

Urban health in India: Chennai city as a case study

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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; health and health care for the Chennai city. The perceptual study has been adopted for the future planning of urban health/living conditions.

Keywords: Urban population, slum population, non-slum population, urban poverty, urban health.

Introduction

A century of industrialization and technical advancement has brought in rapid urbanization. The proportion of urban population in India has gone up from 11% in 1901 to 18% in 1951 and to 32% in 2001. Rapid urban growth resulted into mushrooming 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 problems mainly the 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. 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' is 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.

Economic development & urban poverty

The insufficient employment opportunities and inadequate income among a considerable segment of urban population in India has given rise to urban poverty

(Aldrich & Sandhu, 1995). 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 (Hanumantha Rao, 1998). 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 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.

Tamil Nadu slum clearance board (TNSCB) had conducted that the socio-economic survey of slum areas in Chennai city to take 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 and 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.

Table 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.

Table 2. Population density of Chennai city.

Census Year	Population	Area (sq. km)	Gross density (Persons/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.

Table 3. Workforce composition within Chennai city-main workers.

Sector	No.	% to total workers	% to total population
Primary-cultivators & agricultural labours	1503	0.11	0.04
Secondary-household industries, manufacturing, services & repair	22108	1.53	0.52
Territory-trade & commerce, transport & service sector	1417771	98.36	33.63
Total	1441382	100.00	34.19

Source: Census of India 2001, Govt. of TN.

Table 4. Zone-wise demand-gap assessment for dwelling units.

Zone	No. of families	Dwelling units (Nos.)		
		Existing	Demand	Gap
Zone I	7248	5058	7258	2200
Zone II	3730	2623	3730	1107
Zone III	7282	4380	7282	2902
Zone IV	6003	3752	6003	2251
Zone V	3913	2085	3913	1828
Zone VI	9478	5634	9478	3844
Zone VII	3510	2269	3510	1241
Zone VIII	2618	1687	2618	931
Zone IX	10383	7130	10383	3253
Zone X	17665	11630	17665	6035
Total	71840	46248	71840	25592

Table 5. Zone-wise demand-gap assessment for water supply.

Zone	Public water tanks / water taps(Nos.)		
	Existing	Demand	Gap
Zone I	40	451	412
Zone II	36	231	195
Zone III	51	465	414
Zone IV	54	364	312
Zone V	19	232	213
Zone VI	70	580	510
Zone VII	23	215	192
Zone VIII	28	169	141
Zone IX	75	641	567
Zone X	194	1049	860
Total	590	4398	3816

Table 7. Zone-wise requirement of dustbins/containers for solid waste management.

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 & 2)
	1	2	3
Zone I	203	36	203
Zone II	104	18	104
Zone III	209	66	209
Zone IV	164	39	164
Zone V	105	60	105
Zone VI	261	32	261
Zone VII	97	45	97
Zone VIII	76	21	76
Zone IX	289	41	289
Zone X	474	70	474
Total	1982	428	1982

Table 6. Zone-wise demand-gap assessment for sanitation (sewerage & latrine).

Zone	Public toilet seats (Nos.)			Public urinals (Nos.)			Storm water drains (km)
	Existing	Demand	Gap	Existing	Demand	Gap	
Zone I	32	1127	1111	12	676	673	22.26
Zone II	0	506	578	0	347	347	10.70
Zone III	0	1162	1162	0	697	697	9.59
Zone IV	0	911	911	0	547	547	9.48
Zone V	0	581	581	0	348	348	4.63
Zone VI	0	1449	1449	0	870	870	8.48
Zone VII	0	538	538	0	323	323	4.43
Zone VIII	0	423	423	0	254	254	2.69
Zone IX	0	1604	1604	0	962	962	9.11
Zone X	0	2622	2622	0	1573	1573	18.03
Total	32	10922	10979	12	6596	6594	99.41

Table 8. Zone-wise demand-gap assessment for roads & pavements.

Zone	Roads, pavements & streets-surfaced roads (km)		
	Existing	Demand	Gap
Zone I	9.68	10.68	1.85
Zone II	2.96	4.70	1.97
Zone III	8.54	8.63	0.89
Zone IV	4.87	8.53	4.07
Zone V	2.83	4.16	1.49
Zone VI	7.96	7.63	0.41
Zone VII	2.94	3.99	1.17
Zone VIII	1.45	2.42	1.11
Zone IX	6.79	8.20	2.03
Zone X	11.17	16.23	6.09
Total	59.18	75.17	21.08

Table 9. Zone-wise demand-gap assessment for streetlights.

Zone	Streetlight fixtures		
	Existing	Demand	Gap
Zone I	259	475	220
Zone II	108	209	114
Zone III	220	384	183
Zone IV	148	379	234
Zone V	58	185	134
Zone VI	274	339	110
Zone VII	108	177	75
Zone VIII	95	108	25
Zone IX	300	365	167
Zone X	421	721	340
Total	1991	3341	1601

Table 10. Zone-wise break-up of any health facility within the slum.

Zones	Yes	No	No. of response	Total
Zone I	13.4	58.4	28.2	100
Zone II	49.2	50.0	0.8	100
Zone III	4.2	95.8	0	100
Zone IV	18.2	81.6	0.2	100
Zone V	14.5	84.0	1.5	100
Zone VI	4.7	95.3	0	100
Zone VII	4.8	95.2	0	100
Zone VIII	17.2	82.8	0	100
Zone IX	5.9	93.3	0.8	100
Zone X	12.4	86.9	0.7	100
Total	14.5	82.3	3.2	100

Source: Demand assessment surveys, 2004.

Table 11. Zone-wise break-up of type of health facilities as reported by those reporting facilities in the slum.

Zones	Primary health care unit (govt.)	RMP	Private doctor	Others	No response	Total	PHC, RMP or private doctor
Zone I	15.7	3.9	78.4	2.0	0	100	98.0
Zone II	68.3	0	28.3	3.3	0.1	100	96.6
Zone III	93.3	0	0	0	6.7	100	93.3
Zone IV	29.2	0	52.2	4.4	14.2	100	81.4
Zone V	27.7	4	39.6	28.7	0	100	71.3
Zone VI	0	0	0	94.7	5.3	100	0
Zone VII	50.0	0	50.0	0	0	100	100
Zone VIII	8.9	2.2	88.9	0	0	100	100
Zone IX	19.4	0	77.8	2.8	0	100	97.2
Zone X	4.2	0	79.2	5.2	11.4	100	83.4
Total	31.7	1.0	49.4	14.1	3.8	100	82.1

Source: Demand Assessment Surveys; 2004.

Table 12. Zone-wise break-up of distance of nearest hospital/nursing home.

Zones	<500 m	501 m to 1 km	1-2 km	2 km+	No. of response	Total	<2 kms.
Zone I	15.3	3.2	34.5	18.7	28.3	100	53.0
Zone II	14.8	18.0	47.5	15.6	4.1	100	80.3
Zone III	42.2	17.5	7.6	27.8	4.9	100	67.3
Zone IV	25.1	8.1	34.0	30.6	2.2	100	67.2
Zone V	32.7	12.9	20.8	32.1	1.5	100	66.4
Zone VI	46.0	0.5	8.2	44.6	0.7	100	54.7
Zone VII	38.0	10.2	17.8	31.5	2.5	100	66.0
Zone VIII	6.1	37.8	12.2	43.9	0	100	56.1
Zone IX	3.3	40.2	30.7	24.5	1.3	100	74.2
Zone X	27.5	22.4	12.8	36.1	1.2	100	62.7
Total	25.1	17.1	22.6	30.5	4.7	100	64.8

Source: Demand assessment surveys, 2004

Table 13. Zone-wise break-up of incidence if water borne/airborne diseases in the family in the last one year.

Zones	Yes	No	No response	Total
Zone I	4.7	66.8	28.5	100
Zone II	50.8	47.5	1.7	100
Zone III	5.5	92.1	2.4	100
Zone IV	43.8	52.7	3.5	100
Zone V	28.8	69.2	2.0	100
Zone VI	46.0	53.5	0.5	100
Zone VII	49.3	48.7	2.0	100
Zone VIII	46.9	52.7	0.4	100
Zone IX	23.6	74.9	1.5	100
Zone X	4.9	93.4	1.7	100
Total	30.4	65.2	4.4	100

Source: Demand assessment surveys, 2004

Table 14. Zone-wise break-up of major diseases that outbreak in the last one year as reported by those families reporting incidences.

Zones	Typhoid	Cholera	Dengue	Jaundice	Diarrhea	Others	Total	Well known major diseases
Zone I	5.5	11.1	5.6	11.1	0	66.7	100	33.3
Zone II	16.2	21.0	4.8	1.6	1.6	54.8	100	45.2
Zone III	0	16.2	0	0	0	83.8	100	16.2
Zone IV	2.3	0.7	1.1	1.5	2.2	92.2	100	7.8
Zone V	17.1	6.1	3.0	5.6	5.6	62.6	100	37.4
Zone VI	0	0.5	0	1.1	1.1	97.3	100	2.7
Zone VII	1	1.8	0.4	0.4	0	96.4	100	3.6
Zone VIII	2.4	0	0	3.3	0.8	93.5	100	6.5
Zone IX	0.7	0	0	0	0	99.3	100	0.7
Zone X	15.7	3.1	0	3.1	0	78.1	100	21.9
Total	6.1	6.1	1.5	2.8	1.1	82.5	100	17.5

Source: Demand assessment surveys; 2004

Table 15. Zone-wise break-up of households incurring expenses on health.

Zones	<Rs 100	101-250	251+	None	No response	Total	Hhs. incurring expenses on health
Zone I	23.4	25.3	13.9	9.5	27.9	100	62.6
Zone II	29.5	37.7	13.9	18	0.9	100	81.1
Zone III	46.8	25.2	22.8	4.5	0.7	100	94.9
Zone IV	38.5	34.0	12.4	14.5	0.6	100	84.9
Zone V	42.1	22.8	16.2	17.6	1.3	100	81.1
Zone VI	52.7	20.8	23.3	2.7	0.5	100	96.8
Zone VII	45.7	27.6	15.4	11.1	0.2	100	88.7
Zone VIII	46.9	42.4	7.6	2.7	0.4	100	96.9
Zone IX	33.3	37.8	25.8	2.5	0.6	100	96.9
Zone X	34.6	29.1	24.9	10.5	0.9	100	88.6
Total	39.4	30.3	17.6	9.4	3.4	100	87.3

Source: Demand assessment surveys; 2004

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.

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 upgrading consists 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 2 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.

Aim and objective of the study

Aim: To study about the urban health which influences by the slum development in Chennai city.

Objectives: To study the distribution of slums in Chennai city; to study the categories of slums in Chennai city; to find the existing facilities or infrastructure for slums in Chennai city; To show the demand and gap of infrastructures for slums of Chennai city and to understand the health need for Chennai city.

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 Minjur panchayat union, in the south by Sholinganallur town panchayat, in the west by

Tiruvallur panchayat union and in the east by Bay of Bengal.

Chennai city is located on the coromandel (eastern) coast in south India, with latitudes of $13^{\circ} 4'$ north and longitude of $80^{\circ} 15'$ 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 38th largest city in the world and the 4th 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 harbour, the world's second longest beach (Marina beach) and one of the oldest libraries. This library is one of the 4 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 4 metropolitan cities of India and is well connected with most of the cities in the country by road, rail and air.

Chennai is a blend of historic and modern, traditional and advanced urban agglomeration, mingled in a 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% of State's urban population of 27.24 million. Other major agglomerations in the states are Coimbatore (3.39%), Madurai (3.39%), Trichy (2.74%) and Salem (2.54%). The growth pattern of the Chennai city is illustrated in Table 1. 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 (Table 2) revealing the trend of density. 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 & 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, Otteri Nullah and Mambalam drain for discharge of storm water into watercourses. Otteri Nullah 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 2 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°C with very little seasonal variation or diurnal temperature variation and temperature soar highest in the month of May between 40°C and 45°C .

Socio-economic characteristics: The workers participation rate of the city (within the Municipal corporation limits) was about 34.19% of the total population as per the 2001 Census, comprising of 98.36% of total workers in tertiary sector, followed by about 1.53% in secondary sector (Table 3).

Essential services & 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.

- **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) Tamaraiyapakkam, (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 and KK Nagar.

Sewerage & 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 and bucket cleaning machines to keep sewers free from blocks.

Fig. 1. Categorisation of slums & slum families in Chennai corporation area.

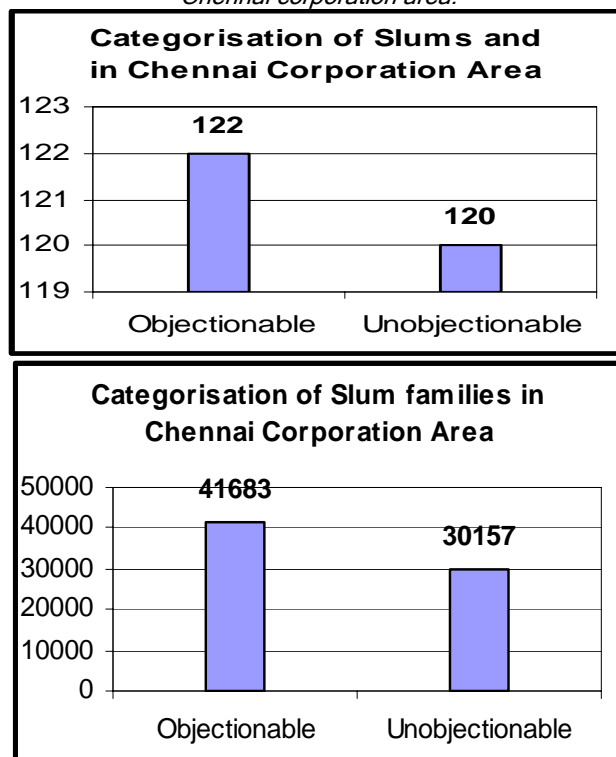


Fig. 3. Distribution of slums & slum families along waterways & seashore.

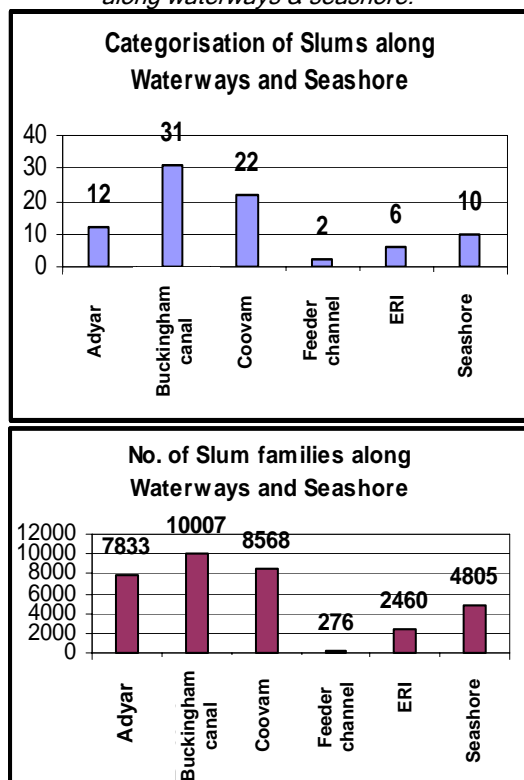


Fig. 2. Categorisation of objectionable slums & no. of slum families living in these slums in Chennai corporation area.

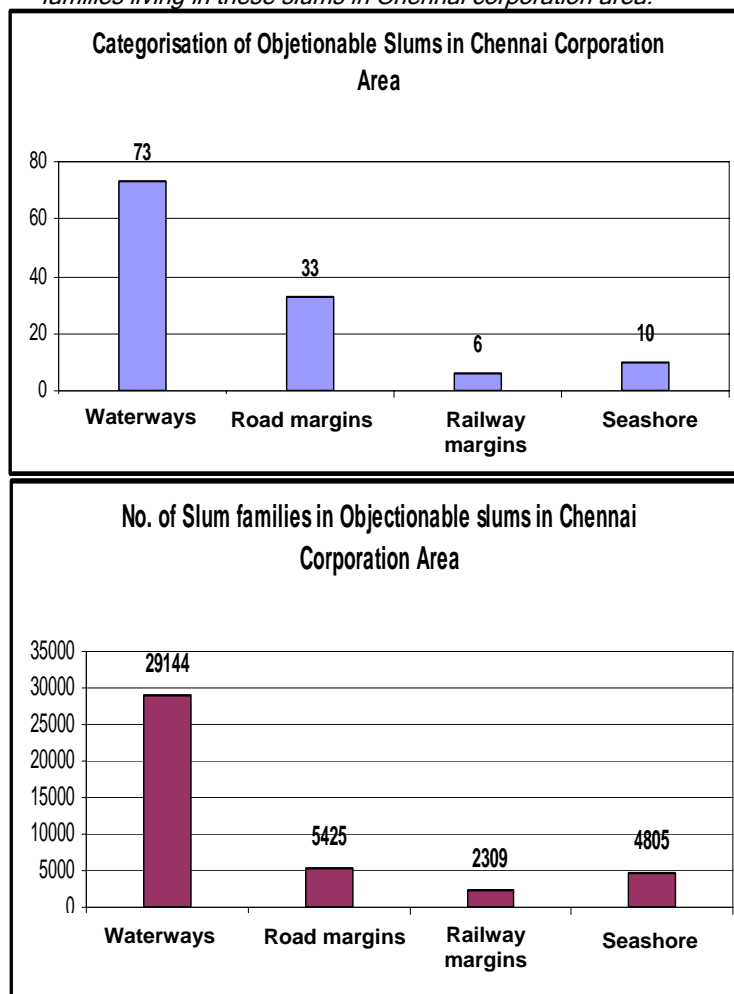
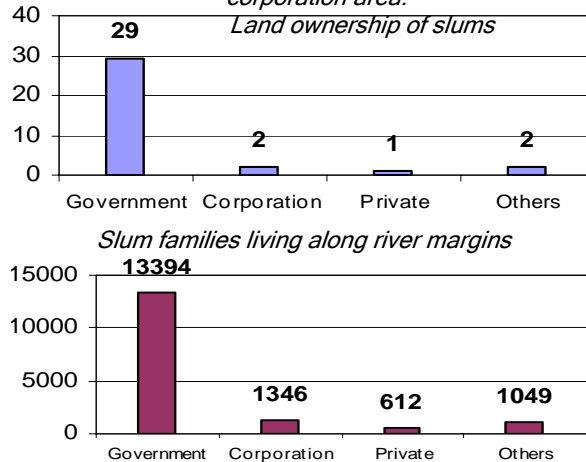
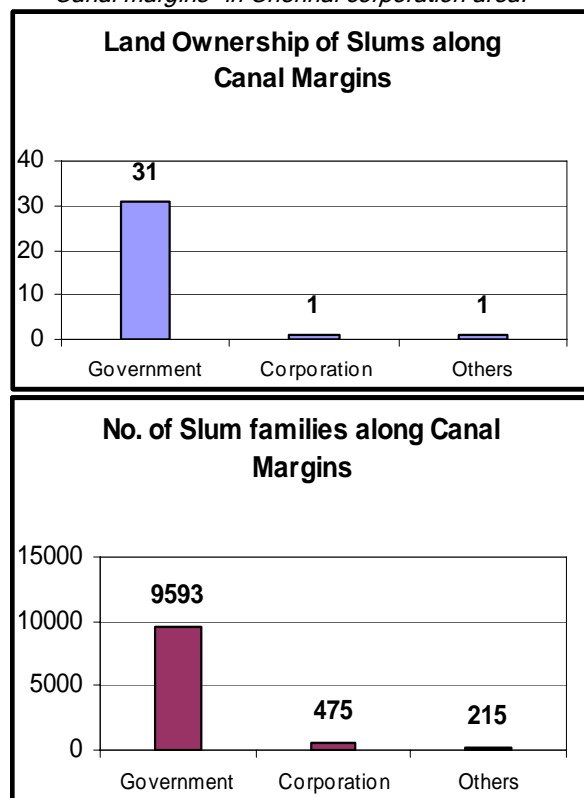


Fig. 4. Land ownership of slums & slum families living along river margins* in Chennai corporation area.



* This covers slums along Adyar & Coovam Rivers.

Fig. 5. Land ownership of slums & slum families along Canal margins* in Chennai corporation area.



* This covers slums along Buckingham canal & Feeder channel.

Fig. 6. Land ownership status of slums & the distribution of the slum families in Chennai corporation area.

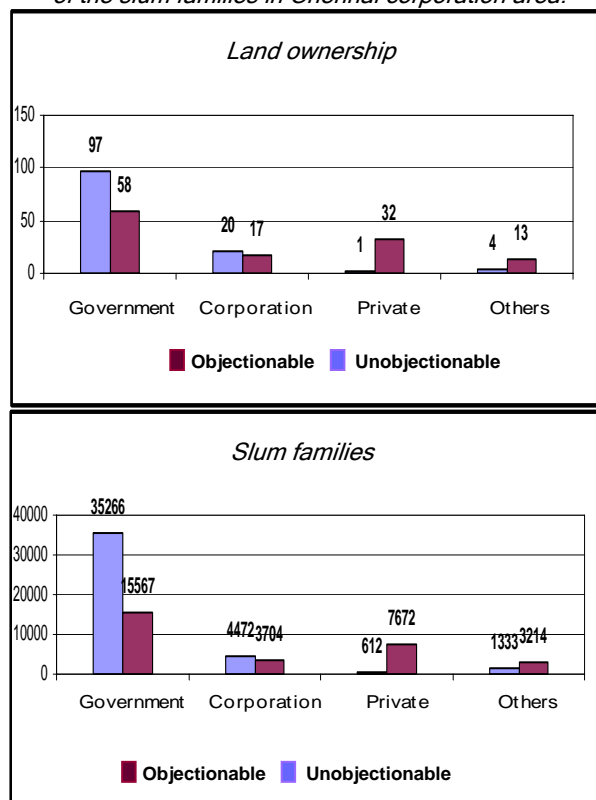


Fig. 7. a. Landownership no. of slums, b. slum families falling under other category of lands like temple TNSCB, etc.

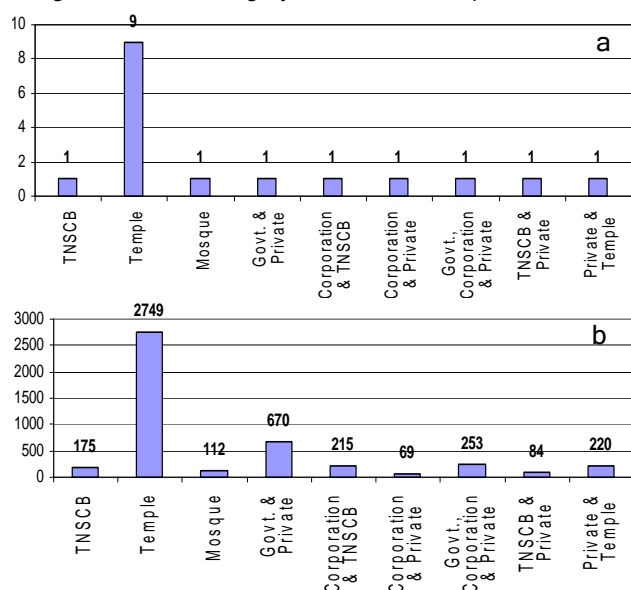
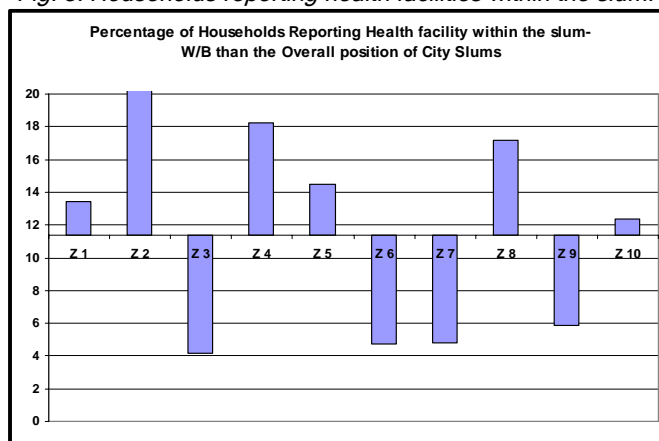


Fig. 8. Households reporting health facilities within the slum.



Source: Demand assessment surveys, 2004.

Fig.9 Households having a Nursing Home / Hospital within 2kms

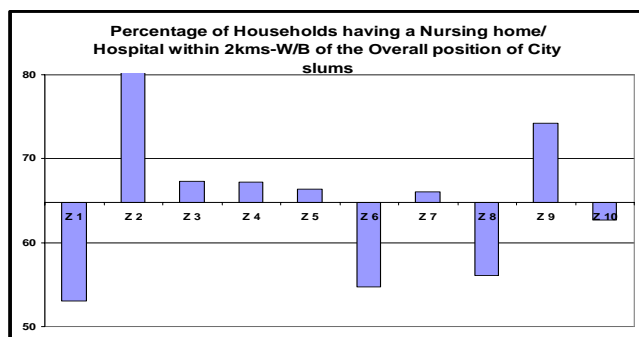
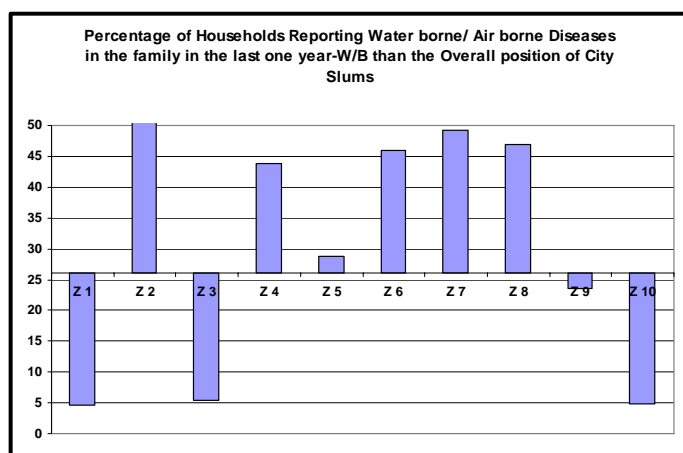
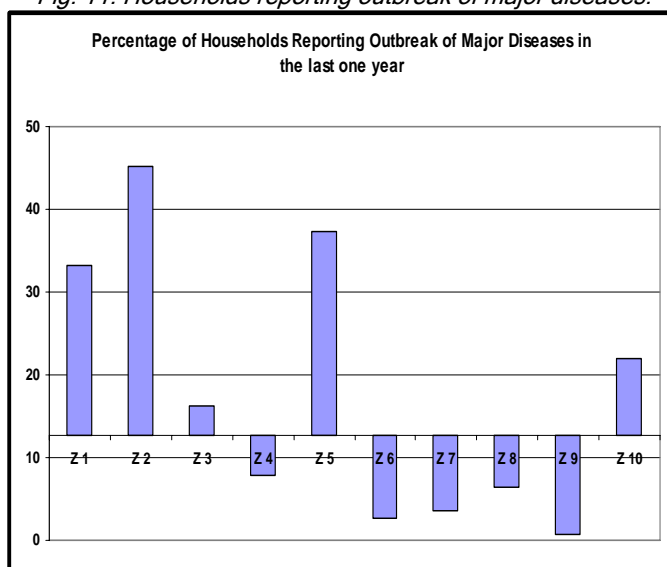


Fig.10 Households reporting Water Borne/ Air Borne Diseases



Source: Demand Assessment Surveys; 2004

Fig. 11. Households reporting outbreak of major diseases.



Source: Demand assessment surveys, 2004.

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 g.

Roads & 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.

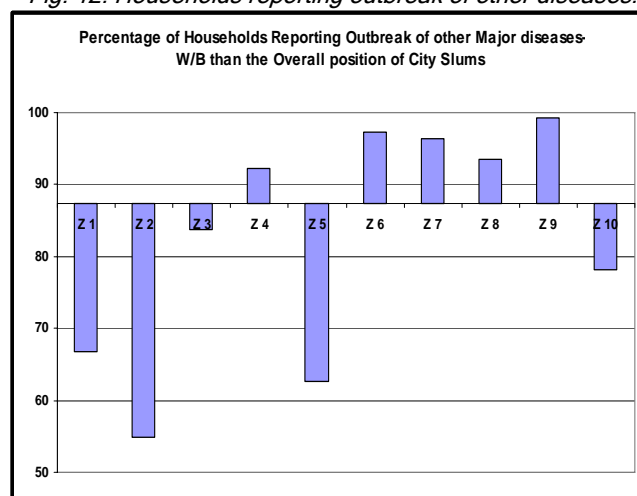
Streetlights: Streetlight is one of the essential obligatory services of the Chennai municipal corporation. About 99% of the fixtures were of high power type, comprising of 108912 sodium vapour lamps, 2194 mercury lamps and 59 high mast lamps.

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

Fig. 12. Households reporting outbreak of other diseases.



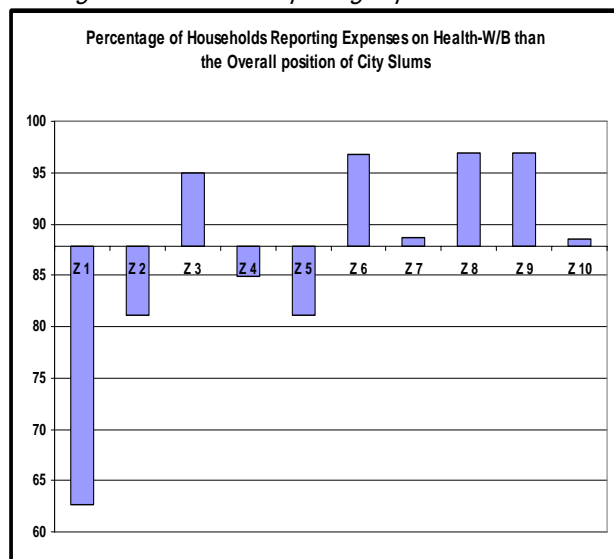
Source: Demand assessment surveys, 2004.

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

Fig. 13. Households reporting expenses on health.



Source: Demand assessment surveys, 2004.

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.

Profile of slums in Chennai city

Categorization of slums

As per the TNSCB, the slums have been categorized 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 conform to the land use assigned in the approved master plan. 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 (Fig. 1).
- **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.

- **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 Figs. 2, 3, 4, 5, 6 & 7, 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 an area, which has the ownership break-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 slum under this category was located on lands owned by other agencies like TNSCB and TNHB.
- 9 slums under this category were located on lands owned by temple/mosque.
- 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.

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 (2004) and the coverage of the facility wherever applicable, for the following core civic service sectors, including the dwelling units: Water supply, Sanitation (Sewerage & 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. 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. Table 3 indicates the sample size in each zone before and after the scrutiny.

The status assessment of services was 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 (2004) and the coverage of the facility wherever applicable, for the following core civic service sectors, including the dwelling units: Water supply, sanitation

(Sewerage & 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 & 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 Table 4. Based on Table 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% 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 & 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 5. Based on Table 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 2 days) to meet the estimated demand of 4398 water tanks/taps/hand pumps, indicating an overall deficiency of about 14% 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 & 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 Table 6. Based on Table 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 g/d 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 & 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 Table 7. It may be noted that the size of each dustbin/container is envisaged as 0.30 cu.m (approx. 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). Based on Table 7, it is estimated that about 1982 numbers of dustbins/containers, each of capacity 0.30 cu. m (approx. about 150 kg) is required to improve the solid waste management system in these slums.

Roads, pavements & 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% of surfaced road is a positive indication, requiring minimum capital expenditure.

Demand & 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 8. Based on Table 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% to meet the demand.

Streetlights

Summary on status assessment: 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 & 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 Table 9. Based on Table 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% to meet the demand.

Health facilities in slums

82.3% of the households reported non-availability of health facilities within the slum, 14.5% indicated their availability. Zones III, VI, VII and IX have far poorer availability as compared to the overall position of the city slums (Table 10 & Fig. 8). The available facility for health is calculated on the availability of private doctors and medical practitioners. Only 1% was registered medical practitioners and 49.54% were private doctors (Table 11).

Distance of the nearest nursing home/hospital: The survey showed that about 64.8% of the households indicated the availability of medical facilities within 2 kms. (Table 12 & Fig. 9).

Incidences of diseases in the slums

It is seen from the Table 13 that about 26% of the households reported incidence of water borne/air borne diseases in the family in the last one year. The status varied across the zones from 4.7% in zone I to 50.8% in zone II. It is seen from the Fig.10 below that zone II, IV, VI, VII and VII had much higher occurrence than the overall position of city slums.

Major diseases in the slums

About 82.5% of the households reported diseases other than typhoid, dengue, jaundice and diarrhea. The incidence of these diseases together was reported by 17.5% of the households (Table 14 & Fig. 11). The zone wise status of occurrence of these diseases is shown in Fig. 12.

Expenditure on health

Based on the demand assessment surveys 9.3% of the households reported zero expenditure on health, others have indicated a monthly expenditure on health ranging from under Rs. 100 to over Rs. 250 per month (Table 15 & Fig. 13).

Summary

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 health management capacities to improve service delivery to the poor (Ensure participatory health delivery; Assess demand for health services; Explore public-private partnerships; Health insurance to widen the access to curative health care.
- Promote education through non-formal and community management education and
- Integrate all slum development schemes into various State and national health and literacy initiatives.

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