and that in Unobjectionable category was 30157 (Chart no. 3).

Chart No. 4: Categorisation of Objectionable Slums and the No. of Slum families living in these slums in Chennai Corporation Area



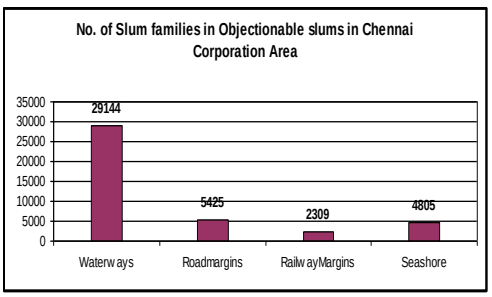
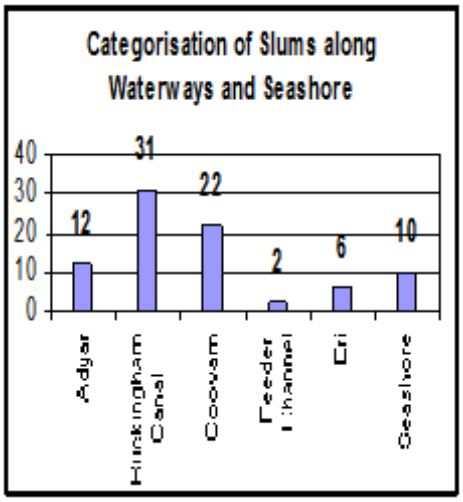


Chart No.5 : Distribution of Slums and Slum families along Waterways and Seashore



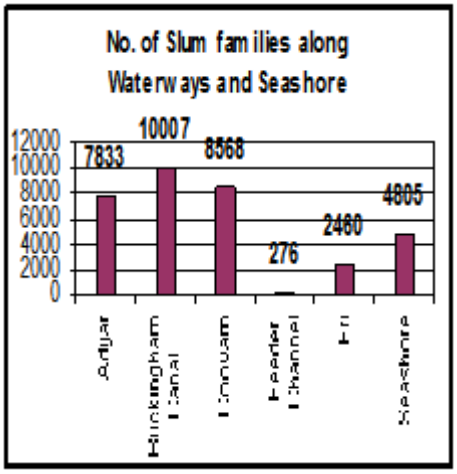
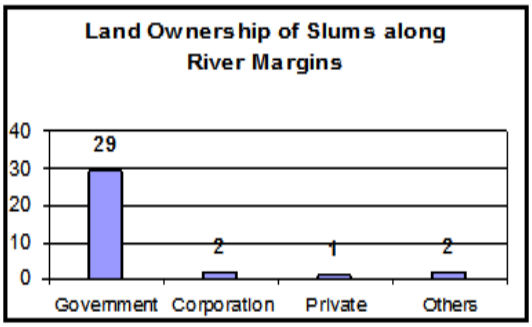
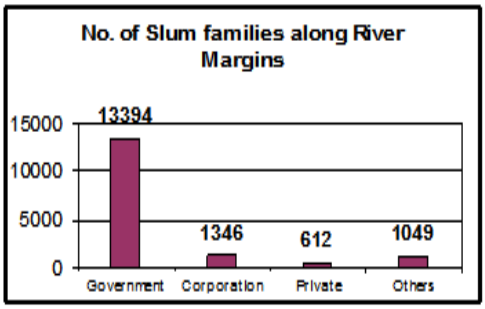


Chart No. 6 : Land Ownership of Slums and Slum families living along River Margins* in Chennai Corporation area.





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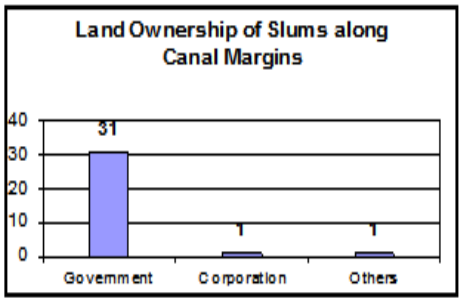
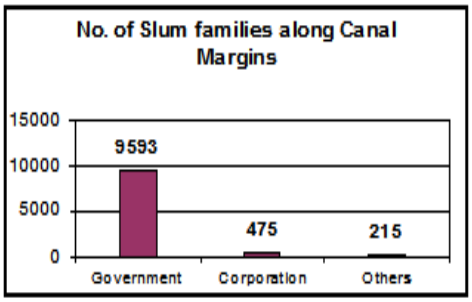
* This covers Slums along Adyar and Coovam Rivers

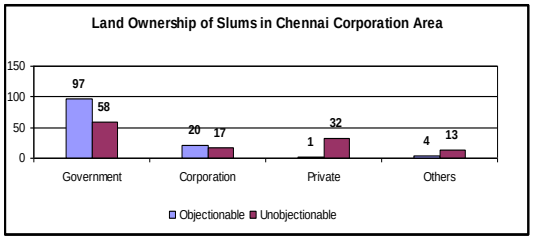
Chart No. 7: Land Ownership of Slums and Slum families along Canal Margins* in Chennai Corporation Area





* This covers Slums along Buckingham Canal and Feeder Channel

Chart No. 8 : Land Ownership Status of Slums and the Distribution of the Slum families in Chennai Corporation Area



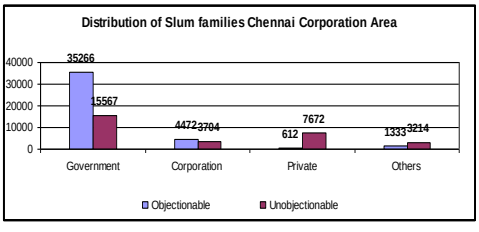
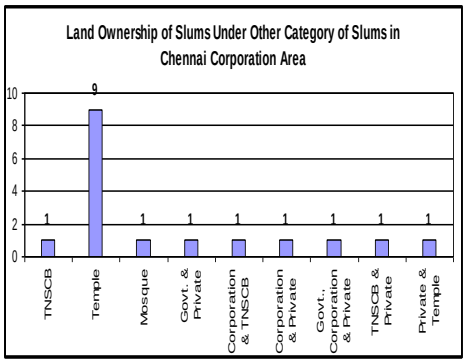
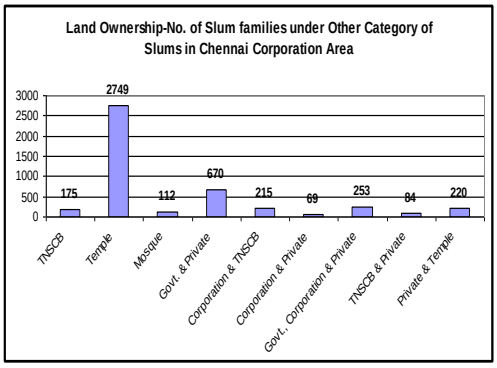


Chart No. 9: Landownership-No. of Slums and Slum families falling under Other Category of lands like Temple TNSCB, etc.





- Slums in Unobjectionable Areas - for those slums that do not encroach upon any kind of land intended for specific purposes or which do not affect the environment of nearby structures, habitations, etc., but do not fall under the first category; and
- Slums in Private Land Areas - for those slums located/formed in land owned by the private individuals/institutions/firms, but do not fall under the first category.

From the above chart nos. 4,5,6,7,8 & 9 it was observed that the following is the summary of findings of the survey and categorization of slums:

- 122 slums have been categorized as slums located in objectionable areas, which include all slums including those owned by the private parties;
- 120 slums have been categorized as slums located on unobjectionable areas, which has the ownership brake-up as follows:
  - 58 slums under this category were located on lands owned by the Government (State/Central) agencies;
  - 17 slums under this category were located on lands owned by Municipal Corporation;
  - 1 slums under this category were located on lands owned by other agencies like TNSCB and TNHB;
  - 9 slums under this category were located on lands owned by Temple/Mosque; and
  - 32 slums under this category were located on lands owned by private agencies.

However, 3 slums are located on land having multiple ownership, i.e. the part parcel of the land where the slum is located, is owned by different agencies.

6. Demand-Gap Assessment Of Environmental Infrastructure Services And Prefeasibility

Assessment Of Environmental Infrastructure

The status of existing service levels in these slums has been reviewed from the point of view of its adequacy for the current population (Year 2004) and the coverage of the facility wherever applicable, for the following core civic service sectors, including the dwelling units:

- Dwelling Units;
- Water Supply;
- Sanitation (Sewerage and Latrine);
- Solid Waste Management;
- Roads and Pavements; and
- Streetlights.

Demand Assessment Surveys

Demand assessment surveys were also undertaken in each of the surveyed slums. A stratified sampling was adopted and the 10 zones provided the 10 strata. A 10% sample of households was drawn from each slum in each zone. The samples were subjected to close scrutiny and consistency checks. In the process 71 samples were excluded for being incomplete or lacking in consistency. The table below indicates the sample size in each zone before and after the scrutiny.

The status assessment of services were undertaken in all the surveyed slums, which included both undeveloped slums, and newly identified slums. The status of existing service levels in these slums has been reviewed from the point of view of its adequacy for the current population (Year 2004) and the coverage of the facility wherever applicable, for the following core civic service sectors, including the dwelling units:

- Dwelling Units;
- Water Supply;

- Sanitation (Sewerage and Latrine);
- Solid Waste Management;
- Roads, Streets and Pavements; and
- Streetlights.

Each of the above core service sectors were assessed quantitatively based on specific service indicators pertaining to service levels, service coverage, and service efficiency. In addition, a qualitative assessment of all of the above core service sectors were undertaken based on the Demand Assessment Surveys carried out in these slums.

Dwelling Units

Summary on Status Assessment

A total of 242 surveyed slums within the administrative jurisdiction of Chennai Municipal Corporation had a total of 46,248 dwelling units to cater to an estimated slum population of 3,29,824 persons and 71,840 families living in these slums, indicating an average of about 7 persons and 2 family/household occupying each dwelling unit. Out of the total stock of the dwelling units, a quarter of it were of pucca in nature while remaining were of semi-pucca and kutcha in nature with almost equal proportion.

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for dwelling units, a demand and gap assessment has been carried out and is presented in the table below zone-wise:

Table No. 4 : Zone-wise Demand-Gap Assessment for Dwelling Units

Sl. No.	Zone	No. of Families	Dwelling Units (Nos.)		
			Existing	Demand	Gap
1.	Zone I	7248	5058	7258	2200
2.	Zone II	3730	2623	3730	1107
3.	Zone III	7282	4380	7282	2902
4.	Zone IV	6003	3752	6003	2251
5.	Zone V	3913	2085	3913	1828
6.	Zone VI	9478	5634	9478	3844
7.	Zone VII	3510	2269	3510	1241
8.	Zone VIII	2618	1687	2618	931
9.	Zone IX	10383	7130	10383	3253
10.	Zone X	17665	11630	17665	6035
	Total	**71840**	**46248**	**71840**	**25592**

Based on the above table no. 4, it is estimated that there is a gap of about 25,592 dwelling units to meet the estimated demand of 71,840 dwelling units, indicating an overall deficiency of about 64 percent to meet the demand.

Water Supply

Summary on Status Assessment

All the surveyed slums located within the administrative jurisdiction of Chennai Municipal Corporation had a total of about 590 public water tanks / water taps / hand pumps to cater to an estimated slum population of 3,29,824 persons and 71,840 families living in these slums, indicating an average of about 620 persons per public water tank/water tap/ hand pump. It may be noted that many of the slums did not have public water tank/tap/ hand pump as these slum dwellers store the water supplied through lorries. It is also evident from the demand assessment surveys that the respondents revealed that a majority of them buy water from these lorries.

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for water supply, a demand and gap assessment has been carried out and is presented in the table below zone-wise:

Table No. 5: Zone-wise Demand-Gap Assessment for Water Supply

Sl. No.	Zone	Public Water Tanks / Water Taps (Nos.)		
		Existing	Demand	Gap
1.	Zone I	40	451	412
2.	Zone II	36	231	195
3.	Zone III	51	465	414
4.	Zone IV	54	364	312
5.	Zone V	19	232	213
6.	Zone VI	70	580	510
7.	Zone VII	23	215	192
8.	Zone VIII	28	169	141
9.	Zone IX	75	641	567
10.	Zone X	194	1049	860
	Total	**590**	**4398**	**3816**

Based on the above table no. 5, it is estimated that there is a gap of about 3816 public water tanks/water taps/ hand pumps, each of capacity of 5000 litres (for two days) to meet the estimated demand of 4398 water tanks/taps/ hand pumps, indicating an overall deficiency of about 14 percent to meet the demand.

Sanitation (Sewerage & Latrine)

Summary on Status Assessment

All the surveyed slums located within the administrative jurisdiction of Chennai Municipal Corporation had a total of about 32 public toilet seats and 12 public urinals to cater to an estimated slum population of 3, 29,824 persons and 71,840 families living in these slums, indicating an average of about 1056 persons and 2817 persons per public toilet seat and public urinal respectively. It may be noted that many of the slums did not have any public toilet/urinal as these slum dwellers were using individual connections or were resorting to open defecation. It is also very evident from the demand assessment surveys that the respondents revealed that a majority of them resort to other means of latrine.

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for sanitation (sewerage and latrine), a demand and gap assessment has been carried out and is presented in the table below zone-wise:

Table No. 6 : Zone-wise Demand-Gap Assessment for Sanitation (Sewerage and Latrine)

Sl. No.	Zone	Public Toilet Seats (Nos.)			Public Urinals (Nos.)			Storm Water Drains (km)
		Existing	Demand	Gap	Existing	Demand	Gap	
1.	Zone I	32	1127	1111	12	676	673	22.26
2.	Zone II	0	506	578	0	347	347	10.70
3.	Zone III	0	1162	1162	0	697	697	9.59
4.	Zone IV	0	911	911	0	547	547	9.48
5.	Zone V	0	581	581	0	348	348	4.63
6.	Zone VI	0	1449	1449	0	870	870	8.48
7.	Zone VII	0	538	538	0	323	323	4.43
8.	Zone VIII	0	423	423	0	254	254	2.69
9.	Zone IX	0	1604	1604	0	962	962	9.11
10.	Zone X	0	2622	2622	0	1573	1573	18.03
	Total	**32**	**10922**	**10979**	**12**	**6596**	**6594**	**99.41**

Based on the above table no.6, it is estimated that there is a gap of about 10979 public toilet seats and 6594 public urinals to meet the estimated demand of 10922 public toilet seats and 6596 public urinals respectively. In addition, about 99.41 km of storm water drains need to be provided along the surfaced roads only.

Solid Waste Management

Summary on Status Assessment

As stated earlier, the solid waste generation in the surveyed slums has been estimated assuming a per capita waste generation of 600 grams per day and as a whole the slums located within the administrative jurisdiction of Chennai Municipal Corporation were generating about 134.21 MT per day. From the field visits and the discussion with the officials of the Chennai Municipal Corporation, the Consultants understand that the temporary waste storage points are located outside the slums irrespective of the road length inside a slum, due to the paucity of space inside. Accordingly, it is assumed that there were no temporary waste storage points / dustbins within the slums as the same need to be designed separately suiting to the space requirements of the slums.

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for solid waste management, a demand and gap assessment has been carried out and is presented in the table below zone-wise. It may be noted that the size of each dustbin/container is envisaged as 0.30 cu. m (approximately 150 kg of solid waste) as larger dustbin or containers are not possible to place due to paucity of space. Accordingly, the numbers of dustbins/containers have been estimated taking the maximum figure out of requirement of dustbins or containers based on quantity of waste generated (1.5 times) or spacing between the dustbins/container (300 m).

Table No. 7 : Zone-wise Requirement of Dustbins/Containers for Solid Waste Management

Sl. No.	**Zone**	**Dustbins/Containers (Nos.)**		
		Based on Waste Generation (1.5 times waste generated)	**Based on Spacing between the Bins** (300 m apart)	**Suggestion** (Maximum of 1 and 2)
		1	**2**	**3**
1.	Zone I	203	36	203
2.	Zone II	104	18	104
3.	Zone III	209	66	209
4.	Zone IV	164	39	164
5.	Zone V	105	60	105
6.	Zone VI	261	32	261
7.	Zone VII	97	45	97
8.	Zone VIII	76	21	76
9.	Zone IX	289	41	289
10	Zone X	474	70	474
	Total	1982	428	1982

Based on the above table no. 7, it is estimated that about 1982 Nos. of dustbins/containers, each of capacity 0.30 cu. m (approximately about 150 kg) is required to improve the solid waste management system in these slums.

Roads, Pavements And Streets

Summary on Status Assessment

As stated earlier, the surveyed 242 slums were spread over an area of about 1725735.66 sq. m (1.73 sq. km) and were covered with about 83.53 running km of road length. Out of which, about 59.18 km was surfaced road. It was observed that the road density was very low with just 0.05 m of road for every sq. m of slum area. However, 71 percent of surfaced road is a positive indication, requiring minimum capital expenditure.

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for roads and pavements, a demand and gap assessment has been carried out and is presented in the table below zone-wise.

Table No. 8: Zone-wise Demand-Gap Assessment for Roads and Pavements

Sl. No.	**Zone**	**Roads, Pavements and Streets - Surfaced Roads (km)**		
		Existing	**Demand**	**Gap**
1.	Zone I	9.68	10.68	1.85
2.	Zone II	2.96	4.70	1.97
3.	Zone III	8.54	8.63	0.89
4.	Zone IV	4.87	8.53	4.07
5.	Zone V	2.83	4.16	1.49
6.	Zone VI	7.96	7.63	0.41

Sl. No.	Zone	Roads, Pavements and Streets - Surfaced Roads (km)		
		Existing	Demand	Gap
7.	Zone VII	2.94	3.99	1.17
8.	Zone VIII	1.45	2.42	1.11
9.	Zone IX	6.79	8.20	2.03
10.	Zone X	11.17	16.23	6.09
	Total	**59.18**	**75.17**	**21.08**

Based on the above table no.8, it is estimated that there is a gap of about 21.08 km of roads to be upgraded into surfaced road category to meet the estimated demand of 75.17 km, indicating an overall deficiency of about 28 percent to meet the demand.

Streetlights

Summary on Status Assessment

As stated earlier, the surveyed 242 slums had about 1,991 light fixtures, spread over a road length of about 59.18 running km. It is observed that the slums of Chennai City were better lit though there is a scope to improve the same.

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for streetlights, a demand and gap assessment has been carried out and is presented in the table below zone-wise.

Table No. 9 : Zone-wise Demand-Gap Assessment for Streetlights

Sl. No.	Zone	Streetlight Fixtures		
		Existing	Demand	Gap
1.	Zone I	259	475	220
2.	Zone II	108	209	114
3.	Zone III	220	384	183
4.	Zone IV	148	379	234
5.	Zone V	58	185	134
6.	Zone VI	274	339	110
7.	Zone VII	108	177	75
8.	Zone VIII	95	108	25
9.	Zone IX	300	365	167
10.	Zone X	421	721	340
	Total	**1991**	**3341**	**1601**

Based on the above table no.9, it is estimated that there is a gap of about 1601 fixtures to meet the estimated demand of 3341 streetlight fixtures, indicating an overall deficiency of about 48 percent to meet the demand.

7. Sanitation - Existing, Demand And Gap Assessment Of Chennai Slums

Existing – Sanitation (Sewerage & Latrine)

A good sanitary environment is essential for overall health and hygiene. Sanitation (both sewerage and latrine including storm water drainage) is one of the core environmental infrastructure services requiring attention in case of slums upgrading. The following indicators have been analyzed to assess the existing service levels, coverage and efficiency in delivery.

Table No. 10: Service Indicators for Sanitation (Sewerage and Latrine)

Sl. No.	Particulars	Service Indicators
1.	Service levels	▪ Population per seat of public latrine ▪ Population per urinal of public latrine

Based on the available fact base, about 319 public toilet seats and 180 public urinals were located within the slums of the Chennai City. In general, it was observed that the sanitation aspects were given little importance in these slums and scenes of open defecation were common in many of the surveyed slums. The following table provides the number of public toilet seats and public urinals available in slums located each zone and their interpretation with respect to the service indicator as number of persons per public toilet seat and public urinal.

Table No. 11: Zone-wise Break-up of Number of Public Toilet Seats & Public Urinals and Number of Persons per Public Toilet Seat & Public Urinal

Sl. No.	Zones	Numbers		No. of Persons per Unit	
		Public Toilet Seats	Public Urinals	Public Toilet Seats	Public Urinals
1.	Zone I	32	12	1056	2817
2.	Zone II	0	0	--	--
3.	Zone III	0	0	--	--
4.	Zone IV	0	0	--	--
5.	Zone V	0	0	--	--
6.	Zone VI	0	0	--	--
7.	Zone VII	0	0	--	--
8.	Zone VIII	0	0	--	--
9.	Zone IX	0	0	--	--
10.	Zone X	0	0	--	--
	Total	**32**	**12**	**1056**	**2817**

From the above table, it is evident that the number of persons sharing the public toilet seats and public urinals is very high with an average of about 1086 persons and 2817 persons per toilet seat and urinal respectively (Table No. 11, Chart No. 10 & 11)). The situation is worse in all zones except Zone where there are no toilets within the slum.

Chart No. 10: Zone-wise Break-up of Number of Public Toilet Seats and Public Urinals

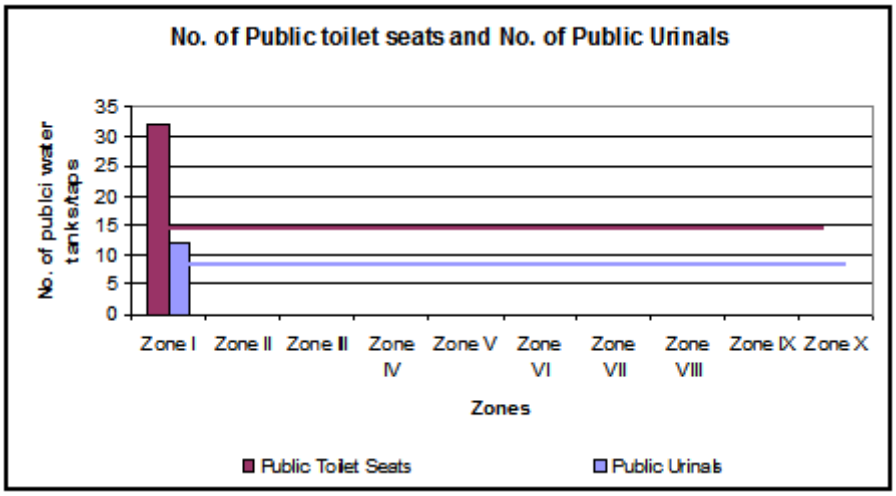
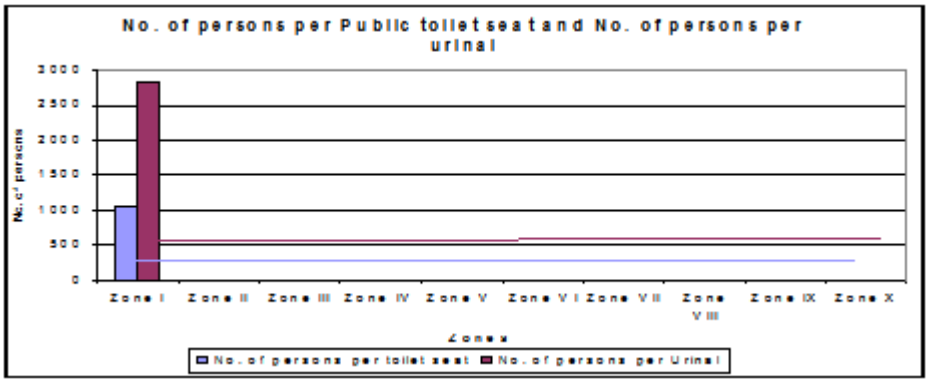


Chart No. 11: Zone-wise Break-up of Number of Persons per Public Toilet Seat and Public Urinal



Distribution Of Public Toilet Seats, Urinals, Waste Dustbins

PUBLIC TOILET SEATS

The Map No. 4.1 infers about the distribution of existing public Toilet Seats in slum of Chennai City.

In zone No.I, the highest existing public toilet seats are 32 in numbers. In zone Nos. from II to X, there is no Public Toilets Seats in numbers.

Out of ten zones in Chennai City, except Zone No. I are plays the lowest existing of public toilet seats of slums in numbers.

PUBLIC URINALS

The Map No. 4.2 infers about the distribution of existing Public Urinals in slum of Chennai City.

In zone No.I, the highest existing public Urinals are 12 in numbers. In zone Nos. from.II to X, there is no Public Urinals in numbers.

Out of ten zones in Chennai City, except Zone No. I are plays the lowest existing of Public Urinals of slums in numbers.

SOLID WASTE DUSTBINS

The distribution of existing public Waste Dust Bin in slum of Chennai City, In zone No.I, the highest existing public toilet seats are 0 in numbers. In zone Nos. from II to X, there is no Public Waste Dust Bins in numbers.

Out of ten zones in Chennai City, almost in all the Zones, are plays the lowest existing and no more public Waste Dustbins of slums in numbers.

Demand Assessment Of Sanitary Facilities

Type of Latrine Facility

While about 29.2 percent of the households have reported that they were using individual latrine/pit, another 48.3 percent of the households revealed that they used community / public latrine. About 22.5 percent of the households were using other means including open defecation, as detailed in the table below (Table No. 12). It may be noted that the Zones 1, 4 and 9 had more number of respondents resorting to other means for latrine. In particular, Zone 1 had nearly 61.7 percent of respondents expressed that they depend on other means, indicating the seriousness of the problem in the zone. The chart below provides zone wise rating based on dependency to the other means for latrine propose (Chart No. 12).

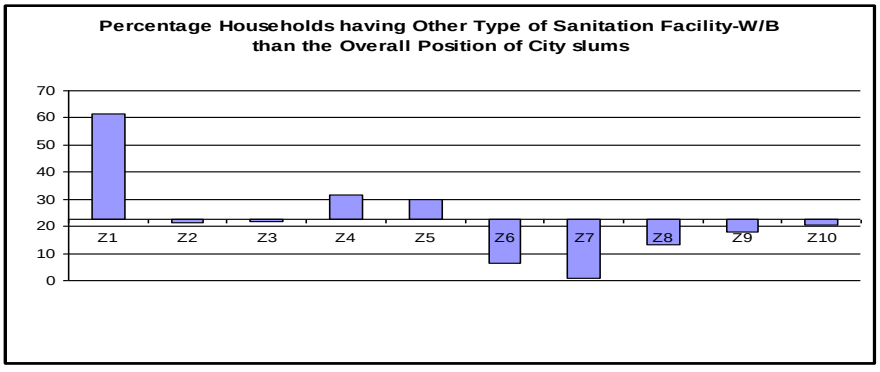
Table No. 12: Zone-wise Break-up of Type of Latrine Facility

All figures are in Percentage

Sl. No.	Zones	Individual/ Pit Latrines	Community/ Public Latrines	Others	Total
1.	Zone I	10.3	28.0	61.7	100.0
2.	Zone II	4.7	73.7	21.6	100.0
3.	Zone III	23.0	55.2	21.8	100.0
4.	Zone IV	36.9	31.7	31.4	100.0
5.	Zone V	42.3	27.9	29.8	100.0
6.	Zone VI	7.0	86.6	6.4	100.0
7.	Zone VII	34.1	65.0	0.9	100.0
8.	Zone VIII	48.4	38.4	13.2	100.0
9.	Zone IX	47.2	34.7	18.0	100.0
10.	Zone X	38.0	41.3	20.7	100.0
	Total	**29.2**	**48.3**	**22.5**	**100.0**

Source: Demand Assessment Surveys; 2004

Chart No. 12: Zone-wise Rating of Slums based on the Usage of Other Means of Latrine



Source: Demand Assessment Surveys; 2004

Distance of Public/Community Latrine

With regard to the distance of public latrines, nearly 6.4 percent of the respondents reported that they had to walk more than 100 m to use community toilet/public latrines, in which about 1.8 percent of the households have revealed that they go beyond 250 meters, as indicated in the table below(Table No. 13). A majority of the respondents (about 32.9 percent) had community toilet/public latrine facility within 50 m distance, while about 38.2 percent did not respond to this query. The chart below presents zone wise rating in terms of respondents going beyond 100 m for using the community toilet/public latrine facility (Char No. 13).

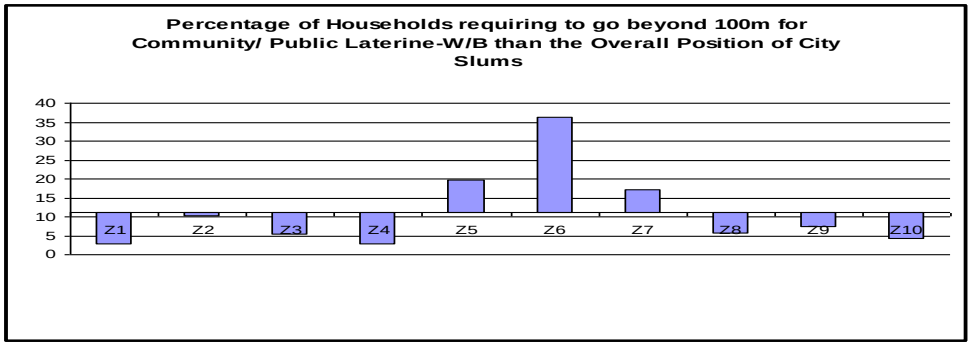
Table No. 13: Zone-wise Break-up of Distance of Community/Public Latrine within Slums

All figures are in Percentage

Sl. No.	Zones	<50m	51-100	101-150	151-200	201-250	251m+	No Response	Total
1.	Zone I	15.4	12.6	0.8	0.8	0.4	0.8	69.2	100.0
2.	Zone II	23.7	44.4	6.5	2.6	1.3	0.0	21.6	100.0
3.	Zone III	24.8	25.9	1.4	0.4	0.2	3.6	43.8	100.0
4.	Zone IV	41.1	5.9	2.1	0.7	0.0	0.0	50.1	100.0
5.	Zone V	38.9	10.1	8.7	0.5	7.7	2.9	31.3	100.0
6.	Zone VI	25.3	26.1	33.3	0.8	1.9	0.2	12.5	100.0
7.	Zone VII	24.8	26.5	5.8	2.7	5.3	3.5	31.4	100.0
8.	Zone VIII	26.3	14.7	0.5	3.7	0.0	1.6	53.2	100.0
9.	Zone IX	12.2	21.4	4.3	0.9	0.6	1.7	58.9	100.0
10.	Zone X	26.1	18.9	0.6	1.8	0.3	1.7	50.6	100.0
	Total	**25.9**	**20.7**	**6.4**	**1.5**	**1.8**	**1.6**	**42.2**	**100.0**

Source: Demand Assessment Surveys; 2004

Chart No. 13: Zone-wise Rating of Slums Having Community Toilet Facility more than 100 m Distance



Source: Demand Assessment Surveys; 2004

Maintenance of Public/Community Latrine

From the demand assessment surveys, it appears that the community/public latrines were maintained well as about 30.7 percent of households indicated that the latrines were always clean; another 15.3 percent indicated that the latrines were often clean. About 54.1 percent of the households indicated that the latrines were rarely or never clean, as given in the table below (Table No.14). The zone wise rating based on response on lack of cleanliness is depicted in the chart below (Chart No. 14). In particular, the level of complaints seems much greater in Zone 1 as compared to the overall position in city slums.

Table No.14: Zone-wise Break-up of Maintenance of Community/Public Latrine

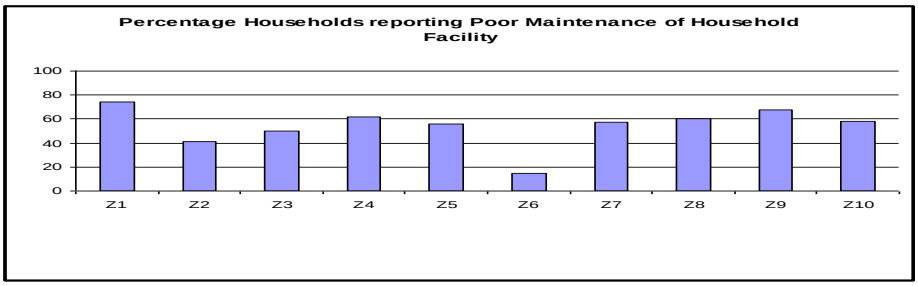
All figures are in Percentage

Sl.	Zones	Always Clean	Often Clean	Rarely Clean	Never Clean	Total	Poor
1.	Zone I	13.6	12.2	1.0	73.2	100.0	74.2
2.	Zone II	42.7	16.4	16.8	24.1	100.0	40.9
3.	Zone III	32.3	18.0	2.8	46.9	100.0	49.7
4.	Zone IV	24.8	13.5	1.2	60.5	100.0	61.7
5.	Zone V	28.4	15.9	2.4	53.4	100.0	55.8
6.	Zone VI	34.4	51.2	1.6	12.8	100.0	14.4
7.	Zone VII	38.1	4.9	12.8	44.2	100.0	57.1
8.	Zone VIII	36.8	2.6	0.5	60.0	100.0	60.5
9.	Zone IX	26.9	5.5	2.8	64.8	100.0	67.6

Sl.	Zones	Always Clean	Often Clean	Rarely Clean	Never Clean	Total	Poor
10.	Zone X	29.0	12.8	0.8	57.4	100.0	58.2
	Total	**30.7**	**15.3**	**4.3**	**49.8**	**100.0**	**54.0**

Source: Demand Assessment Surveys; 2004

Chart No. 14: Zone-wise Rating of Slums Reporting Poor Maintenance of Public/ Community Latrine



Source: Demand Assessment Surveys; 2004

Monthly Expenditure on Maintenance of Public/Community Latrine

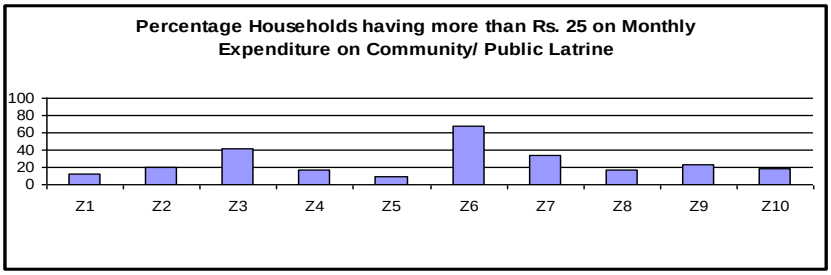
The cleanliness of the public latrine comes at a cost, which some slum dwellers were bearing. The monthly expenditure on maintenance of public latrine was under Rs. 25 for about 16 percent of the households, between Rs. 26 to Rs. 50 for 23.3 percent of the households and above Rs. 50 for another 2.7 percent of the households, as given in the table below (Table No. 15). The zone wise rating on the status of those slums with monthly expenditure of more than Rs. 25 as compared to the overall position of city slums is depicted in the chart below(Chart No.15).

Table No. 15: Zone-wise Break-up of Monthly Expenditure on Maintenance of Community/ Public Latrine
All figures are in Percentage

Sl. No.	Zones	Less than Rs. 25	Rs. 26 to Rs. 50	More than Rs. 50	None	No Response	Total	More than Rs. 25
1.	Zone I	11.2	12.0	0.6	16.4	59.8	100.0	12.6
2.	Zone II	46.6	19.4	0.4	10.3	23.3	100.0	19.8
3.	Zone III	6.7	28.3	13.7	31.9	19.4	100.0	42.0
4.	Zone IV	10.9	17.0	0.2	35.2	36.6	100.0	17.3
5.	Zone V	24.5	8.2	0.5	43.8	23.1	100.0	8.7
6.	Zone VI	6.6	67.3	0.4	19.3	6.4	100.0	67.7
7.	Zone VII	16.4	32.7	0.4	31.0	19.5	100.0	33.2
8.	Zone VIII	9.5	15.8	1.1	53.7	20.0	100.0	16.8
9.	Zone IX	7.7	16.7	6.9	53.3	15.4	100.0	23.7
10.	Zone X	20.1	15.2	2.8	26.1	35.8	100.0	18.0
	Total	**16.0**	**23.3**	**2.7**	**32.1**	**25.9**	**100.0**	**26.0**

Source: Demand Assessment Surveys; 2004

Chart No.15: Zone-wise Households Reporting Monthly Expenditure of more than Rs. 25 on Maintenance of Public/ Community Latrine



Source: Demand Assessment Surveys; 2004

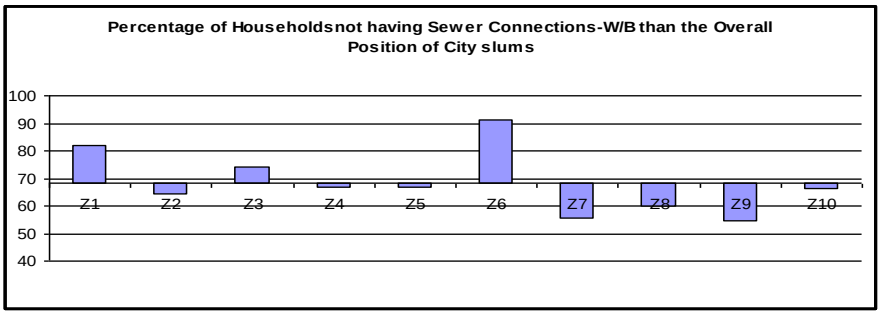
Availability of Sewer Connection

Based on the demand assessment survey, it was observed that almost 68.2 percent of the households did not have sewer connection as given in the table below (Table No. 16). The chart below depicts the zone wise position in this regard. A far greater proportion of households in Zones 1, 3, 4, 6,8 & 9 did not have sewer connection as compared to the overall position of city slums (Chart No. 16).

Table No. 16: Zone-wise Break-up of Availability of Sewer Connections
All figures are in Percentage

Sl. No.	Zones	Yes	No	Total
1.	Zone I	18.3	81.7	100.0
2.	Zone II	35.8	64.2	100.0
3.	Zone III	25.9	74.1	100.0
4.	Zone IV	33.1	66.9	100.0
5.	Zone V	33.2	66.8	100.0
6.	Zone VI	8.6	91.4	100.0
7.	Zone VII	44.2	55.8	100.0
8.	Zone VIII	40.0	60.0	100.0
9.	Zone IX	45.3	54.7	100.0
10.	Zone X	33.6	66.4	100.0
	Total	**31.8**	**68.2**	**100.0**

Chart No. 16: Zone-wise Rating based on the Households having Sewer Connection



Source: Demand Assessment Surveys; 2004

Willingness-to-Pay for New Sewer Connection

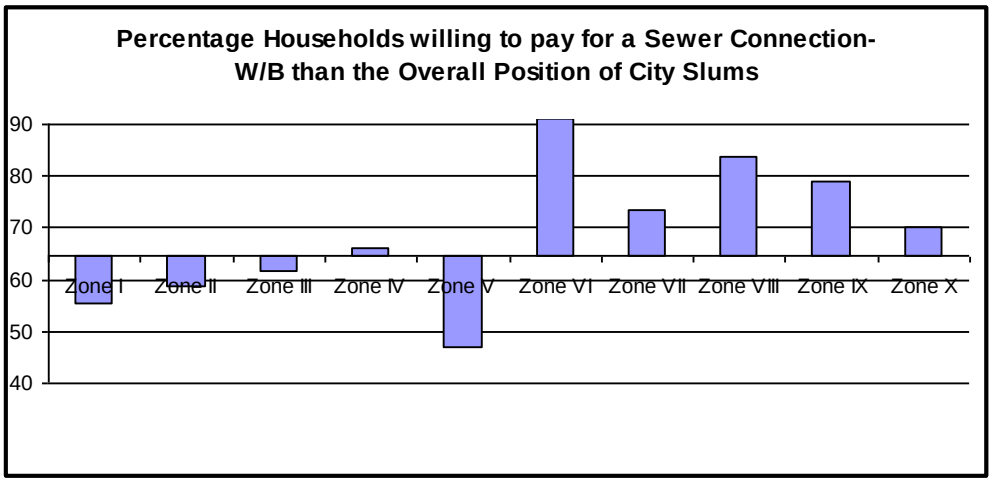
The survey found that a majority of the households (about 68.6 percent), who did not have a sewer connection, were willing to avail a new connection at a price, as given in the table below (Table No. 17). In case of Zone 5, about half of the respondents are not willing to pay for the new sewer connection. The chart below presents zone wise position of the households who wished to avail sewer connection at a cost (Chart No. 17).

Table No. 17: Zone-wise Break-up of Households Willingness to Pay for New Sewer Connection
All figures are in Percentage

Sl. No.	Zones	Yes	No	No Response	Not Necessarily	Total
1.	Zone I	55.6	19.5	24.9	0.0	100.0
2.	Zone II	58.6	40.1	1.3	0.0	100.0
3.	Zone III	61.6	34.7	3.8	0.0	100.0
4.	Zone IV	66.2	32.2	1.7	0.0	100.0
5.	Zone V	47.1	51.9	1.0	0.0	100.0
6.	Zone VI	91.1	7.8	0.4	0.8	100.0
7.	Zone VII	73.5	25.7	0.4	0.4	100.0
8.	Zone VIII	83.7	14.7	1.6	0.0	100.0
9.	Zone IX	79.1	18.8	1.8	0.3	100.0
10.	Zone X	70.0	28.4	1.2	0.4	100.0
	Total	**68.6**	**27.4**	**3.8**	**0.2**	**100.0**

Source: Demand Assessment Surveys; 2004

Chart No. 17: Zone-wise Rating based on the Households Willingness to Pay for New Sewer Connection



Source: Demand Assessment Surveys; 2004

Availability of Storm Water Drains

With regard to the availability of storm water drains, while 38.9 percent of the households indicated its availability, the other 61.1 percent of the households indicated its absence. Zone wise details about the availability of storm water details are given in the table below (Table No. 18).

Table No. 18: Zone-wise Break-up of Availability of Storm Water Drains in the Slum

All figures are in Percentage

Sl.	Zones	Yes	No	Total
1.	Zone I	35.3	64.7	100.0
2.	Zone II	44.8	55.2	100.0
3.	Zone III	23.0	77.0	100.0
4.	Zone IV	48.7	51.3	100.0
5.	Zone V	38.0	62.0	100.0
6.	Zone VI	39.1	60.9	100.0
7.	Zone VII	63.7	36.3	100.0
8.	Zone VIII	21.6	78.4	100.0
9.	Zone IX	23.9	76.1	100.0
10.	Zone X	50.7	49.3	100.0
	Total	**38.9**	**61.1**	**100.0**

Source: Demand Assessment Surveys; 2004

Monthly Expenditure on Sewerage and Drainage

Only about 12 percent of the households were incurring a monthly expenditure on sewerage and drainage, as given in the table below (Table No. 18a). The chart below depicts the zone wise position of the households incurring expenses on sewerage and drainage (Chart No. 18).

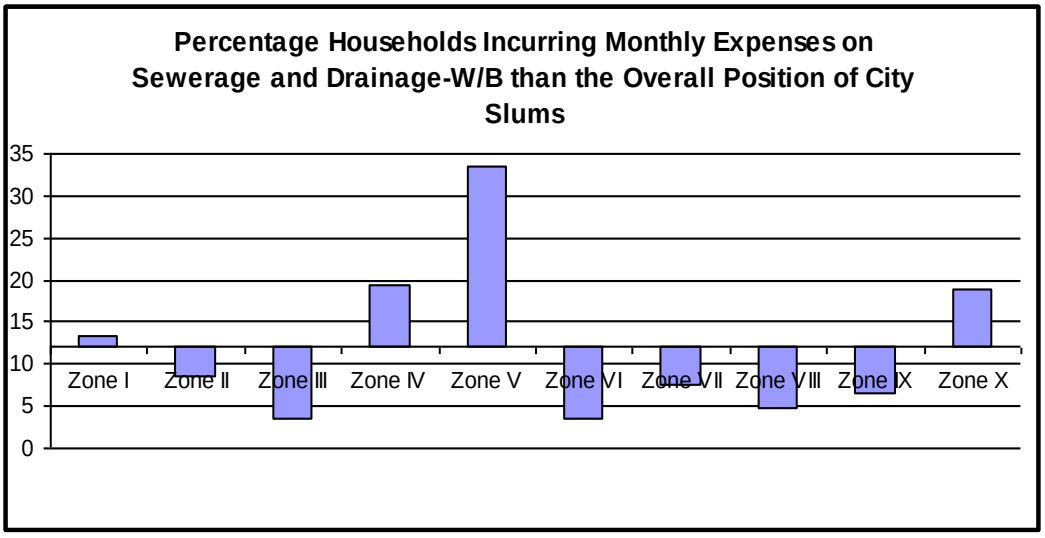
Table No. 18a : Zone-wise Break-up of Monthly Expenditure on Sewerage and Drainage

All Figures in Percentage

Sl. No.	Zones	<Rs. 50	Rs. 51 -Rs. 100	>Rs. 100	None	No Response	Total
1.	Zone I	12.0	1.4	0.0	62.5	24.1	100.0
2.	Zone II	8.6	0.0	0.0	90.5	0.9	100.0
3.	Zone III	2.8	0.8	0.0	95.2	1.2	100.0
4.	Zone IV	19.1	0.2	0.2	79.2	1.2	100.0
5.	Zone V	31.7	1.4	0.5	65.4	1.0	100.0
6.	Zone VI	1.4	1.0	1.0	96.7	0.0	100.0
7.	Zone VII	0.9	4.9	1.8	92.0	0.4	100.0
8.	Zone VIII	4.2	0.5	0.0	94.2	1.1	100.0
9.	Zone IX	5.4	1.2	0.0	92.0	1.4	100.0
10.	Zone X	17.3	1.2	0.4	79.0	2.1	100.0
	Total	**10.3**	**1.3**	**0.4**	**84.7**	**3.3**	**100.0**

Source: Demand Assessment Surveys; 2004

Chart No. 18: Zone-wise Rating based on Monthly Expenses on Sewerage and Drainage



Source: Demand Assessment Surveys; 2004

Willingness-to-Pay for Improved Sewerage and Drainage

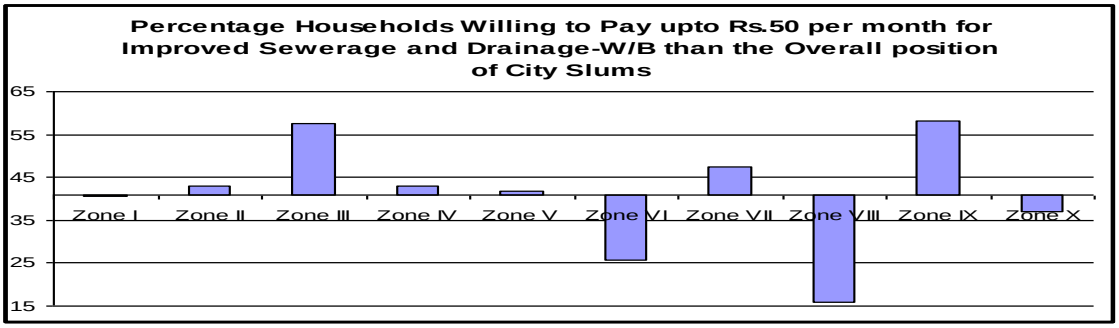
For the query on the willingness-to-pay for the improved sewerage and drainage, a majority of the respondents (about 54.6 percent) responded unfavorably while about 41 percent were willing to pay less than Rs. 50 per month. About 0.7 percent were willing to pay Rs. 51-100 per month for improved sewerage and drainage, while about 0.3 percent were willing to pay more than Rs. 100 per month for the improved sewerage and drainage, as presented in the table below (Table No. 19). The chart below presents zone wise rating of the slums in terms of respondents' willingness-to-pay up to Rs. 50 per month on the improved sewerage and drainage (Chart No. 19).

Table No. 19: Zone-wise Break-up on Amount Willing to pay per month on Sewerage and Drainage
All Figures in Percentage

Sl. No.	Zones	Less than Rs. 50	Rs. 51 -Rs. 100	More than Rs. 100	None	No Response	Total
1.	Zone I	40.6	0.2	0.0	34.9	24.3	100.0
2.	Zone II	43.1	0.4	0.0	55.6	0.9	100.0
3.	Zone III	57.6	0.0	0.2	40.8	1.4	100.0
4.	Zone IV	43.0	0.2	0.0	55.8	0.9	100.0
5.	Zone V	41.8	0.5	0.0	56.7	1.0	100.0
6.	Zone VI	25.7	0.4	0.8	73.0	0.2	100.0
7.	Zone VII	47.3	4.0	0.4	48.2	0.0	100.0
8.	Zone VIII	15.8	0.5	1.1	81.6	1.1	100.0
9.	Zone IX	58.3	0.3	0.3	39.9	1.2	100.0
10.	Zone X	37.0	0.8	0.2	59.9	2.1	100.0
	Total	**41.0**	**0.7**	**0.3**	**54.6**	**3.3**	**100.0**

Source: Demand Assessment Surveys; 2004

Chart No. 19: Zone-wise Rating for up to Rs. 50 Willingness-to-Pay for the Improved Sewerage and Drainage



Source: Demand Assessment Surveys; 2004

Problems of Sewerage and Drainage

With regard to problems of sewerage and drainage, an overwhelming majority of households (85.9 percent) indicated that there were no problems. A minority of about 10.6 percent of the households indicated choking, poor maintenance and flooding during rain, etc., as given in the table below (Table No. 20). The zone wise variation in this aspect is presented in the chart below (Chart No. 20). It may be noted that about one-third of the respondents in Zone 1 did not answer for this query.

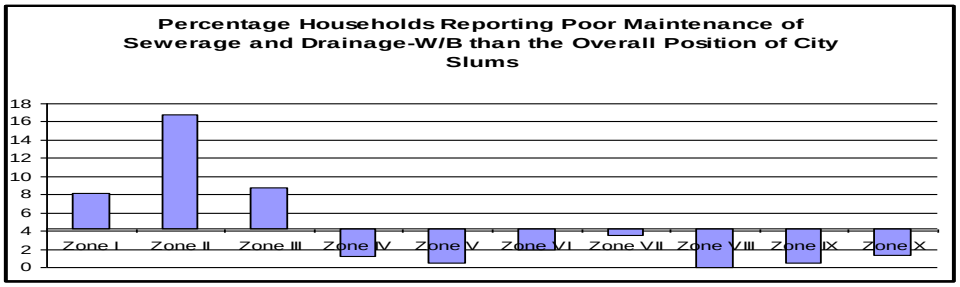
Table No. 20: Zone-wise Break-up Indicating Problems in Sewerage and Drainage

All Figures in Percentage

Sl. No.	Zones	Choking of Drains	Poor Maintenance	Flooding during Rain	None	No Response	Total
1.	Zone I	0.2	8.1	0.0	64.1	27.6	100.0
2.	Zone II	0.0	16.8	0.4	81.9	0.9	100.0
3.	Zone III	0.0	8.7	0.0	91.1	0.2	100.0
4.	Zone IV	7.8	1.2	0.0	89.8	1.2	100.0
5.	Zone V	41.8	0.5	0.0	56.7	1.0	100.0
6.	Zone VI	0.8	1.9	0.4	96.9	0.0	100.0
7.	Zone VII	0.0	3.5	5.3	91.2	0.0	100.0
8.	Zone VIII	2.1	0.0	0.0	96.3	1.6	100.0
9.	Zone IX	0.6	0.5	0.2	97.6	1.2	100.0
10.	Zone X	3.6	1.3	0.0	93.6	1.4	100.0
	Total	**5.7**	**4.3**	**0.6**	**85.9**	**3.5**	**100.0**

Source: Demand Assessment Surveys; 2004

Chart No. 20: Zone-wise Rating Indicating the Poor Maintenance of Sewerage & Drainage



Source: Demand Assessment Surveys; 2004

Demand Gap Of Sanitation In Slums Of Chennai City

PUBLIC TOILET SEATS

The Map No. 4.3 infers about the distribution of existing, demand, gap of Public Toilet Seats in slums of Chennai City.

In zone No.I, the highest existing public toilet seats are 32 in numbers. The highest demand public toilet seats are 1126 in numbers. The highest gap public toilet seats are 1111 in numbers.In zone No.II, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 506 in numbers. The highest gap public toilet seats are 578 in numbers. In zone No.III, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 1162 in numbers. The highest gap public toilet seats are 1162 in numbers.In zone No.IV, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 910 in numbers. The highest gap public toilet seats are 910 in numbers. In zone No.V, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 581 in numbers. The highest gap public toilet seats are 581 in numbers. In zone No.VI, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 1449 in numbers. The highest gap public toilet seats are 1449 in numbers. In zone No.VII, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 538 in numbers. The highest gap public toilet seats are 538 in numbers.In zone No.VIII, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 423 in numbers. The highest gap public toilet seats are 423 in numbers.In zone No.IX, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats are 1604 in numbers. The highest gap public toilet seats are 1604 in numbers.In zone No.X, the highest existing public toilet seats are 0 in numbers. The highest demand public toilet seats is 2622 in numbers. The highest gap public toilet seats are 2622

in numbers.

Out of ten zones in Chennai City except Zone No. I plays the lowest existing of public toilet seats of slums in numbers. The highest demand public toilet seats falls under the zone no. X. The highest gap of public toilet seats falls under the zone no. X.

PUBLIC URINALS

The Map No. 4.4 infers about the distribution of existing, demand, gap of public urinals in slum of Chennai City.

In zone No.I, the highest existing public urinals are 12 in numbers. The highest demand public urinals is 676 in numbers. The highest gap public urinals are 673 in numbers.In zone No.II, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 347 in numbers. The highest gap public urinals are 347 in numbers.In zone No.III, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 697 in numbers. The highest gap public urinals are 697 in numbers.In zone No.IV, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 546 in numbers. The highest gap public urinals are 546 in numbers.In zone No.V, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 348 in numbers. The highest gap public urinals are 348 in numbers.In zone No.VI, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 867 in numbers. The highest gap public urinals are 867 in numbers.In zone No.VII, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 323 in numbers. The highest gap public urinals are 323 in numbers.In zone No.VIII, the highest existing public urinals is 0 in numbers. The highest demand public urinals are 254 in numbers. The highest gap public urinals are 254 in numbers.In zone No.IX, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 962 in numbers. The highest gap public urinals are 962 in numbers.In zone No.X, the highest existing public urinals are 0 in numbers. The highest demand public urinals are 1573 in numbers. The highest gap public urinals are 1573 in numbers.

Out of ten zones in Chennai City except Zone No. I play the lowest in numbers existing of public urinals of slums. The highest demand public urinals falls under the zone no. X. The highest gap of public urinals falls under the zone no. X.

SOLID WASTE DUSTBINS

The Map No. 4.5 infers about the distribution of existing, demand, gap of public Waste Dust Bins in slum of Chennai City.

In zone No.I, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 203 in numbers. The highest gap solid waste dustbins are 203 in numbers.In zone No.II, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 104 in numbers. The highest gap solid waste dustbins are 104 in numbers.In zone No.III, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 209 in numbers. The highest gap solid waste dustbins are 209 in numbers. In zone No.IV, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 164 in numbers. The highest gap solid waste dustbins are 164 in numbers.In zone No.V, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 104 in numbers. The highest gap solid waste dustbins are 104 in numbers.In zone No.VI, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 261 in numbers. The highest gap solid waste dustbins are 261 in numbers.In zone No.VII, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 97 in numbers. The highest gap solid waste dustbins are 97 in numbers.In zone No.VIII, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste 76tbins are 169 in numbers. The highest gap solid waste dustbins are 76 in numbers.In zone No.IX, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 289 in numbers. The highest gap solid waste dustbins are 289 in numbers.In zone No.X, the highest existing solid waste dustbins are 0 in numbers. The highest demand solid waste dustbins are 474 in numbers. The highest gap solid waste dustbins are 474 in numbers.

Out of ten zones in Chennai City all Zones are plays the lowest existing of Public Waste Dust Bins of slums in numbers. The highest demand Public Waste Dust Bins falls under the zone no. X. The highest gap of public water tanks falls under the zone no. X.

Demand Gap Of Infrastructure (Sanitary) In Slums Of Chennai City

The Map No. 4.6 infers about the distribution of requirements of infrastructure needed in Chennai City. In zone No. X, is the first highest requirements of infrastructure needed in numbers, plays a first role in Chennai City. The second highest number of requirements of infrastructure needed in Chennai City falls under Zone No. IX. The third highest number of requirements of infrastructure needed in Chennai City falls under the zone No.VI. The lowest number of requirements of infrastructure needed for slums in Chennai City falls under the zone Nos. VII, II, and VIII .

Summary on Status Assessment

All the surveyed slums located within the administrative jurisdiction of Chennai Municipal Corporation had a total of about 32 public toilet seats and 12 public urinals to cater to an estimated slum population of 3, 29,824 persons and 71,840 families living in these slums, indicating an average of about 1056 persons and 2817 persons per public toilet seat and public urinal respectively. It may be noted that many of the slums did not have any public toilet/urinal as these slum dwellers were using individual connections or were resorting to open defecation. It is also very evident from the demand assessment surveys that the respondents revealed that a majority of them resort to other means of latrine.

Service and Cost Norms

The service norms for sanitation have been fixed only for the number of public toilet seats/ urinals and percentage of roads to be provided with storm water drains, as per the following. Further, a broad cost norm for both of the above components have been evolved and presented below:

Table No. 20a: Service and Cost Norms for Sanitation (Sewerage and Latrine)

Sl. No.	Particulars	Unit	Norm	Basis
A.	**Service Norms**			
1.	**Persons per Public Toilet Seat**	**Number**	**30**	**Proposed**
2.	**Persons per Public Urinal**	**Number**	**50**	**Proposed**
3.	**Percentage of Surfaced Roads to be Provided with Storm Water Drains**	**Percent**	**50**	**Proposed**
B.	**Cost Norms**			
1.	**Public Toilet Seat**	**Rs. / Unit**	**50,000**	**Proposed**
2.	**Public Urinal**	**Rs. / Unit**	**17,000**	**Proposed**
3.	**Storm Water Drain (Pucca Open)**	**Rs. / km**	**15,00,000**	**Proposed**

Demand and Gap Assessment

Based on the existing status and in comparison with the above indicated service norms for sanitation (sewerage and latrine), a demand and gap assessment has been carried out and is presented in the table below zone-wise:

Table No. 21: Zone-wise Demand-Gap Assessment for Sanitation (Sewerage and Latrine)

Sl. No.	Zone	Public Toilet Seats (Nos.)			Public Urinals (Nos.)			Storm Water Drains (km)
		Existing	Demand	Gap	Existing	Demand	Gap	
1.	Zone I	32	1127	1111	12	676	673	22.26
2.	Zone II	0	506	578	0	347	347	10.70
3.	Zone III	0	1162	1162	0	697	697	9.59
4.	Zone IV	0	911	911	0	547	547	9.48
5.	Zone V	0	581	581	0	348	348	4.63
6.	Zone VI	0	1449	1449	0	870	870	8.48
7.	Zone VII	0	538	538	0	323	323	4.43
8.	Zone VIII	0	423	423	0	254	254	2.69
9.	Zone IX	0	1604	1604	0	962	962	9.11
10.	Zone X	0	2622	2622	0	1573	1573	18.03
	Total	**32**	**10922**	**10979**	**12**	**6596**	**6594**	**99.41**

Source: Demand Assessment Surveys; 2004

Based on the above table, it is estimated that there is a gap of about 10979 public toilet seats and 6594 public urinals to meet the estimated demand of 10922 public toilet seats and 6596 public urinals respectively (Table No. 21). In addition, about 99.41 km of storm water drains need to be provided along the surfaced roads only.

Capital Investment Estimate

Based on the norms proposed for the sanitation (sewerage and latrine) and the assessed demand and gap, and the cost norms proposed, the capital investment estimate has been prepared and presented zone-wise in the table below.

Table No. 21a : Zone-wise Estimate of Capital Investment Requirement for Sanitation

Sl. No.	Zone	Capital Investment Estimate (Rs. in Lakhs)			Percentage Contribution		
		Toilets	Storm Water Drains	Total	Toilets	Storm Water Drains	Total
1.	Zone I	670.11	166.97	837.08	10.14	22.40	11.48
2.	Zone II	348.00	80.27	428.27	5.26	10.77	5.88
3.	Zone III	699.40	71.96	771.36	10.58	9.65	10.58
4.	Zone IV	548.36	71.07	619.43	8.30	9.53	8.50
5.	Zone V	349.52	34.70	384.22	5.29	4.65	5.27
6.	Zone VI	872.54	63.59	936.13	13.20	8.53	12.84
7.	Zone VII	323.88	33.23	357.11	4.90	4.46	4.90
8.	Zone VIII	254.61	20.19	274.80	3.85	2.71	3.77
9.	Zone IX	965.43	68.36	1033.79	14.60	9.17	14.18
10.	Zone X	1578.50	68.36	1646.86	23.88	9.17	22.59
	Total	6610.35	745.55	7289.05	100.00	100.00	100.00

Source: Demand Assessment Surveys; 2004

Based on the above table, it is estimated that a capital investment of Rs. 66.10 crores and Rs. 7.46 crores is required to meet the existing gap in toilets and storm water drains respectively (Table No. 21a). It is estimated that about Rs. 72.89 crores is required to meet the existing gap in sanitation.

IV. SUMMARY AND CONCLUSION

The present work is on the slums and its demand gap assessment of water supply in Chennai City to find the slums in Chennai, categories them into - Slums in unobjectionable areas, Slums in objectionable areas, Slums in private land areas; To list the number of households in each of these locations; To assess the environmental infrastructure needs of the slums in the unobjectionable area with a view to improve the living conditions of the urban poor.

Based on the existing, demand and gap analysis of the existing situation on the key environmental infrastructure in the slums located within the administrative jurisdiction of the Chennai Municipal Corporation, certain key issues are emerging to meet the challenges emerging in slum upgrading and management. In addition, certain critical success factors have been identified for effectively implementing the policy measures and other development initiatives to address the challenges of slum upgrading and slum management. The following sections briefly describe such key policy issues and critical success factors identified based on the mapping and infrastructure assessment exercise on the slums.

Policies, Development Options And Improvement Measures

Based on the mapping exercise, review and analysis of the existing situation on the key environmental infrastructure in the slums located within the administrative jurisdiction of the Chennai Municipal Corporation, certain key issues are emerging to meet the challenges emerging in slum upgrading and management. In addition, certain critical success factors have been identified for effectively implementing the policy measures and other development initiatives to address the challenges of slum upgrading and slum management. The following sections briefly describe such key policy issues and critical success factors identified based on the mapping and infrastructure assessment exercise on the slums.

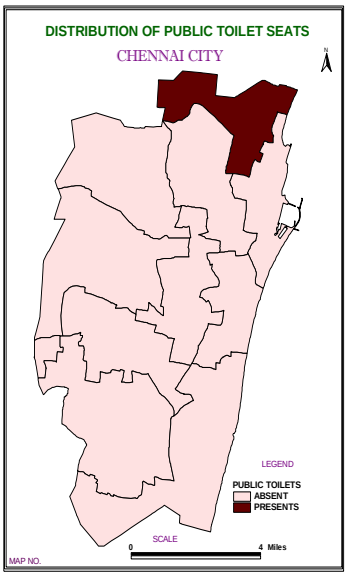
Infrastructure and Services

Following policy issues and interventions are suggested with respect to 'infrastructure and services' in slum upgrading and slum management:

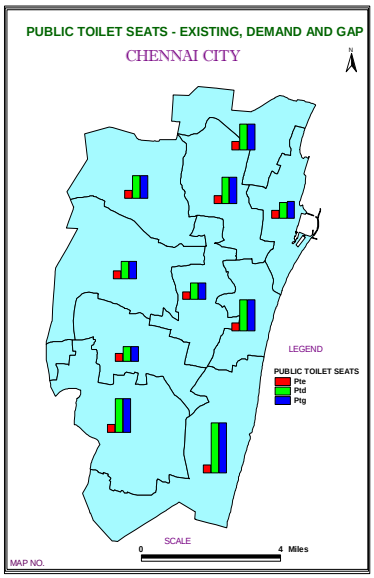
- Adopt 'community based approach' in service provision and delivery to suit to the local context and requirements;
- Ensure involvement of women and children from project formulation to implementation to achieve sustainability;
- Target to provide services like water supply, sanitation and electricity on individual household basis - to facilitate improvement in performance & collection of user charges;
- Facilitate service provision and delivery, by the communities with appropriate supervision by the respective ULBs;
- Explore the possibility of contracting the services wherever possible to NGOs, CBOs and private

companies;

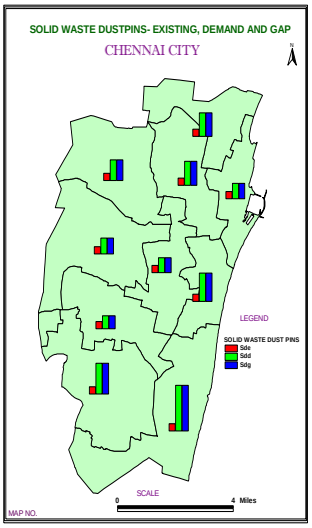
- ULBs to bear the cost of provision of services (with full/part recovery mechanism) but with full cost recovery on O&M;
- Develop appropriate norms and benchmarks for the provision and delivery of services;
- Integrate service provision in slums to other city level schemes to achieve economy;
- Provide proper access to basic social services like health, education and access to credit as these would facilitate human capital development;
- ULBs to build sanitation management capacities to improve service delivery to the poor
  - Ensure participatory sanitation delivery;
  - Assess demand for sanitation services;
  - Explore public-private partnerships;



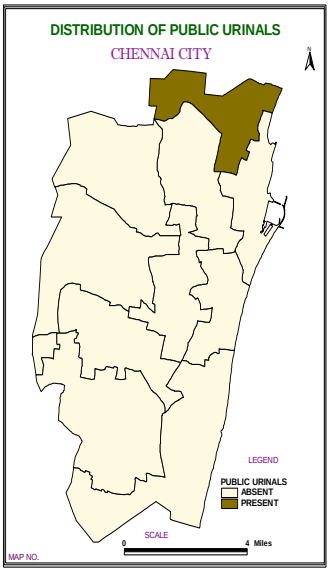
Map No. 1



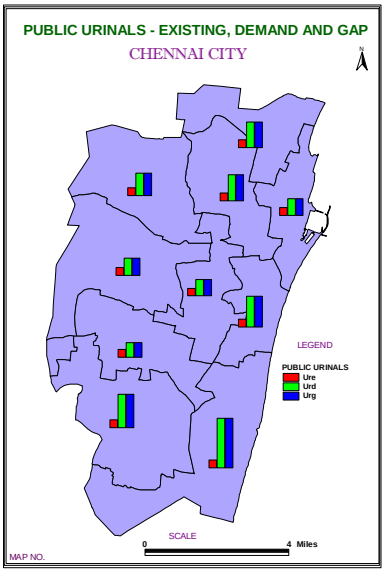
Map No. 3



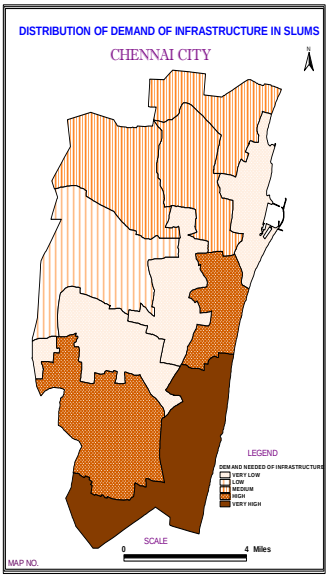
Map No. 5



Map No. 2



Map No. 4



Map No. 6

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