TN TAMIL NADU | US URBAN SANITATION | SP SUPPORT PROGRAMME

REPORT

KODAIKANAL BASELINE STUDY FOR URBAN SANITATION

January 2019

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TN US SP
TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

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Kodaikanal Baseline Study for Urban Sanitation

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Abbreviations

CC	Cement Concrete
CT	Community Toilets
CPHEEO	Central Public Health and Environmental Engineering Organisation
GIS	Geographic Information System
GoTN	Government of Tamil Nadu
HSC	House Service Connections
IIHS	Indian Institute for Human Settlements
IHSDP	Integrated Housing and Slum Development Programme
LPCD	Litres per Capita per Day
MLD	Millions of Litres Per Day
mm	millimetre
MRSI	Market Research Society of India
OHT	Over Head Tank
OSS	On-site sanitation system
PCC	Plain Cement Concrete
PF	Public Fountain
PVC	Polyvinyl Chloride
PT	Public Toilet
RCC	Reinforced Cement Concrete
SEC	Socio Economic Classification
SHG	Self Help Group
TNUSSP	Tamil Nadu Urban Sanitation Support Programme
UGD	Underground drainage
ULB(s)	Urban Local Bodies
WHO	World Health Organisation
WWTP	Waste Water Treatment Plant

Executive Summary

Executive Summary

The Tamil Nadu Urban Sanitation Support Programme (TNUSSP) carried out a baseline study in Kodaikanal municipality to understand the current situation of access to sanitation and arrangements made for fecal sludge management in households and establishments. The findings from the study provide an overview of the gaps, and challenges across the sanitation chain in Kodaikanal which would help in effective implementation and monitoring of the State's Operative Guidelines for Septage Management.

E1.1. Methods

The baseline study was implemented in two phases. The first phase included a preliminary reconnaissance using a mix of spatial mapping and discussions with selected stakeholders in the study location. The team interacted with municipal officers, self-help group members, masons/ builders and farmers. This helped understand the community in terms of topography, settlement patterns, housing typology, availability of public water, sanitation amenities and helped design the baseline survey.

In the second phase, a household and establishment baseline survey was carried out. The survey was carried out in 6,978 households and 3,285 establishments using a semi-structured questionnaire. The survey collected the following information – demographic details, access to potable water, access to toilet, access to on-site sanitation systems (OSS), infrastructure and dimension of OSS, and desludging frequency and practices.

Further, an assessment of 20 community Toilets (CTs) /Public Toilets (PTs) in Kodaikanal municipality was also carried out.

E1.2. Key Findings

E1.2.1 Location

Kodaikanal is a town in the hills of Dindigul district in the state of Tamil Nadu. It is situated on a plateau above the southern escarpment of the upper Palani Hills with a municipal area is 21.45 sq kms. It has an irregular basin at its heartland, the centre of which is now the Kodaikanal lake, which is man-made with a circumference of five kms. Kodaikanal experiences a pleasant subtropical climate throughout the year due to its high altitude. Annually there is an average rainfall of about 1,650 mm which occurs mainly in the months of June and September.

E1.2.1.1. Demography and Socio-economic Profile

The town has a population of 36,501 as per Census 2011 of which the scheduled tribe population is 102 and scheduled caste population is 7,250. The population density of Kodaikanal has more than doubled in the past three decades. The present density of the town is 1,702 persons/sq km. Analysis of settlement patterns reveals that the northern and north-eastern parts of the town are the most densely populated and home to the urban poor. The areas adjoining the Kodaikanal lake are the primary commercial areas in the town with multiple ground+2 shopping complexes. The south-western part of the town is a high-income area with individual bungalows and villas.

E1.2.1.2. Tourism and Connectivity

The economy of Kodaikanal is predominantly fueled by tourism. The number of tourists increased from 14,64,789 in 1999 to 49,69,982 in 2009. The nearest airports are Madurai (135 kms), Coimbatore (170 kms) and Trichy (200 kms) and nearest railway stations are Palani railway station (64 kms), Kodai Road station (80 kms) and Dindigul railway junction (100 kms). The town has a total road length of 66.5 kms. The Kodai ghat road through which the majority of traffic enters the town, is the main access to Kodaikanal.

E1.2.1.3. Household Socio-economic Profile

The socio-economic status of the households was assessed by a set of questions about the educational achievement of the chief wage earner and the number of consumer durables owned by the household (pre-defined list). Most slum households were within the socio-economic classification of 'illiterate to some college' and owned 4 to 7 durables, and 'illiterate to some college' and owned 1 to 4 durables.

E1.2.2 Water Supply, Sanitation and Drainage

E1.2.2.1. Municipal and Household Water Supply

The Kodaikanal municipality relies on multiple water sources – dams (1.63 MLD), bore wells (0.78 MLD) and open wells (0.20 MLD) for supplying water to its residents in 24 wards. Water from the source is held in 11 tanks with a capacity of 16.88 litres and 2 OHTs with 0.06 litres.

E1.2.2.2. Household Water Supply

Residents report that over the months, water shortage had escalated to an alarming rate and that the municipal water which was supplied once in 6 days had now been reduced to once in 15 days. With irregular municipal drinking water supply, households rely heavily on other alternative sources such as private open well, springs and bubble top water cans. While the high- and middle-income groups depend largely on private vendors for drinking water (such as 25-litre capacity bubble tops), the low-income groups usually stored the municipal piped water in huge plastic barrels. Additionally, they also depend on water sources like springs and private wells for bathing and washing clothes.

E1.2.2.3. Household Access to Sanitation

In terms of access to sanitation, over three-fourth of the households (80 per cent) have an individual toilet, with non-slum areas accounting for a higher percentage (82 per cent) of individual toilets in comparison to 76 per cent in slum areas. In most slum and non-slum households, the toilet facility was inside the house (66.3 per cent). In more than one-fourth of households (28.4 per cent), the toilet facility was located outside the house but attached to the house. About 8 per cent of the households in non-slum areas and 10 per in slums use community toilets.

Open defecation was practiced and was more prevalent among slum households (9 per cent). There was high incidence of open defecation reported in two slums, Chellapuram and Anna Nagar and among a few low-income residents in VGP Nagar. Lack of space and financial constraints were cited as the two main reasons for not having a toilet within their premises. Additionally, in Anna Nagar, the dysfunctional CT added to this problem.

E1.2.2.4. Household Containment

About three-fourth of the households with individual household toilets (N=5,545) reported that the predominant containment system was a septic tank. All 4,084 households with individual household

toilets reported that the predominant containment system was septic tanks. As per WHO standards, it is necessary for a septic tank to be watertight and it should ideally have at the least one partition wall so as to meet the two-chamber criteria. Of the households which reported having septic tanks, only one per cent (59 households) had proper septic tanks that were watertight and connected to a soak pit.

Most of the OSS at the household level do not comply with the required standards. The design and specifications of these 'septic tanks' largely depend on the financial capability of the household, the space available to build the structure, and also in some cases on the availability of local materials like stone, horse dung or red soil to layer the base.

E1.2.2.5. Collection, Conveyance and Disposal

Direct and easy access to the containment system for desludging depends on three components of accessibility including location of the onsite system; width of the road to accommodate desludging vehicles; and if the onsite system can be easily opened to insert the pipe for desludging.

The majority of containment systems in slum and non-slum households with reported septic tanks or single/twin pits were located in the front of the house, facilitating easy and direct access by a truck. It was observed that in a majority of the households (76 per cent) the approach road was either 5 to 10 feet wide with sufficient space for a desludging truck to park. However, in older parts of the town, the lanes were narrow with tightly packed houses which restricted the entry of desludging trucks.

The majority of the containment systems were also sealed and needed to be broken to access the system which was time-consuming. Such sealed containment systems were more prevalent in slum households (57.6 per cent) than in non-slum households (47.6 per cent).

As per the Central Public Health and Environmental Engineering Organisation (CPHEEO) norms, septic tanks need to be cleaned periodically at an interval of 2-3 years. Across households which had emptied their septic tank or pit, only half or 49.1 per cent cleaned their tank either once a year or once in two years while the remaining half or 50.9 per cent had a desludging frequency above 3 years.

Households were heavily dependent on private parties to empty or clean their septic tank/pit. This was observed among both slum (79.8 per cent) and non-slum households (73.4 per cent). In some households, the septic tank or pit cleaning was carried out by the residents themselves. The municipality reportedly had a minimal role in desludging, catering to only 6.1 per cent households, with mostly slum households dependent on their services to empty the septic tank/pit.

With respect to private desludging operators, there were no operators in Kodaikanal and most operated out of neighbouring areas such as Batlagundu and Vadipatti, 60 kms and 88 kms respectively from Kodaikanal. The major challenge faced by these operators was the presence of narrow roads as well as the hilly topography of the area. Some operators used long hose pipes to overcome this challenge.

At present, there are no facilities available for septage treatment in Kodaikanal. Informal discussions with residents and private water suppliers indicate that the fecal sludge collected from households and establishments are disposed of in a farmland at the foothills of Kodaikanal.

E1.2.2.6. Drainage and Grey Water

Two thirds of the households had drainage facilities outside their premises. Closed drains were observed mostly in non-slum households whereas, open drains were common in slum areas. Over one-third of households in slums do not have any drainage facility outside their premises.

Grey water was mostly disposed of to the drain outside and was reportedly high in non-slum households (71.6 per cent). Very few households (5.4 per cent) diverted the grey water to the septic tank/pit. This practice was more prevalent in non-slum households (6.1 per cent) than in slum households (4.6 per cent).

E1.2.3 Assessment of Community and Public Toilets

There are 47 CT/PTs in Kodaikanal, out of which 38 were functional. Of these functional toilets, 33 were for free usage and 4 were pay-and-use toilets. A sample of 20 CT/PTs were assessed in residential and tourist areas.

Usage of PTs was observed to be very high compared to CTs with an average of 300 people using the PT in the bus complex, followed by PTs in tourist places (241). In residential areas, the average number of users per day for CTs was reported to be around 86. With a decline in CT users due to Swacch Bharat Mission toilets, community groups are finding it unviable to maintain toilets.

Most of these toilet blocks assessed were more than 10 years old with general condition of the toilet structure being 'average' – structure is intact but some deterioration in concrete, doors/locks coming loose and some repair were necessary. All the toilet blocks assessed had pour flush toilets and majority had only squatting pans. On an average, women and girls had more seats than men and boys.

Most of the toilet blocks were connected to the septic tank while four toilet blocks were connected to a holding tank. It was observed that three toilet blocks were not connected to any type of OSS but was let out into the open drain. Overall, only seven toilet blocks had ever de-sludged the OSS. It was reported that two toilet blocks were directly connected to the wastewater treatment plant at Kallaraimedu.

E1.3. Establishment

The majority of establishments (80.9 per cent) surveyed were provision stores, petty shops or eateries. Commercial establishments are mainly concentrated around the north of the Kodaikanal lake and Bazaar road, another major hub for commercial establishments.

Establishments are heavily dependent on private vendors for potable water. The majority of the establishments purchase bottled or canned water for drinking and cooking purposes, while 8 per cent used municipal stand posts outside premises and 7 per cent had direct access to piped water inside the building.

About 10 per cent of establishments have a toilet in the building, with 70 per cent reporting a toilet inside the facility, 19 per cent outside the establishment but attached, and 11 per cent having standalone/ detached toilets. A considerable proportion of establishments were connected to the OSS – single or twin pit (42.9 per cent) followed by a septic tank (37.0 per cent), while one-tenth (14.1 per cent) of the establishments reported that the toilet was not connected to any type of containment system. However, only five (1.8 per cent) establishments had their septic tank walls and base plastered, more than one chamber and connected to a soak/leach pit. Majority of the establishments had their septic tanks located in accessible locations and access road was 5 feet or above in 57 per cent of the establishments. 45 per cent of the containment structures were sealed while the rest had a manhole cover (33 per cent) or

had a pipe with cap (23 per cent). The practice of establishments getting the septic tank or pit cleaned was reportedly low with only 19.3 per cent reported to have ever emptied the containment system while being dependant on private operators to empty or clean the septic tank.

E1.4. Way Forward

Based on the findings, the following recommendations are suggested along the sanitation chain.

E1.4.1 Access and Containment

At the household, there is a need for the municipality to address the issue of open defecation and also ensure that those toilets that directly discharge in the open are converted into sanitary toilets. CT/PTs that have poor OSS infrastructure require immediate attention. Further, septic tanks need to be built in PT blocks that are currently connected to the open drain. Focussed information and education on septage management, especially on regular desludging is required both at the household and establishment level. There exists a gap on how fecal sludge is managed in large resorts and hotels. The ULB can undertake a detailed study on the current practices.

E1.4.2 Conveyance

Currently, there is a monopoly in the desludging market and the ULB could look at other potential players to operate within the town which would in turn result in competitive prices for the service. ULB could invest in smaller-sized trucks to access narrow and steep roads.

E1.4.3 Treatment

The possibility of co-treatment of fecal sludge at the existing wastewater treatment plant at Kallaraimedu could be explored. A standalone fecal sludge treatment plant could also be constructed.

1 Background

1. Background

Under the Tamil Nadu Sanitation Support Programme (TNUSSP), a baseline study in Kodaikanal town was carried out to understand the current status of sanitation practices and arrangements in households and establishments. It also included a study of the wastewater plant and water quality testing facility at Kallaraimedu. Simultaneously, reconnaissance visits and stakeholder interactions were conducted among masons, builders, households and Urban Local Body (ULB) officers, to understand the current practices, challenges and needs of sanitation arrangements. In addition, an assessment was conducted among a sample community and public toilets (CT/PTs) in the town to identify gaps and challenges in the existing on-site sanitation systems (OSS).

The baseline study comprised of the following elements in Kodaikanal town: preliminary reconnaissance for understanding the current arrangements and practices across the full chain of sanitation, involving different stakeholders and scoping the survey exercise and household and establishment baseline survey.

1.1. Preliminary Reconnaissance

A primary study was carried out in Kodaikanal town to gain an in-depth understanding of the current arrangements and practices in the full-chain of sanitation—ranging from design and construction practices of the OSS to septage collection and waste disposal. This study used a mix of spatial mapping and discussions with selected stakeholders in the study location. In addition, observations and documentation of built OSS structures were also undertaken. A semi-structured questionnaire was used for the baseline survey.

The purpose of the reconnaissance visits was to observe and gain understanding on the community in terms of topography, settlement patterns, housing typology and availability of public water and sanitation amenities. Dense residential areas were selected for physical evaluation and informal discussions with households to understand the sanitation arrangements in the community and the prevalence of open defecation. Figure 1.1 represents the Pakkiyapuram locality where the reconnaissance visit was carried out.

Figure 1.1: Pakkiyapuram

Source: TNUSSP Kodaikanal Primary Study, 2017

The team interacted with the following stakeholders to collect information on sanitation:

a) **Municipal officers**: The team met with the Kodaikanal municipality officers including the commissioner, sanitary inspector, municipal health officer, engineer and sanitary workers. Further, the team met with officers from the town planning department to collect relevant maps and data on Kodaikanal town.

b) **Self-help group members**: Members of a self-help group involved in maintaining CT/PTs were interviewed to understand different management models and issues related to usage and maintenance of CT/PTs in Kodaikanal town.

c) **Masons/builders**: Through informal interviews with masons, details on OSS construction practices, materials used and other locally prevalent construction methods were collected.

d) **Farmers**: Local farmers were interviewed to gain insight on their preferences and opinion on reuse of fecal sludge as manure in their agricultural land.

1.2. Baseline Study

The primary objective of the baseline survey was to provide quantitative data on the sanitation practices and situation in Kodaikanal town, specifically across the full sanitation chain. It also aimed to gain research insights to identify on-site sanitation sytems and arrangements in households and establishments.

The baseline study was designed to collect sanitation-related details from all households and establishments including shops, eateries, hotels and clinics spread across the 24 wards in Kodaikanal. Indicators measured in the study included access to toilets, type and dimension of OSS and frequency of desludging. Besides collecting field-level data, spatial data was collected for all the surveyed households and establishments. Photographs of toilets and visible portions of the containment structures were taken.

The questionnaire was designed by the Indian Institute for Human Settlements (IIHS) and data was collected using GIS-enabled tablets. The following areas of information were covered:

a. Demographic details
b. Access to potable water
c. Access to toilet
d. Access to OSS
e. Infrastructure and dimension of OSS
f. Desludging frequency and practice

The questionnaire was pre-tested in a sampled number of households in Mahabalipuram. Annexure 1 presents the household and establishment questionnaire.

1.2.1. Coverage and Response Rate

As per Census 2011, the total number of households in Kodaikanal town was 9,442. With respect to establishments, there was no existing data available with the Kodaikanal municipality on the numbers. The study attempted to cover 100 per cent of households and establishments in Kodaikanal town. Of the total 9,442 households, successful interviews were carried out in 6,978 households and 3,285 establishments. The remaining households were not covered due to reasons such as refusal and locked door even after three visits. Overall, 50.2 per cent of respondents were male and 49.7 per cent were female. Of the respondents, 0.1 per cent were transgenders.

Table 1.1 shows the actual coverage of households and establishments across the 24 wards.

Table 1.1: **Distribution of Households and Establishments Covered across Wards**

Wards	Households	Establishments
1	283	20
2	429	141
3	305	132
4	351	59
5	362	82
6	259	50
7	265	6
8	374	12
9	321	36
10	218	22
11	306	111

Table 1.1: **Distribution of Households and Establishments Covered across Wards**		
Wards	**Households**	**Establishments**
12	213	49
13	316	64
14	665	107
15	237	82
16	238	937
17	202	780
18	394	12
19	289	32
20	80	9
21	155	143
22	249	341
23	349	56
24	118	2
Total	6,978	3,285
Source: TNUSSP Kodaikanal Baseline Study, 2017		

Of the 6,978 households covered, 48 per cent were slum households and the rest 53 per cent were non-slum households. In Kodaikanal town, there were 14 slums out of which 4 were notified and 10 were non-notified slums.

Table 1.2: **Distribution of Households Covered across Slums**			
Sl. No.	**Slum Name**	**Status**	**Households covered**
1	Anna Nagar	Notified	551
2	Indira Nagar	Notified	308
3	Gandhi Puram	Notified	133
4	Turner Puram	Notified	26
5	Observatory	Non-Notified	182
6	Pudhukadu	Non-Notified	348
7	Chellapuram	Non-Notified	97
8	Theresa Nagar	Non-Notified	362
9	Shenbaganur	Non-Notified	445
10	Kallukuli	Non-Notified	39

Table 1.2: **Distribution of Households Covered across Slums**			
Sl. No.	**Slum Name**	**Status**	**Households covered**
11	Shanmugapuram	Non-Notified	288
12	Pakkiyapuram	Non-Notified	91
13	Pamparpuram	Non-Notified	195
14	Antoniyar Kovil Street	Non-Notified	263
		Total	**3,328**
Source: TNUSSP Kodaikanal Baseline Study, 2017			

1.3. Community Toilet / Public Toilet Assessment

An assessment of sampled community Toilets (CTs)/Public Toilets (PTs) in Kodaikanal municipality was carried out to collect details on the following:

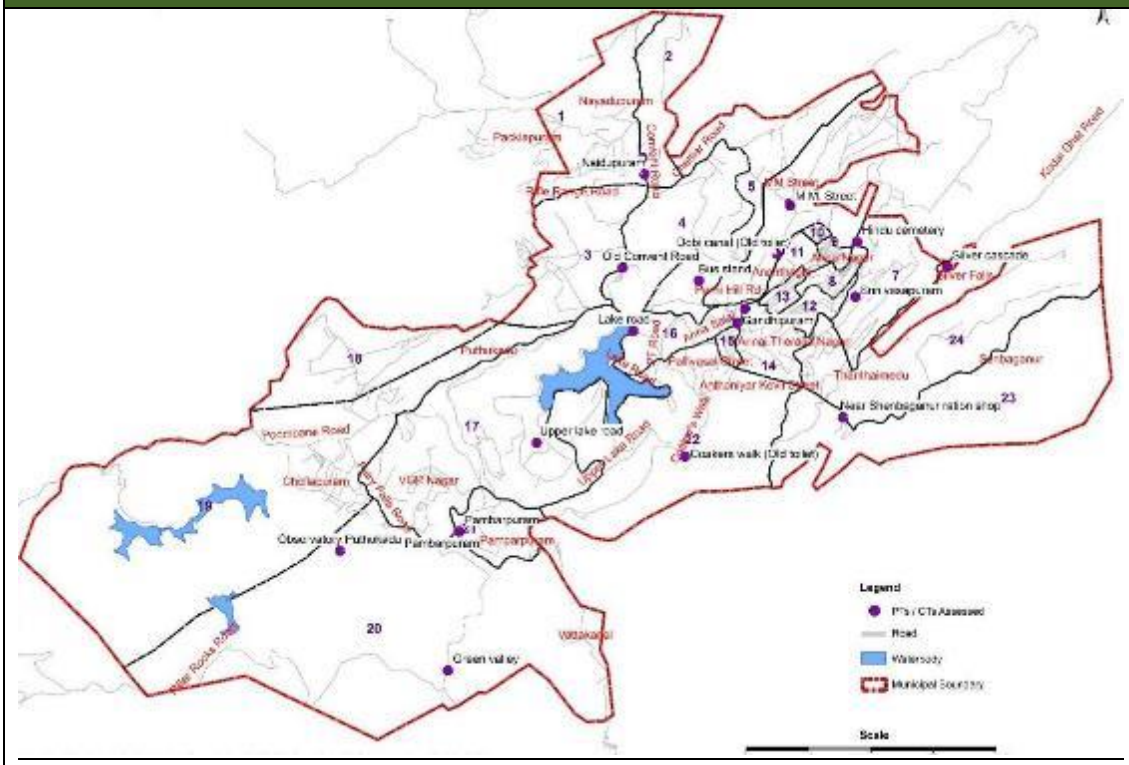
a) Type of on-site sanitation arrangement
b) Dimension and volume
c) Usage
d) Desludging frequency
e) Desludging operator details

The assessment covered 20 CT/PTs that were randomly selected across the 24 wards. Totally 8 CTs, 11 PTs and 1 paid toilet were assessed. Details were collected using a semi-structure questionnaire and interactions with the sanitary worker/caretaker of the toilet complex.

Table 1.3: **Community and Public Toilets Covered**			
Sl. No.	**Toilet typology**	**Area**	**Ward**
1	Community Toilet	Shenbaganur	24
2	Community Toilet	Srinivasapuram	7
3	Community Toilet	Hindu Kallaraimedu	9
4	Community Toilet	M.M. Street	6
5	Community Toilet	Dobby Canal	5
6	Community Toilet	Naidupuram	2
7	Community Toilet	Bliswilla	15
8	Community Toilet	Gandhi puram (R.C. Palli backside)	14
9	Public Toilet	Law Ghat Road	24
10	Public Toilet	Pakkiyapuram	1
11	Public Toilet	Old Convent Road	3
12	Public Toilet	Anna Salai	14

Table 1.3: **Community and Public Toilets Covered**			
Sl. No.	**Toilet typology**	**Area**	**Ward**
13	Public Toilet	Upper Lake Road	17
14	Public Toilet	Green Valley	1
15	Public Toilet	Pambarpuram	20
16	Public Toilet	Pambarpuram Post Office Road	21
17	Public Toilet	Bus Stand Complex	22
18	Public Toilet	Lake Road	16
19	Public Toilet	Coakers Walk	22
20	Paid Toilet	Observatory	18
Source: TNUSSP Kodaikanal CTs/PTs Assessment, 2017			

Figure 1.2: **Kodaikanal Ward Map with CT/PTs assessed**



Source: TNUSSP Kodaikanal CTs/PTs Assessment, 2017

Town Profile of Kodaikanal

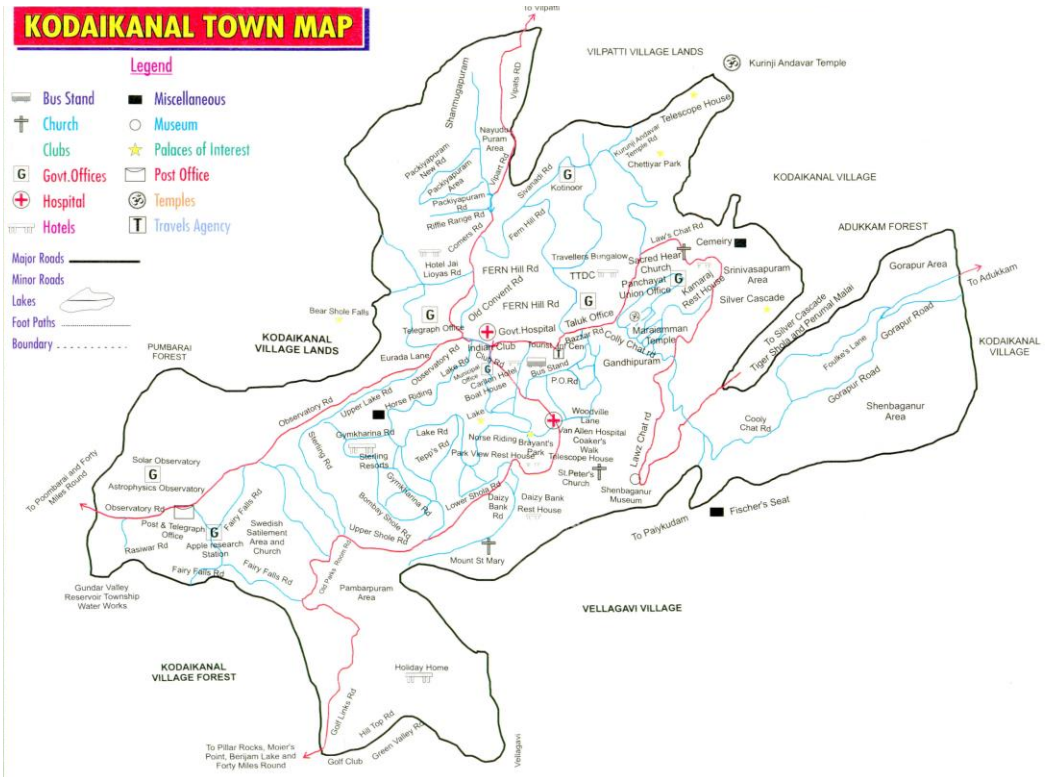
2. Profile of Kodaikanal

2.1. Overview

2.1.1. Location of Kodaikanal

Kodaikanal is a town in the hills of Dindigul district in the state of Tamil Nadu. It is situated on a plateau above the southern escarpment of the upper Palani Hills at 2,133 metres between Parappar and Gundar valleys.

Figure 2.1: **Kodaikanal Town Map**



Source: Kodaikanal municipality website

The extent of the municipal area is 21.45 sq kms. It has an irregular basin at its heartland, the centre of which is now the Kodaikanal lake-a man-made lake, five kms in circumference.[1]

2.1.2. Linkages and Connectivity

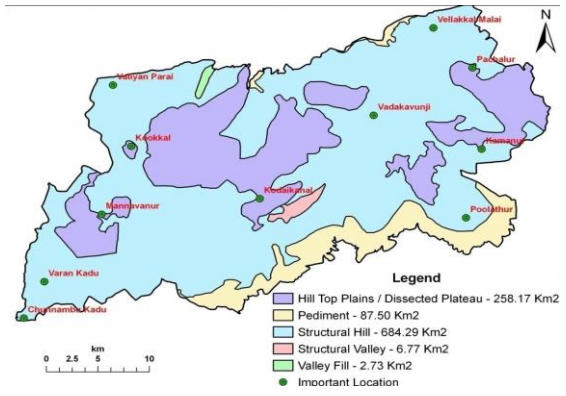
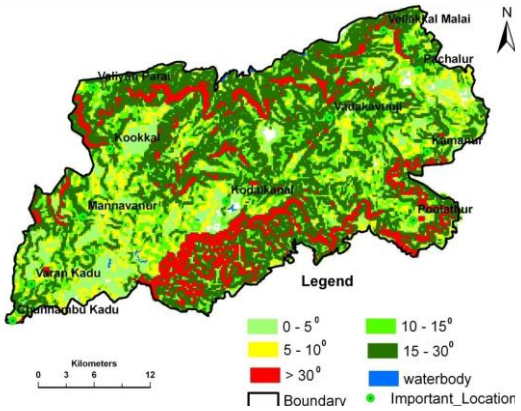
The nearest airports are Madurai (135 kms), Coimbatore (170 kms) and Trichy (200 kms). The nearest railway stations are Palani railway station which is 64 kms to the north, Kodai Road station which is 80 kms southeast and Dindigul railway junction which is 100 kms to the east.[2]

[1] https://en.wikipedia.org/wiki/Kodaikanal. Accessed on 20/06/17
[2] ibid

2.1.3. Physiography and Topology

The physiography of Kodaikanal mainly consists of a dissected plateau. Dissected plateaus occupy almost 24.8 per cent of the geographic area.[3]

Figure 2.2: **Kodaikanal Town Map**

Physiography	Slopes
	

Source: Bagyaraj M., Ramkumar T., Venkatramanan S., Chung S. Y. and Gurugnanam B, "Assessment of soil erosion probability in Kodaikanal, India using GIS and remote sensing", ResearchGate(2014) Tamil Nadu

The Kodai hill rises abruptly from the adjacent plains from about 300 m to 1000 m. In some parts of the hill this elevation continues even up to 2500 m.[4] The town is rich in biodiversity with epiphytes, orchids and thirteen varieties of *shola* forests which are unique.[5]

2.1.4. Climate and Physical Features

Kodaikanal experiences a pleasant subtropical climate throughout the year due to its high altitude. The temperature around the year varies between moderate to cold. In summers the average temperature varies between 11 to 20 degrees while in winter the temperatures are between 17 to 8 degrees. During the months of June and September there is rainfall in Kodaikanal due to the north retreating monsoon. Annually there is an average rainfall of about 1,650 mm.[6]

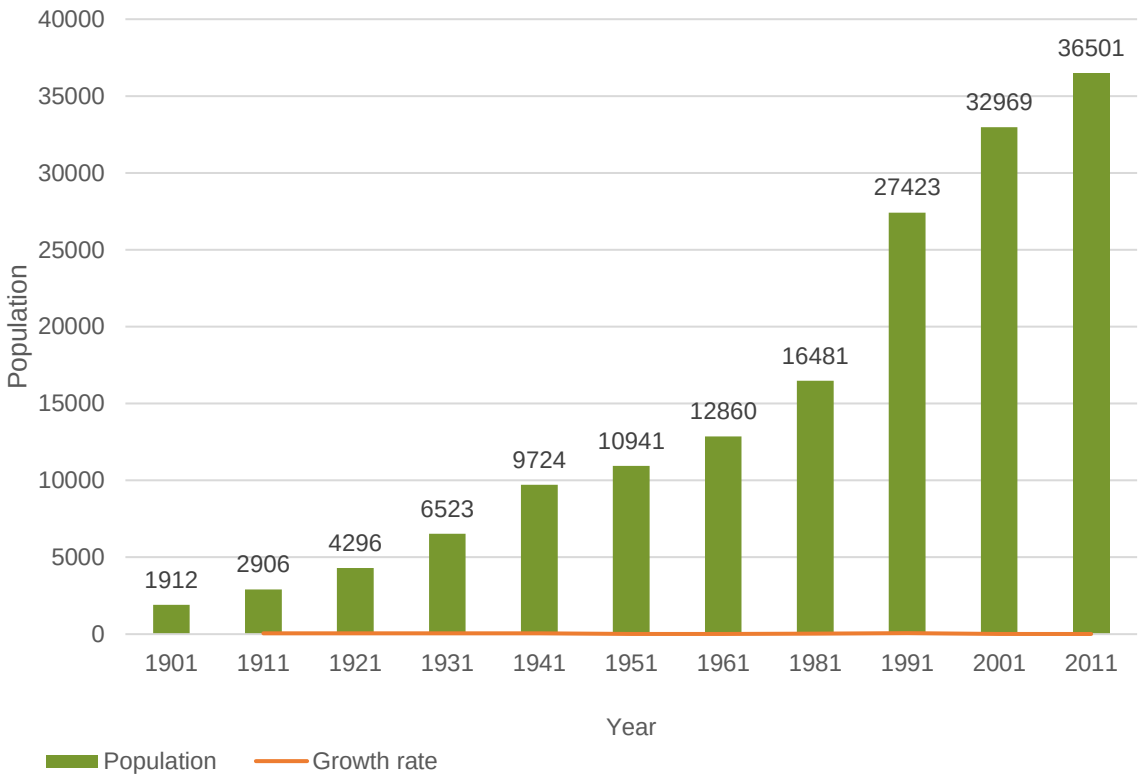
2.2 Demographic and Socio-economic Profile

The town has a population of 36,501 in which 18,216 are males and 18,285 are females as per Census 2011. As per Census 2011, the scheduled tribe population is 102 and scheduled caste population is 7,250. The growth rate was around 50 per cent from 1901 to 1941 before a sudden decline between 1951 and 1991. After 2001, while the number of wards increased from 17 to 24, the growth rate

[3] Bagyaraj M., Ramkumar T., Venkatramanan S., Chung S. Y. and Gurugnanam B, "Assessment of soil erosion probability in Kodaikanal, India using GIS and remote sensing", ResearchGate (2014) Tamil Nadu
[4] ibid
[5] ibid
[6] https://www.mapsofindia.com/kodaikanal/climate.html

decreased to 10 per cent. The population density of Kodaikanal has more than doubled in the past three **decades. The present density of the town is 1,702 persons/sq km.7**

Figure 2.3**: Population Growth in Kodaikanal**



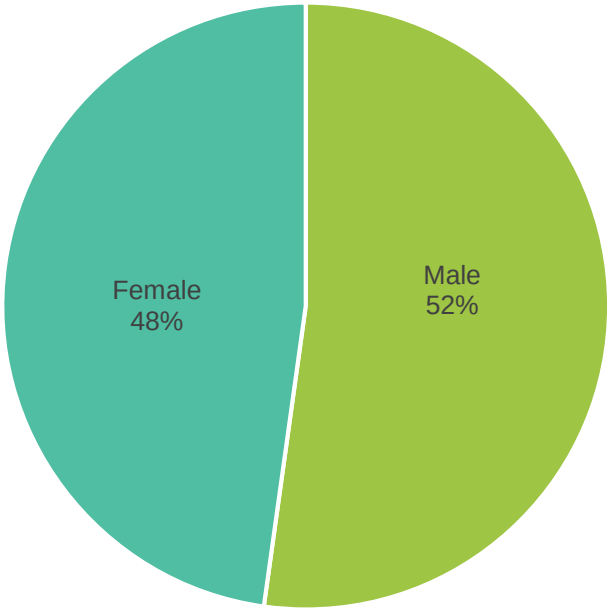
Source: Census, 2011

2.2.1. Literacy

The literate population consists of 52 per cent males and 48 per cent females. Literacy levels in Kodaikanal are higher than the state literacy levels.[8]

[7] Census 2011
[8] ibid.

Figure 2.4: Literacy rate in Kodaikanal



Source: Census, 2011

2.2.2. Socio-economic Profile

As per the Religion Census 2011, Kodaikanal had 48.8 per cent hindus, 12.0 per cent muslims, 38.6 per cent christians and the remaining 1 per cent were sikhs, buddhists, jains and other religions. As per Census 2011, the tribal population of Kodaikanal was located more in the urban areas than in the villages.[9] This may be attributed to migration.

The economy of Kodaikanal is predominantly run by tourism. The number of tourists increased from 14,64,789 in 1999 to 49,69,982 in 2009. The average annual growth rate of 2008–9 is 8.6 per cent. The town also depends on agriculture and forestry activities.[10]

Table 2.1: **Tourism Trends in Kodaikanal**

Sl. No.	Year	Domestic	Foreign	Total
1	1993	14,27,679	37,110	14,64,789
2	1994	15,87,274	40,201	16,27,475
3	1995	16,21,352	44,675	16,66,027
4	1996	16,25,187	45,087	16,70,274
5	1997	16,29,462	45,399	16,74,861
6	1998	14,90,895	40,724	15,31,619

[9] ibid.
[10] ibid.

Table 2.1: **Tourism Trends in Kodaikanal**				
7	1999	15,32,985	43,357	15,76,342
8	2000	15,22,802	45,694	15,68,496
9	2001	15,47,184	45,694	15,92,878
10	2002	16,62,616	50,906	17,13,522
11	2003	18,42,995	56,774	18,99,769
12	2004	21,99,541	66,229	22,65,770
13	2005	21,96,639	74,385	22,71,024
14	2006	29,80,711	78,885	30,59,596
15	2007	38,39,241	96,634	39,35,875
16	2008	44,76,032	98,510	45,74,542
17	2009	48,27,036	1,42,946	49,69,982
Source: Tourism and Culture Department, Tamil Nadu Tourism, Chennai, Srileka's Tourism impact on Kodai ecosystem- A futuristic approach, International journal of Research in Management,(2014).Chennai				

Kodaikanal is known for its assorted cheeses, home-made chocolates, herbal tea, coffee, spices, marshmallows, jam, peanut butter, brown bread, muffins, eucalyptus oil, herbal oils, aromatic oils, winter oil, flowers, fruits, woollen clothes, Tibetan warm clothes, shawls, leather items, handloom, handicrafts, embroidery, ceramic items, toys, jewellery, bone and walnut wood articles. Manufacture of these are the small scale economic activities in the town. [11]

2.3 Source of Lighting

As per Census 2011, above 90 per cent of the population depends on electricity and only 1 per cent does not have any form of lighting.

2.4 Public Transportation

The town has a total road length of 66.5 kms. The Kodai ghat road through which majority of traffic enters the town, is the main access to Kodaikanal.

2.5 Settlement Patterns

In order to understand the settlement patterns in Kodaikanal, the team with the help of Google Maps identified different typologies such as densely populated areas and different socio-economic patterns. It was observed that the northern and north-eastern parts of the town are the most densely populated parts. Most of the urban poor pockets are part of these settlements. The areas adjoining the Kodaikanal lake are the primary commercial areas in the town with multiple ground+2 shopping complexes. The south-western part of the town is a high income area with individual bungalows and villas. The

[11] http://123.63.242.116/kodaikanal/sal_population.htm

southernmost part of the town is sparsely populated with more of a vegetation cover. The settlement pattern and housing typologies across the major settlement patterns are described below.

2.5.1. VGP Nagar

VGP Nagar is a residential locality and caters largely to the high-income group. Most bungalows and luxury houses are leased out to tourists while the owner lives in other parts of the country. Main occupations around here include business and real estate. Wild animals such as wild buffaloes, porcupines and wild boars roam these areas. Very few low-income houses are present and they are mostly of the helpers of the private houses. The big residences are two-storied or multi-storied with concrete walls and flat concrete roofs. The low-income households have concrete walls and flat tin roof.

Figure 2.5: **VGP Nagar**

Source: TNUSSP Primary Study, Kodaikanal, 2017

2.5.2. Naidupuram

Naidupuram is a dense residential area. It houses many resorts and hotels apart from commercial shops and a temple. The houses are mostly two or three storied.

Figure 2.6: **Naidupuram**

Source: TNUSSP Primary Study, Kodaikanal, 2017

2.5.3. Anna Nagar

Anna Nagar is a dense residential area. The area has three streets which begin at an elevation and slope down towards the Kallaraimedu road. Residents belong to the lower-income group and are mostly engaged in blue-collar jobs such as daily-wage labour. Very few are self-employed and own a travel company or a souvenir/petty shop. Majority are hindus and there are a few muslims and christians belonging to the scheduled caste.

There seems to be a clear difference between the settlement pattern uphill and downhill. It was reported by the residents that the community uphill is predominantly muslims due to the presence of a mosque. The area is not densely populated with medium-rise standalone residences. The materials used for construction of the houses are predominantly brick and Reinforced Cement Concrete (RCC) for the flat concrete roof. A few houses have a flat tin roof. As the hill descends, the houses are low-rise and densely populated. Here, while majority of the houses are built of brick and RCC with flat concrete roof, there are houses with tin roof and tiled roof as well. Some of the households have availed the Kalaignar Veetu Vasathi Thittam (Kalaignar State Housing Scheme). Compared to uphill, the houses downhill are much smaller in size and small petty shops and utility shops dot the area.

Figure 2.7: Anna Nagar

Source: TNUSSP Primary Study, Kodaikanal, 2017

2.5.4. Chellapuram

Chellapuram is a non-notified slum. It begins at an elevation and slopes down. It accommodates around 150 households whose residents are mostly daily-wage labourers. The houses have concrete walls and flat concrete roof or flat tin/tiled roof.

Figure 2.8: **Chellapuram**

Source: TNUSSP Primary Study, Kodaikanal, 2017

2.5.5. Pamparpuram

The area has approximately 800 voters. It has schools, temples, churches and a tourist shopping complex. Tourists visiting Dolphin Nose, have to pass through Pamparpuram to reach the main town. So, a tourist shopping complex has been strategically placed here. Reportedly, there has been a steady increase in the number of households since 1975. This has been due to population growth and various government schemes that have enabled families to build houses in the area. This is a mixed residential area with a few high-rise standalone residences among medium-rise and low-rise structures.

Main occupations among the residents of Pamparpuram are:

- High-middle income: Doctors, teachers and government officers
- Middle income: Own souvenir shop/petty shop
- Lower income: Taxi drivers

It was observed that the residents live in either rented or own houses. High-middle income and middle-income families have medium-rise standalone residences. These houses are situated uphill and are not densely populated. The materials used for construction of the houses are brick and RCC with a flat concrete roof. Lower income groups have low-rise standalone residences that are made of brick and RCC with flat concrete, tin or tiled roof.

2.5.6. Pakkiyapuram

Pakkiyapuram was originally a British settlement. It is a dense residential area with schools, shops and a church. It is a mixed neighbourhood and has one, two and three storied houses. There is a stream which flows through the area. A few flat tin-roofed houses were also spotted.

Figure 2.9: **Pakkiyapuram**

Source: TNUSSP Primary Study, Kodaikanal, 2017

2.6 Slums

Under the Integrated Housing and Slum Development Programme (IHSDP) infrastructure facilities (cement concrete pavement with retaining wall, water supply, community toilet and hall, street lighting and solid waste disposal) were provided for 6 slums in Pudukad, Annanagar, Indiranagar, Gandhipuram, Chellapuram, Shanmugapuram and Pamparpuram in Kodaikanal municipality.[12] The Kodaikanal municipality has reported 4 notified slums and 10 non-notified slums and the list is given below:

Table 2.2: **Slums in Kodaikanal**

Sl. No.	Name of Slum	Status
1	Anna Nagar	Notified
2	Indiranagar	Notified
3	Gandhipuram	Notified
4	Turnerpuram	Notified
5	Observatory	Non-notified
6	Pudukad	Non-notified
7	Chellapuram	Non-notified

[12] Census 2011, IHSDP

Table 2.2: **Slums in Kodaikanal**		
Sl. No.	**Name of Slum**	**Status**
8	Thersanagar	Non-notified
9	Shenbaganur	Non-notified
10	Kallukuli	Non-notified
11	Shanmugapuram	Non-notified
12	Pakkiyapuram	Non-notified
13	Pamparpuram	Non-notified
14	Antoniyar Kovil Street	Non-notified
Source: Kodaikanal municipality		

3 Study Findings

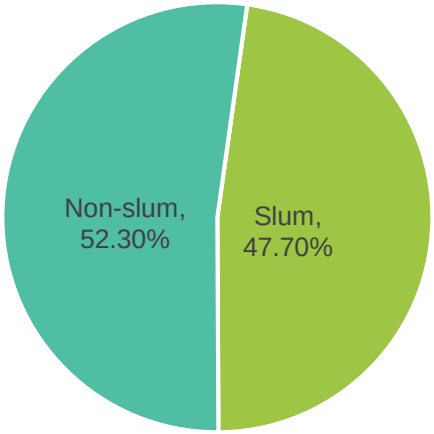
3. Study Findings

This section presents key findings from the households. The findings for establishments are presented separately.

3.1. Households

More than half of the households interviewed (52.30 per cent), reside in non-slum areas and the rest 47.70 per cent, reside in slums. The average household size is 4.

Figure 3.1: **Settlement Pattern**



Source: TNUSSP Kodaikanal Baseline Study, 2017

The socio-economic status of the households was assessed by a set of questions about the educational achievement of the chief wage-earner and the number of consumer durables owned by the household (pre-defined list). Developed by the Market Research Society of India (MRSI), the urban socio-economic classification (SEC) has eight grades ranging from A1 to E3 based on the two variables as presented below in Fig. 3.2.

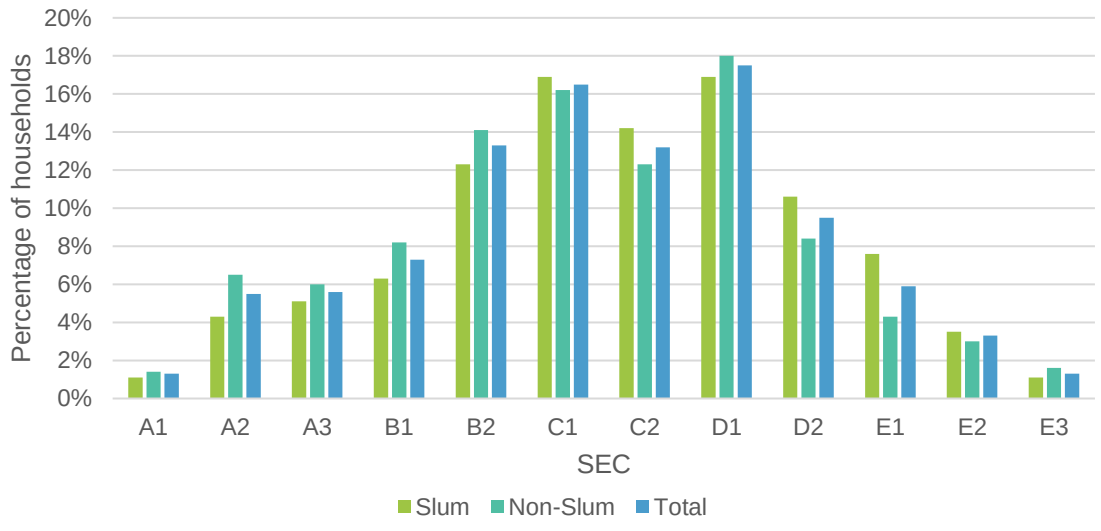
Figure 3.2: **SEC Grid**

No. of Durables (TRANSFER FROM Q1)	Chief Earner: Education (Q2)						
	Illiterate	Literate but no formal schooling/ School-Upto4 years	School-5 to 9 years	SSC/ HSC	Some College (incla Diploma) but not Grad	Graduate/ Post Graduate: General	Graduate/ Post Graduate: Professional
	1	2	3	4	5	6	7
None	E_3	E_2	E_2	E_2	E_2	E_1	D_2
1	E_2	E_1	E_1	E_1	D_2	D_2	D_2
2	E_1	E_1	D_2	D_2	D_1	D_1	D_1
3	D_2	D_2	D_1	D_1	C_2	C_2	C_2
4	D_1	C_2	C_2	C_1	C_1	B_2	B_2
5	C_2	C_1	C_1	B_2	B_1	B_1	B_1
6	C_1	B_2	B_2	B_1	A_3	A_3	A_3
7	C_1	B_1	B_1	A_3	A_3	A_2	A_2
8	B_1	A_3	A_3	A_3	A_2	A_2	A_2
9+	B_1	A_3	A_3	A_2	A_2	A_1	A_1

Source: Socio-Economic Classification, 2011—The New SEC System, MRSI and Media Research Users Council

Data revealed that while most slum households were within the socio-economic classification C1 (illiterate to some college (not graduates and owning 4 to 7 durables) and D1 (illiterate to some college (not graduates and owning 1 to 4 durables) and most non-slum houses were classified as D1.

Figure 3.3: **Household SEC**



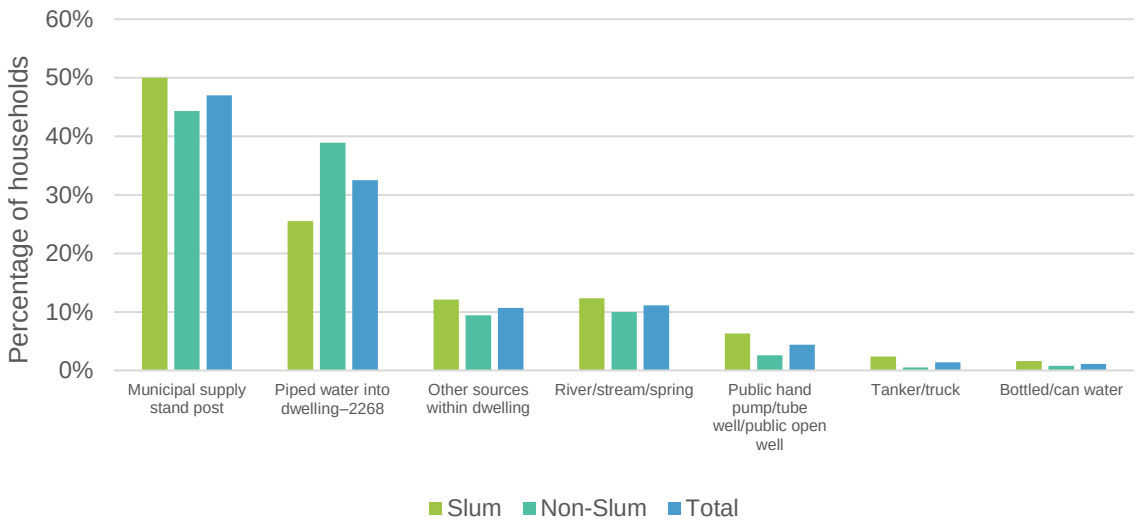
Source: TNUSSP Kodaikanal Baseline Study, 2017

3.1.1. Water Supply

3.1.1.1. Water Supply from Kodaikanal Municipal Administration

The principal source of potable water is the municipal supply stand post. Half of the households (50 per cent) in slum areas and 44.3 per cent households in non-slum areas depend on this source. Access to piped water inside the dwelling was observed to be comparatively higher among non-slum households than slum households. On the other hand, more slum households than non-slum households depended on other sources within the dwelling such as own hand pump/tube well, own protected/unprotected well for potable water. According to Census 2011, a majority of 73 per cent of the households have access to tap water from treated sources followed by 8 per cent households accessing water from springs.

Figure 3.4: **Household Water Supply Arrangements***



**Total exceeds 100 due to multiple response.* n=7561
Source: TNUSSP Kodaikanal Baseline Study, 2017

The Kodaikanal municipality relies on multiple water sources for supplying water to its residents including open wells, bore wells and dams. The water supply details from open well, bore well and dam are given in Table 3.3.

Table 3.1: **Water Supply Details from Open Well, Existing Bore Well and Dam Source**

Sl. No.	Source	Numbers	Water Supply (in MLD)
1	Open well	6	0.20
2	Existing bore well	15	0.78
3	Water from dam	-	1.63
	Total		**2.61**

Source: Kodaikanal Municipality

The length of the water distribution network is 42.05 kilometres and 90 lpcd is supplied through this network. Municipal officers reported that water is supplied once in six days.

Figure 3.5: **Public Standpost in Pakkiyapuram**

Source: TNUSSP Primary Study, Kodaikanal, 2017

a. Municipal Level Water Infrastructure

The municipality has in place varied water infrastructure to hold and supply water across the 24 wards. Water from the source is mostly held in tanks and also in overhead tanks (OHT). There are a total of 11 tanks with a capacity of 16.88 litres and 2 OHTs with 0.06 litres capacity. The water storage and distribution details in Kodaikanal are given in Table 3.4.

Table 3.2: **Water Storage and Distribution in Kodaikanal**

Sl. No	Storage Type	Capacity (litres)	Wards covered
1	Anna Salai tank	1.50	5,7,8,9,10,11,12,13,14
2	Moonjikal tank	2.00	7,8,12,13,14,23
3	Naidupuram tank	3.50	1,2,3,4,5,6
4	Chellapuram tank	1.00	19
5	I.I.A tank	22,000	18
6	KPN Parsi well	8,000	24
7	Bliss Villa OHT	30,000	14,15,16,17,22
	Total	**60,008**	

Source: Kodaikanal municipality

3.1.1.2. Household Arrangements for Potable Water

a. Self-supply

With irregular municipal drinking water supply, households heavily rely on other alternative sources such as private open well, springs and bubble top water cans. The residents reported that over the months, water shortage had escalated to an alarming rate and that the municipal water which was supplied once in 6 days had now been reduced to once in 15 days.

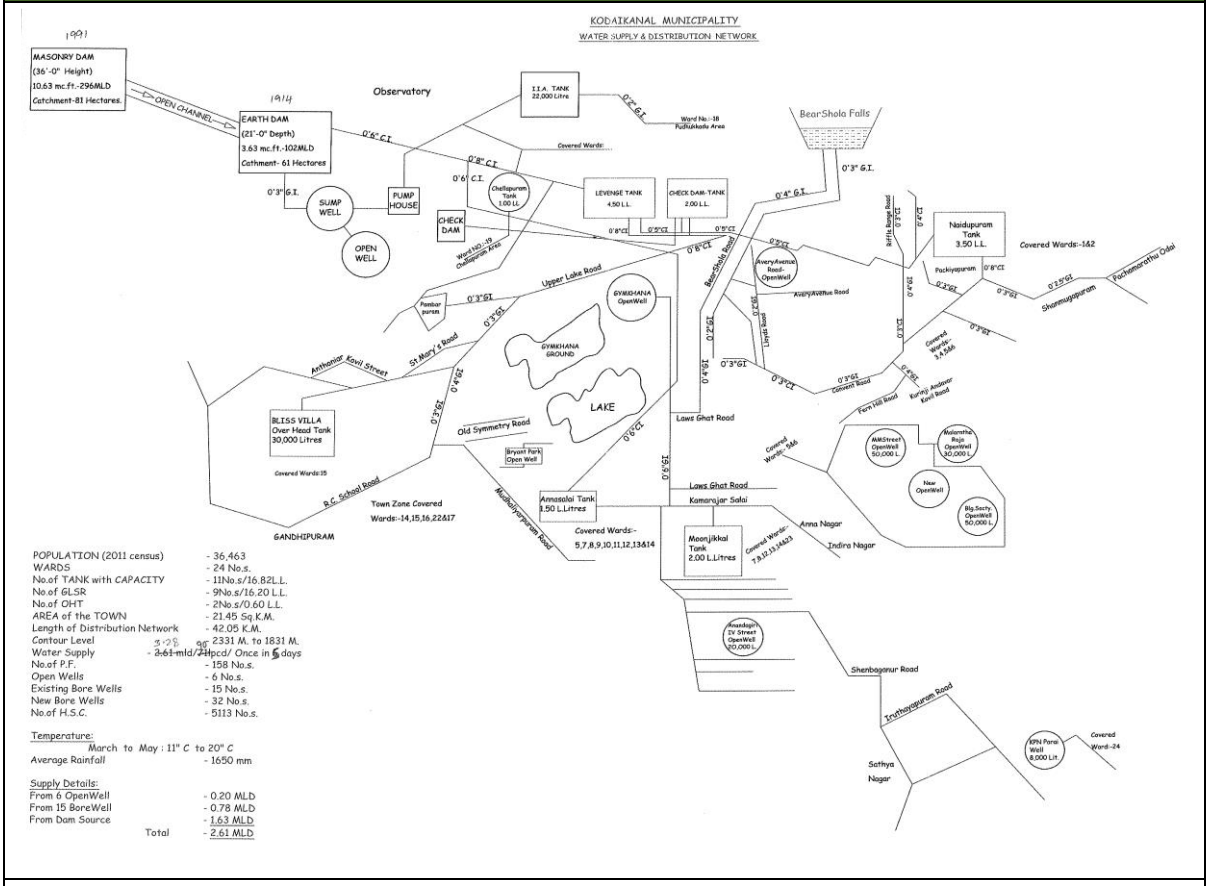
Economic levels among households played a large role in access to potable and non-potable water. While the high and middle income groups depended largely on private vendors for drinking water such as 25-litre capacity bubble tops priced between Rs.50/- to Rs.70/- a can, the low-income groups usually stored the municipal piped water in huge plastic barrels. Additionally, they depended on water sources like springs and private wells for bathing and washing clothes.

Figure 3.6: **A Spring Located in Anna Nagar**

Source: TNUSSP Primary Study, Kodaikanal, 2017

The map states that the municipality has provided 4,278 to 5,113 House Service Connections (HSC) and 158 Public Fountains (PF).

Figure 3.7: **Water Supply and Distribution Network in Kodaikanal Municipality**



Source: Kodaikanal municipality

3.1.2. Household Sanitation Arrangements

Household sanitation arrangements highlighted that the majority (76 per cent) of the households had toilets within the dwelling while 10 per cent used CTs. Census 2011 also reported that around 78 per cent households had individual household toilets.

Table 3.3: **Defecation Pattern in Kodaikanal (Percentage of Households)***

Sl. No.	Access	Slum (n=3,328)	Non-slum (n=3,650)
1	Individual household toilets	76.4%	82.3%
2	Community toilets	10.3%	8.3%
3	Open defecation	9.1%	5.5%

**Total exceeds 100 due to multiple response*
Source: TNUSSP Primary Study, Kodaikanal, 2017

3.1.2.1. Individual Household Toilets

A considerable proportion of households in both slum and non-slum areas had access to individual household toilets. However, the proportion of households with an individual household toilet was higher in non-slum areas (82.3 per cent) than in slum areas (76.4 per cent). On the other hand, a slightly higher percentage of households in slum areas than in non-slum areas accessed CTs. Data revealed that open defecation is practiced by a few households in both slum and non-slum households but this practice was more prevalent among slum households.

Figure 3.8: **Individual Household Toilet**

Source: TNUSSP Primary Study, Kodaikanal, 2017

During the primary study, the team interacted with households in different parts of the town to understand the sanitation arrangements currently in place among households. It was generally observed that the majority of households had an independent toilet within their premises. The most common toilet type was the Indian style pour flush latrine. Western closets were also used in high and middle income households.

In most slum and non-slum households, the toilet facility was inside the house (66.3 per cent). This arrangement was observed to be more prevalent among households in non-slum areas. In more than one-fourth of households (28.4 per cent), the toilet facility was located outside the house but attached to the house.

Table 3.4: **Location of Toilet Facility in Households**				
Sl. No.	**Location**	**Slum**	**Non-Slum**	**Total**
1	Inside the house	59.6%	72.0%	66.3%
2	Outside the house but attached	34.7%	23.0%	28.4%
3	Outside the house but detached standalone	5.7%	5.0%	5.3%
	Total	**100.0%**	**100.0%**	**100.0%**
Source: TNUSSP Primary Study, Kodaikanal, 2017				

Of the total of 5,545 toilets surveyed, irrespective of the location, the predominant material of the roof was RCC for 63 per cent of the toilets. This was followed by burnt brick/stone for facilities inside the house (26.5 per cent) and tin/metal sheet for toilet facilities outside the house but attached and outside the house but detached/standalone. In terms of predominant material of the wall, 97.7 per cent of toilet facilities had burnt brick/stone/concrete block. Few toilets outside the house but attached and outside the house but detached/standalone had walls made of tin/metal sheet.

3.1.3. Community/Public Toilets

As per the Kodaikanal municipality records, there were 47 CT/PTs in Kodaikanal, out of which 38 were currently functioning. Majority of the functional toilets in Kodaikanal municipality were open to both public and community members and were free of charge. Of the 38 functional toilets, 33 were for free usage and 4 were pay-and-use toilets. These CTs were maintained by the users themselves. The community members reported erratic water supply as a problem for the users. In Indira Nagar, a notified slum, the CT complex was run down and non-functional. One of the reasons cited by the residents was that the increase in the uptake of government schemes like Swachh Bharath Mission has resulted in households building individual toilets within their premises. Consequently, this had resulted in the decline of CT users.

Figure 3.9: **Public Toilet in Naidupuram, Kodaikanal**

Source: TNUSSP Primary Study, Kodaikanal, 2017

3.1.3.1. Location of the Toilet Complexes

A sample of 20 CT/PTs were assessed in residential and tourist areas. The paid toilet is located in a residential area.

Table 3.5: **Location of the Toilet Complexes**

Sl. No.	Location	Community toilet	Public toilet	Paid
1	Near/inside bus stop/complex	0	2	0
2	Near/inside market	1	1	0
3	Near temple/mosque	1	1	0
4	In a residential area	5	2	1
5	In a tourist area	0	5	0
6	Near hospital	1	0	0
	Total	**8**	**11**	**1**

Source: TNUSSP Kodaikanal CTs/PTs Assessment, 2017

3.1.3.2. Usage

Usage of PTs was observed to be very high compared to CTs. On an average, it was reported that around 300 people used the PT in the bus complex in a day. This was followed by the PTs in tourist places where the reported average number of users per day was 241 and this number was reported to increase during peak season. In residential areas, the average number of users per day for CTs was reported to be around 86.

An interview with the Abdul Kalam Self Help Group (SHG) corroborated the declining usage of CTs. This SHG was involved in maintaining CTs in five wards in Kodaikanal but with a substantial decrease in the number of users they no longer found it economically feasible to maintain these CTs.

3.1.3.3. Physical Infrastructure and Facilities

All except one toilet block located inside the bus complex were single-storied. The general condition of the toilet structure was observed to be ‘average’; that is, structure is intact but some deterioration in concrete, doors/locks coming loose and some repair were necessary. Most of these toilet blocks assessed were more than 10 years old.

Figure 3.10: **Public Toilet in Pakkiyapuram**

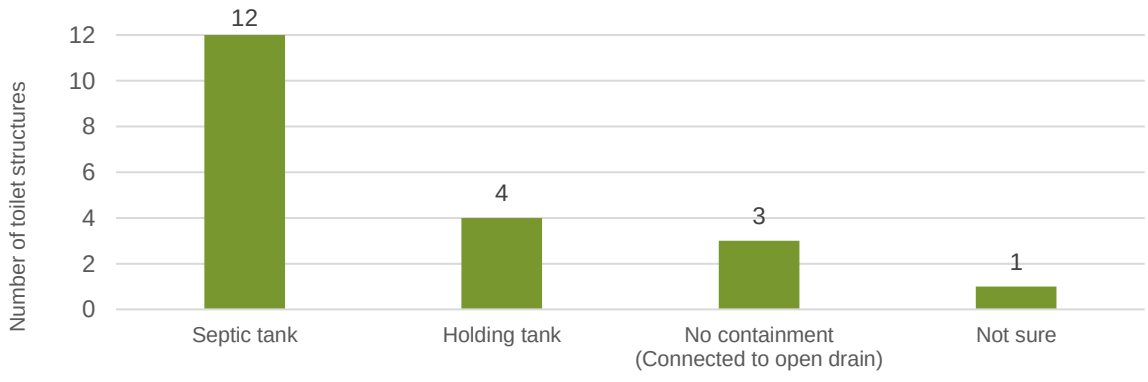
Source: TNUSSP Kodaikanal CTs/PTs Assessment, 2017

All the toilet blocks assessed had pour flush toilets and majority had only squatting pans. On an average, women and girls had more seats than men and boys.

3.1.3.4. On-site Sanitation Arrangement

As reported, most of the toilet blocks were connected to the septic tank while four toilet blocks were connected to a holding tank. It was observed that three toilet blocks were not connected to any type of OSS but was let out into the open drain.

Figure 3.11: **Types of On-site Sanitation Arrangements in CT/PTs**



Source: TNUSSP Kodaikanal CTs/PTs Assessment, 2017

The volume of the containment in most of the toilet blocks was reported to be 1,001 to 2,000 m^3. Overall, only seven toilet blocks had ever desludged the OSS. It was reported that two toilet blocks were directly connected to the wastewater treatment plant at Kallaraimedu.

3.1.4. Open Defecation

There was high incidence of open defecation reported in two slums, Chellapuram and Anna Nagar and among a few low-income residents in VGP Nagar. Lack of space and financial constraints were cited as the two main reasons for not having a toilet within their premises. Additionally, in Anna Nagar, the dysfunctional CT added to this problem. Hence, the residents used the cemetery located on the main road for defecation. In VGP Nagar, a high-income residential area, the residents complained that open defecation was practiced by people who worked in private bungalows as helpers. The possible site used by them was the backyard much to the annoyance of many residents.

Figure 3.12: Open Defecation Site in VGP Nagar

Source: TNUSSP Primary Study, Kodaikanal, 2017

3.1.5. Containment

All households with individual toilets were asked about their toilet outlets and their responses are presented in Table 3.8. As reported, a considerable proportion of households were connected to some type of OSS. Among them, almost three-fourth (73.7 per cent) of the households with individual household toilets (N=5,545) reported that the predominant containment system was a septic tank. More

slum households (76.4 per cent) than non-slum households (71.4 per cent) reported it as septic tank. Overall, 18.3 per cent households with individual toilets had single/twin pits.

Direct discharge into drain/open areas was reportedly more prevalent in non-slum areas (5.4 per cent) than in slum areas (2.2 per cent). A similar trend was reported with respect to households not connected to any type of containment system where the black water was being let out into a hole in the ground or into buckets or the pan was being manually removed.

Table 3.6: **Predominant Containment System in Households—Reported**

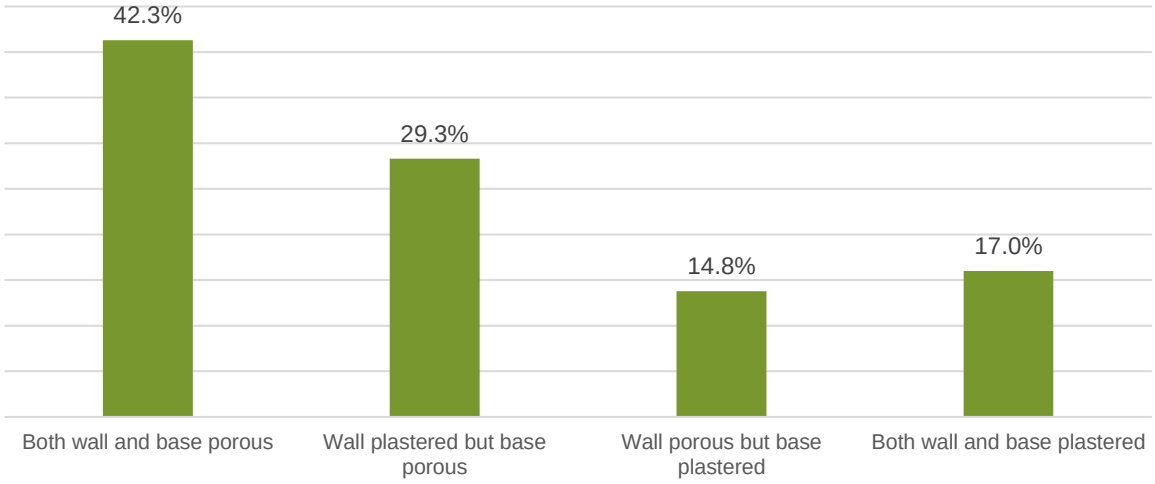
Sl. No.	Type	Slum	Non-Slum	Total
1	Septic tank	76.4%	71.4%	73.7%
2	On-site (single/twin pit)	17.6%	18.8%	18.2%
3	Direct discharge (drain/open areas)	2.2%	5.4%	3.9%
4	Not connected (Hole in the ground/bucket/pan is manually removed)	3.6%	4.0%	3.8%
5	DEWATS treatment system (community septic tank)	0.0%	0.3%	0.2%
6	Water bodies (canal, pond, lake, river etc.)	0.3%	0.1%	0.2%
	Total	**100.0%**	**100.0%**	**100.0%**
	n	**2,542**	**3,003**	**5,545**

Source: TNUSSP Primary Study, Kodaikanal, 2017

During the study, the respondents were probed on the types of materials used to construct the walls and base of the septic tank or single/twin pit. This data was used to confirm if the reported data on the type of containment system matches with the existing infrastructure. The results revealed that a high proportion of OSS reported as septic tanks or single/twin pits were just crude structures that did not follow any standards in terms of dimensions or infrastructure. More than one-third of the containment structures had both walls and base that were porous in nature (42.3 per cent). Over one-fourth (29.3 per cent) of containment structures had walls that were plastered but with a porous base and 14.8 per cent had porous walls and plastered base.

Overall, only 17 per cent or 969 households had containment systems with both walls and base plastered.

Figure 3.13: **Pit/septic Tank Infrastructure in Households**



Source: TNUSSP Primary Study, Kodaikanal, 2017

As per WHO standards[13], it is necessary for a septic tank to be watertight and it should ideally have at the least one partition wall so as to meet the two-chamber criteria.

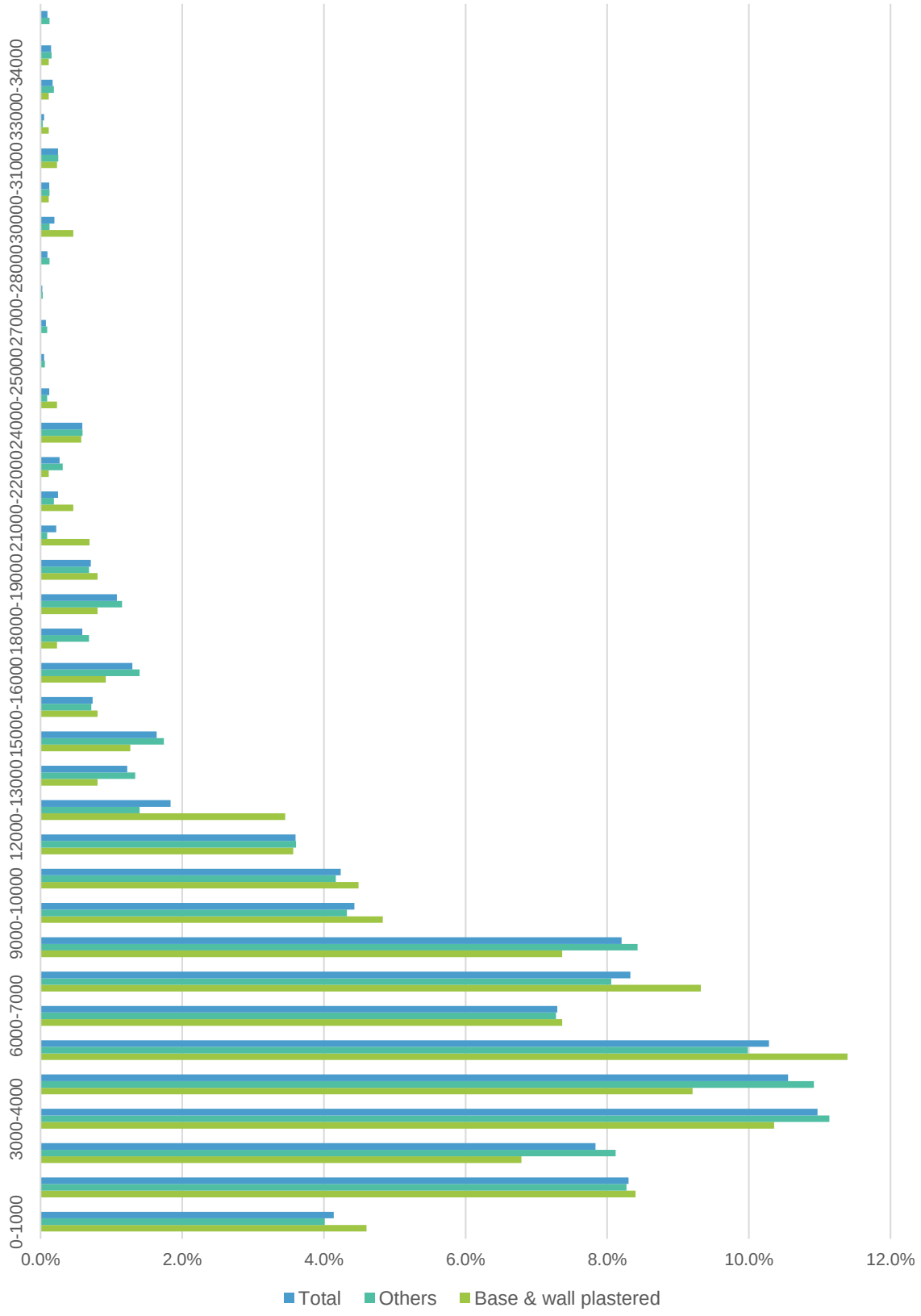
Of the septic tanks which had both walls and base plastered (n=869), only 5.7 per cent were partitioned and had more than one chamber. This type of arrangement was more prevalent in non-slum households (64.3 per cent) than in slum households (35.7 per cent).

Further, only 25 households had their septic tank (with both walls and base plastered and with more than one chamber) connected to a soak/leach pit.

Reported data on the volume of the containment systems indicate that most septic tanks that have both walls and base plastered were of 5,000 to 6,000 litres containment volume. In case of septic tanks that are porous, the containment volume was mostly between 3,000 to 5,000 litres.

[13] The World Health Organisation[13] defines septic tanks as "Watertight chambers sited below ground level which receive excreta and flush water from flush toilets and other domestic sullage (collectively known as wastewater). It is best to build a septic tank with two compartments, the first compartment being twice the size of the second". (http://www.who.int/water_sanitation_health/hygiene/emergencies/fs3_9.pdf)

Figure 3.14: **Septic Tank Volume**



Source: TNUSSP Primary Study, Kodaikanal, 2017

Table 3.7: **Septic Tank Wall and Floor Plastered**				
Sl.No.	**Septic Tank Volume (litres)**	**Septic Tank Wall and Floor Plastered**		**Total**
		Yes	**No**	
1	0–1,000	40	129	169
2	1,000–2,000	73	266	339
3	2,000–3,000	59	261	320
4	3,000–4,000	90	358	448
5	4,000–5,000	80	351	431
6	5,000–6,000	99	321	420
7	6,000–7,000	64	234	298
8	7,000–8,000	81	259	340
9	8,000–9,000	64	271	335
10	9,000–10,000	42	139	181
11	10,000–11,000	39	134	173
12	11,000–12,000	31	116	147
13	12,000–13,000	30	45	75
14	13,000–14,000	7	43	50
15	14,000–15,000	11	56	67
16	15,000–16,000	7	23	30
17	16,000–17,000	8	45	53
18	17,000–18,000	2	22	24
19	18,000–19,000	7	37	44
20	19,000–20,000	7	22	29
21	20,000–36,000	28	83	111
Total		**869**	**3,215**	**4,084**
Source: TNUSSP Primary Study, Kodaikanal, 2017				

Based on the team's interaction with the builders, local masons and residents during our site reconnaissance, septic tanks can be classified into different sub-types, as presented in Table 3.10.

Table 3.8: **Types of Septic Tanks in Households**

Sl. No	Type	No. of Chambers	Water Tightness	Materials Used		Outlet Arrangements
				Walls	Base	
1	Type 1a	2	Yes	All four sides–brick work	Plain concrete cement	No outlet
2	Type 1b	2	Yes	All four sides–RCC	RCC	No outlet
3	Type 2a	1	Porous	All four sides–soft rock without any mortar	No material	Percolating to the ground
4	Type 2b	1	Porous	All four sides–soft rock and rubble stones	No material	Percolating to the ground
5	Type 3	1	Porous	Brick walls with cement mortar on three sides and soft rock with no mortar on fourth side of the wall	Horse dung	Percolating to the ground
6	Type 4	1	Porous	Brick walls and cement mortar on three sides and soft rock with no mortar on fourth side of the wall	PCC	Soak pit

Source: TNUSSP Primary Study, Kodaikanal, 2017

As presented in Table 3.10—Type 1a and 1b are almost in line with WHO specifications where both the base and walls are non-porous, plastered and two-chambered. However, most of the OSS at the household level are built based on the availability of space and resources and do not comply with the required standards.

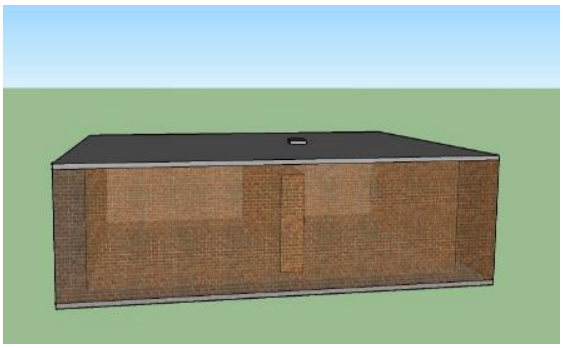
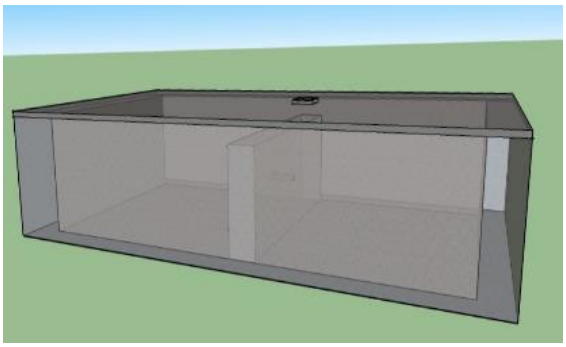
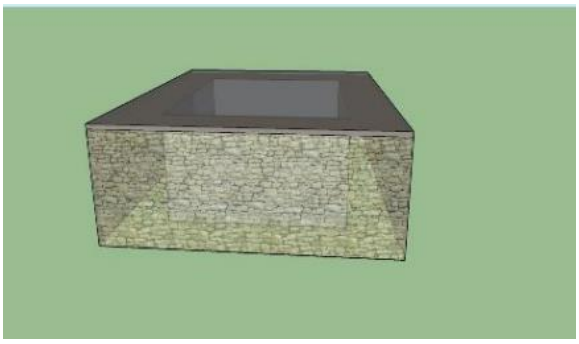
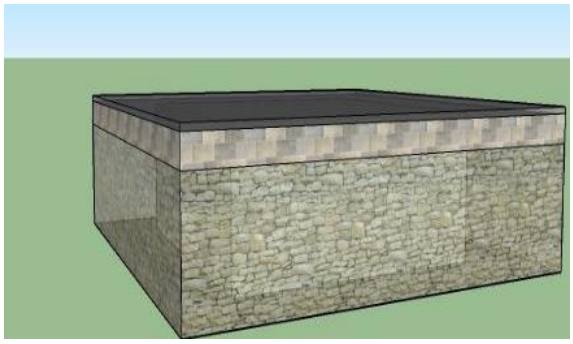
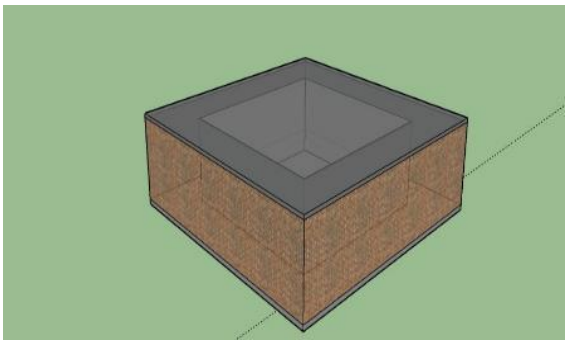
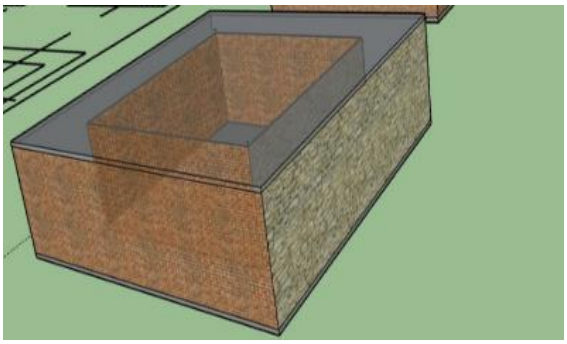
Figure 3.15: **Illustration and Description of Type of Septic Tanks**	
Type 1a	**Type 1b**
	
Dimension (LxBxD): 8'x 6'x 6' (approx.) Chambers: 2 (separated by baffle wall at the centre with holes) Base: non-porous, PCC Walls: non-porous, brick work Top clab: RCC Access cover (Y/N): Yes Soak pit: No Other details: Generally noticed in high-income groups and big hotels. Septic tank constructed with support walls made of brick and base made of plain CC (a mixture of sand, cement and crushed stones). According to the local masons, this structure requires to be desludged frequently as the water does not percolate into the ground.	Dimension (LxBxD): 8'x 5'x 10' (approx.) Chambers: 2 (separated by baffle wall at the centre with holes) Base: non-porous, RCC Walls: non-porous, RCC Top slab: RCC Access cover (Y/N): Yes Soak pit: No Other details: Generally noticed in multiple dwelling unit buildings (group houses) or bungalows/villas (middle or high income group) The entire structure (rectangle/square) is made of RCC with a RCC covering with provision for a manhole.
Type 2a	**Type 2b**
	
Dimension (LxBxD): 6'x 4'x 8' (approx.) Chambers: 1 Base: porous Walls: porous, soft rock Top slab: RCC Access cover (Y/N): No	Dimension (LxBxD): 6'x 4'x 8' (approx.) Chambers: 1 Base: porous Walls: porous, soft rock and rubble stones Top slab: RCC Access cover (Y/N): Yes

Figure 3.15: **Illustration and Description of Type of Septic Tanks**	
Other details: Generally noticed in middle or low income groups. Rectangle/square structure with walls made of soft rock without any mortar. The width of the wall is 45 cms and is not plastered. The base is also porous and the covering is a concrete lid or in certain structures there is provision for a manhole.	Soak pit: No Other details: Generally noticed in low and middle income groups. Rectangle/square structure with soft rock walls without any mortar. However, from the lid for 30-45 cms the wall structure is made of soft rocks with cement mortar. The base is porous with no plastering and the covering is a concrete lid or in certain structures there is provision for a manhole.
Type 3	**Type 4**
	
Dimension (LxBxD): 8'x 5'x 10' (approx.) Chambers: 1 Base: porous, horsedung placed at the bottom Walls: 3 sides porous; 1 side non-porous Top slab: RCC Access cover (Y/N): Yes Other details: Generally noticed in middle or high income groups. Households construct rectangle/square structures with brick walls and cement mortar on three sides and soft rock with no mortar on the fourth side of the wall. The base is porous and horsedung, which helps in faster microbial action, is placed at the bottom of the pit. The cover is usually an RCC slab.	Dimension (LxBxD): 8'x 5'x 10' (approx.) Chambers: 1 Base: non-porous Walls: 3 sides non-porous; 1 side porous Top slab: RCC Access cover (Y/N): Yes Soak pit: Yes Other details: Suggested for all income groups. Suggested in red soil areas (red soil when in contact with water turns into a sluggish consistency). Households construct rectangle/square structures with brick walls and cement mortar on three sides and soft rock with no mortar on the fourth side of the wall. The base is PCC with three or four small openings at the corners which is connected to a trench filled with rubbles and stones. This trench is connected to a soak pit. The cover is usually an RCC slab.
Source: TNUSSP Analysis, 2017	

The design and specifications of these 'septic tanks' largely depend on the financial capability of the household, the space available to build the structure and also in some cases on the availability of local materials like stone, horsedung or red soil to layer the base. Table 3.11 presents the differences in terms of structural masonry, septic tank size and design and disposal systems.

Table 3.9: **Design Norms vs Construction in Practice of Septic Tanks**

Sl. No.	Aspects of Septic Tank	Standard Design Norms	Observed Construction Practice
1	Structural Masonry	Septic tank functions as a solid–liquid separation tank which should hold sewage for about two days. The supernatant is to flow out and the solids to settle down and thicken at the bottom so that it can be removed after two to three years. As per CPHEEO standards, it is recommended that the septic tank should be constructed using CC with water proofing. This is to avoid percolation by achieving water tightness.	Households prefer to construct a rectangle/square structure with soft rock walls without any mortar. The base is porous with no plastering and the covering is a concrete lid or in certain structures there is provision for a manhole
2	Septic Tank Size and Design	As per CPHEEO standards, the size of septic tanks is to be determined based on the household size and desired desludging frequency	In practice, the size of the septic tank is determined by the space available to build one. These septic tanks do not follow a standard design and are often porous at the base. Percolation is also allowed on the sides of the wall. Locally available materials such as horsedung and red soil are used to layer the base. While horsedung is believed to augment the anaerobic process, the red soil turns the sludge into a sluggish consistency and prevents percolation into the ground.

Table 3.9: **Design Norms vs Construction in Practice of Septic Tanks**			
Sl. No.	**Aspects of Septic Tank**	**Standard Design Norms**	**Observed Construction Practice**
3	Disposal Systems	There are two types of wastes generated in septic tanks: 1. Liquid effluent which comes out of the outlet every day; 2. Settled solids in the form of sludge that needs to be removed once in two or three years. For the liquid effluent, treatment is deemed appropriate by methods like soak pits or dispersion trenches with the caution that these sub-soil dispersion systems shall be at least 20 m away from any drinking water source. The distance between the soak pit and adjacent dwelling is recommended to be at least 7 m to avoid any corrosive effect due to tank gases vented into atmosphere. Sludge needs to be emptied by mechanical vacuum tankers and should be sent for further treatment at sludge treatment units at sewage treatment plants or appropriate septage treatment facility. For this regular desludging, access covers need to be provided.	Desludging is not done at regular intervals. Mostly, households prolong the need to desludge by building deeper septic tanks. Further, residents presume that since traditional materials like horsedung and red soil ensures natural anaerobic process desludging is not required.
Source: CPHEEO, TNUSSP Primary Study, Kodaikanal, 2017			

Table 3.12 below shows tin detail the types of septic tanks observed during the household survey.

Table 3.10: **Summary of On-site Systems Observed through Interaction with Households**

Sl. No.	Household No.	Household Size	Age of the Building (years)	Age of Septic Tank	Shape of Septic Tank	Size of Septic Tank (m^3)	No. of Chambers	Watertight Base (Y/N)	Openable Access Cover (Y/N)	Outlet	Frequency of Desludging (yearly)
1	H1	2	15	Under construction	Square	8	1	Yes	yes	Outlet maybe constructed	Not done
2	H2	3	20	20	Rectangular	14.4	1	No	No	Side walls sealed with manhole opening. Base open	Not done
3	H3	3	20	7	Circular	25	1	No	No	Side walls sealed with provision for desludging. Base open	Not done
4	H4	3	6	Under construction	Rectangular	6	1	No	No	All Sides and base porous. Ongoing construction	Not done
5	H5	4	10	1 year	Rectangular	18	1	No	No	Side walls sealed up to 1 feet with manhole opening. Base open	Not done

Source: TNUSSP Primary Study, Kodaikanal, 2017

Table 3.11: **Summary of Construction Practice by Builders and Masons**

Sl. No.	Respondent	Number of Buildings Executed	Dimensions (LxBxD)	Avg. Capacity of Septic Tank (m^3.)	Water Tight		No. of Chambers	Design of Partition Wall	Access Covers	Outlet	Avg. Cost
					Side Walls	Bottom					
1	Builder 1	2,000	8'x 4'x 6' , 6'x10"x8, and depends upon area availability	6 to 25	3 sides sealed. With one mud /porous wall	Most structures left open at the base. Few big hotels requested base to be plastered	Max–1 Some place 2	2 holes on the bottom corner	Some sealed, some have openable cover	Soak pit	50,000
2	Builder 2	More than 1,500; have 20 years' experience	8'x 4'x 6' , 6'x10"x8, 6' diameter 12'depth and depends upon area availability	3 to 10	Not provided	Not provided	Max–1	Not applicable	Most places sealed, some have openable cover	Percolates into ground	10,000 to 35000
3	Mason 1	200	7' x 4'x 10' and 6'x6'x6'	2 t0 8	Some place provided, most places not provided	Some place provided, most places did not provide	1	Not applicable	Most places sealed, some have openable cover	Percolates into ground	10,000 to 25000

Table 3.11: **Summary of Construction Practice by Builders and Masons**											
Sl. No.	**Respondent**	**Number of Buildings Executed**	**Dimensions (LxBxD)**	**Avg. Capacity of Septic Tank (m^3.)**	**Water Tight**		**No. of Chambers**	**Design of Partition Wall**	**Access Covers**	**Outlet**	**Avg. Cost**
					Side Walls	**Bottom**					
4	Mason 2	More than 2,000	Different dimensions	2 to 15	3 sides water tight. One side open. Or all sides porous	Not provided	1	2 holes on the bottom corner	Some sealed, some have openable cover	Percolates into ground	
5	Mason 3	More than 1,000	Different dimensions	2 to 10	Not provided	Not provided	1	Not applicable	Some sealed, some have openable cover	Percolates into ground	Part of the building cost (difficult to give separate cost)
Source: TNUSSP Primary Study, Kodaikanal, 2017											

3.1.6. Collection, Conveyance and Disposal

Direct and easy access to the containment system for desludging depends on three components of accessibility including location of the onsite system; width of the road to accommodate desludging vehicles and if the onsite system can be easily opened to insert the pipe for desludging.

Majority of the containment systems in slum and non-slum households with reported septic tank or single/twin pit (N=5,097) were either located in front of the house or behind the house or on the side of the house facilitating easy and direct access by a truck to the containment system. Mostly, the containment system was located in front of the house. More non-slum households (29.9 per cent) than slum households (31.4 per cent) had the containment system located behind the house. A similar proportion of households in slum (27.3 per cent) and non-slum areas (27.5 per cent) had the containment system on the side of the house. Less than one-tenth households (4.5 per cent), had the containment system below the pan/platform or below the building.

Table 3.12: **Location of Containment System in Households–Reported**				
Sl. No.	**Location**	**Slum**	**Non-Slum**	**Total**
1	In front of the house	36.5%	35.5%	36.0%
2	Behind the house	29.9%	32.8%	31.4%
3	On the side of the house	27.3%	27.5%	27.4%
4	Below the pan/platform (below the building)	5.7%	3.4%	4.5%
5	Along the road	0.6%	0.7%	0.7%
	Total	**100.0%**	**100.0%**	**100.0%**
Source: TNUSSP Primary Study, Kodaikanal, 2017				

It was observed that in majority of the households (76.4 per cent) the approach road was either 5 to 10 feet or more than 5 feet with sufficient space for a desludging truck to park.

Very narrow roads/lanes were observed in the old part of the town around the Sathakathullah Appa Dargha. The spatial growth pattern revealed a densely populated core town area around the *dargha* with narrow lanes and tightly packed houses. This being the old part of town, had no open or adequate spaces for large vehicles to navigate or park.

Table 3.13: **Width of the Nearest Road to the Containment System in Households**

Sl. No.	Type	Slum	Non-Slum	Total
1	Less than 5 feet	21.9%	25.1%	23.6%
2	5-10 feet	36.7%	32.3%	34.4%
3	Greater than 5 feet	41.4%	42.6%	42.0%
Total		**100.0%**	**100.0%**	**100.0%**

Source: TNUSSP Primary Study, Kodaikanal, 2017

Less than half (47.6 per cent) of the households had a containment system with an opening such as a manhole or a pipe to facilitate cleaning and emptying. However, majority of the containment systems were sealed and needed to be broken to access the system. Such sealed containment systems were more prevalent in slum households (57.6 per cent) than in non-slum households (47.6 per cent).

Table 3.14: **Top Slab of Containment in Households**

Sl. No.	Type	Slum	Non-Slum	Total
1	Manhole opening with cover	28.8%	37.7%	33.4%
2	Pipe with cap	13.6%	14.8%	14.2%
3	Sealed	57.6%	47.6%	52.3%
Total		**100.0%**	**100.0%**	**100.0%**

Source: TNUSSP Primary Study, Kodaikanal, 2017

The practice of cleaning septic tanks or pits among households is reportedly low in both slum and non-slum households. While 22.2 per cent non-slum households have ever emptied their septic tank or pit, only 15.6 per cent slum households reported on the same.

As per CPHEEO norms, septic tanks need to be cleaned periodically at an interval of 2-3 years. Across households who have ever emptied their septic tank or pit, almost half or 49.1 per cent clean their tank either once a year or once in two years while the remaining 50.9 per cent households have desludging frequency above 3 years.

Table 3.15: **Frequency of Desludging in Households**				
Sl. No.	**Frequency**	**Slum**	**Non-Slum**	**Total**
1	Once a year	27.2%	19.8%	22.6%
2	Once in 2 years	21.0%	29.9%	26.5%
3	Once in 3 years	15.6%	13.8%	14.5%
4	Once in 4 years	5.9%	5.1%	5.4%
5	Once in 5 years	10.5%	16.3%	14.1%
6	Once in 6 years and above	19.8%	15.1%	16.9%
Total		**100.0%**	**100.0%**	**100.0%**
Source: TNUSSP Primary Study, Kodaikanal, 2017				

Households were heavily dependent on private operators to empty or clean the septic tank/pit. This was observed among both slum (79.8 per cent) and non-slum households (73.4 per cent). In some households, the septic tank or pit cleaning was carried out by the residents themselves. This practice is more prevalent among non-slum households (20.9 per cent) than in slum households (13.4 per cent). The municipality reportedly had a minimal role in desludging (6.7 per cent) with more households in slum areas dependent on their services to empty their septic tank/pit.

Table 3.16: Who Emptied Septic Tanks/Pits in Households				
Sl. No.	**Type**	**Slum**	**Non-Slum**	**Total**
1	Municipality	6.7%	5.6%	6.1%
2	Private	79.8%	73.4%	75.9%
3	Self	13.4%	20.9%	18.1%
Total		**100.0%**	**100.0%**	**100.0%**
Source: TNUSSP Primary Study, Kodaikanal, 2017				

The Kodaikanal municipality owns a 5,000 litre capacity desludging truck which is currently not functional and they charge Rs. 600 to Rs. 800 per trip.

Currently, there are four private operators offering desludging services to both residents and hotels in Kodaikanal. While three operators are from Batlagundu which is 60 kms from Kodaikanal, one operator is from Vadipatti, 88 kms from Kodaikanal. As reported by the Kodaikanal municipal authorities and the residents, one of the main private desludging operators who have a strong presence in the town are Shakthi operators. They are based in Batlagundu and in a week make four or five trips to the town. Sometimes, the trucks are stationed in the town for a period of time during which they take up desludging services before returning to their base in Batlagundu. Their charges are much higher than the government rates with different rates for hotels and residential units. For big hotels, the charges are around Rs. 60,000 to Rs. 1,00,000 per desludging operation for which the truck makes 8 to 12 trips to empty the sludge. For households, the charges are around Rs. 8,000 to Rs.13,000 per trip. Topography

and width of the roads often pose a challenge and at such places the service is either declined or efforts are made with longer pipes.

3.1.7. Treatment

At present, there are no facilities available for septage treatment in Kodaikanal. Informal discussions with residents and private water suppliers indicate that the fecal sludge collected from residential and non-residential units are disposed of in a farmland at the foot hills of Kodaikanal.

3.1.7.1. Wastewater Treatment Plant (WWTP)

The WWTP is owned by the Kodaikanal Eco-Protection Engineer Limited (ETP) Company formed by the Hotel Association. The land was provided by Kodaikanal municipality free of cost. While the company financed the plant through 50 per cent contribution of capex requirement, 25 per cent each was contributed by the central government and state government respectively. The WWTP site is easily accessible and is on the main road in Kallaraimedu in Anna Nagar. Access inside the WWTP however is limited—the entrance is via a brick staircase. It is not feasible for any vehicles to enter the site. The access paths beyond the main entrance are very narrow and slope steeply, with steps provided throughout the site.

The WWTP receives wastewater flow from the following entities:

- 45 hotel complexes (both standalone eateries as well as hotels providing accommodation).
- The Carlton hotel is the largest contributor accounting for a substantial flow to the plant.
- The Kodai International School is the other significant contributor to the WWTP.
- Other significant contributors are the golf club, municipality guest house and the three PTs owned by the municipality

3.1.8. Drainage

Most households (65.1 per cent) have a drainage facility outside the premises. Closed drain was observed mostly in non-slum households whereas, open drain was common in slum areas. Over one-third of households in slums do not have any drainage facility outside their premises.

Table 3.17: **Drainage Facility Outside House**

Sl. No.	Type	Slum	Non-Slum	Total
1	Yes, open drain	27.9%	25.7%	26.7%
2	Yes, closed drain	33.5%	42.5%	38.4%
3	No drain	38.6%	31.7%	34.9%
	Total	**100.0%**	**100.0%**	**100.0%**

Source: TNUSSP Primary Study, Kodaikanal, 2017

Greywater was mostly disposed of to the drain outside and was reportedly high in non-slum households (71.6 per cent). Very few households (5.4 per cent) diverted the greywater to the septic tank/pit. This practice was more prevalent in non-slum households (6.1 per cent) than in slum households (4.6 per cent).

Table 3.18: **Where Greywater is Disposed in Households**				
Sl. No.	**Outlet**	**Slum**	**Non-Slum**	**Total**
1	To the drain outside	65.8%	71.6%	68.9%
2	To soak pit/leach pit within premises	11.9%	6.1%	8.7%
3	To plants within premises	17.7%	16.2%	16.9%
4	To septic tank/pit (constructed for toilet)	4.6%	6.1%	5.4%
Total		**100.0%**	**100.0%**	**100.0%**
Source: TNUSSP Primary Study, Kodaikanal, 2017				

3.2. Establishments

Majority of the establishments (80.9 per cent) surveyed were provision stores, petty shops or eateries. While 5.9 per cent were hotels, guest houses or lodges, 2.3 per cent were offices. Hospitals, clinics and nursing homes constituted 0.7 per cent of the total establishments covered.

Commercial establishments are mainly concentrated around the north of the Kodaikanal lake. The commercial establishments on Club road and PT road are mostly shops located in big complexes and are 2 or 3 storied structures. The underground and ground level structures are full RCC structures with tin and concrete roofs. The complex has restaurants, hotels, book shops, internet cafes and tailoring shops. The Kodaikanal International School is located on Club road opposite the Hill Top inn complex.

Bazaar road is another major hub for commercial establishments. There is a mix of complexes, lodges, hotels, banks as well as individual shops there. The structures are mostly double or triple storied buildings with concrete walls and concrete or tin roofs.

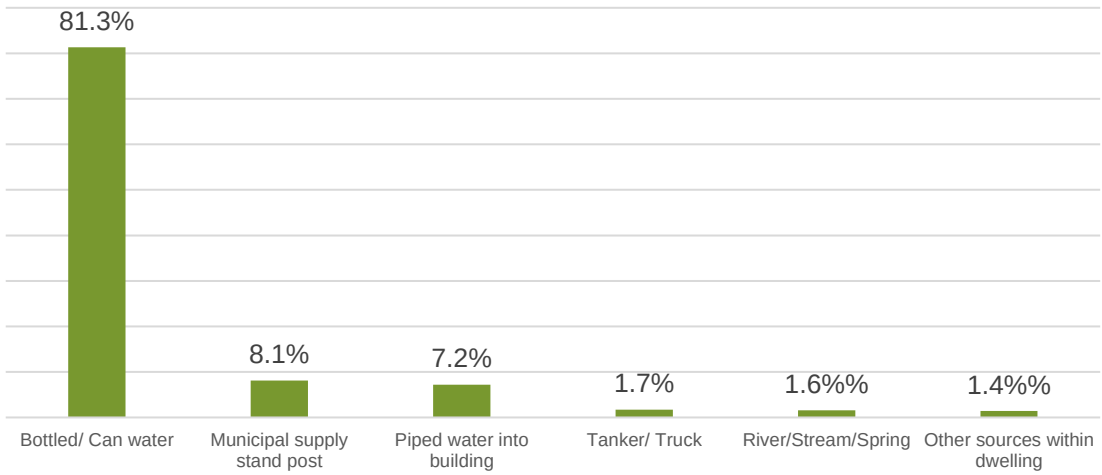
Figure 3.16: **Commercial Establishments**

Source: TNUSSP Primary Study, Kodaikanal, 2017

3.2.1. Water Supply

Establishments are heavily dependent on private vendors for potable water. Majority of the establishments purchase bottled or canned water for drinking and cooking purposes. Less than one-tenth (8.1 per cent) have access to municipal standpost outside premises. A slightly lesser proportion of establishments (7.2 per cent) have direct access to piped water inside the building.

Figure 3.17: **Main Source of Potable Water in Establishments**



Source: TNUSSP Primary Study, Kodaikanal, 2017

3.2.2. Sanitation Arrangements

In all, only 10.4 per cent or just 341 establishments have a toilet in the building. In most establishments, the toilet facility is inside the building (69.5 per cent). In more than one-tenth of establishments, the toilet facility is either located outside the building but attached to the building (18.8 per cent) or outside the building as detached/standalone structures (11.7 per cent).

Table 3.19: **Location of Toilet Facility in Establishments**

Sl. No.	Location	Total
1	Inside the establishment	69.5%
2	Outside the establishment but attached	18.8%
3	Outside the establishment but detached/standalone	11.7%

N=341 (Establishment with toilets)
Source: TNUSSP Primary Study, Kodaikanal, 2017

3.2.3. Containment

All establishments with individual toilets were asked about their toilet outlets and their responses are presented in Table 3.22. As reported, a considerable proportion of establishments were connected to the OSS. Mostly, the toilets were connected to a single or twin pit (42.9 per cent) followed by a septic tank (37.0 per cent).

Over one-tenth (14.1 per cent) of the establishments reported that the toilet was not connected to any type of containment system and that the black water was let into a hole in ground or into buckets or the

pan was manually removed. Direct discharge into drain/open areas was reported by 5.3 per cent establishments.

Table 3.20: **Predominant Containment System Reported in Establishments**

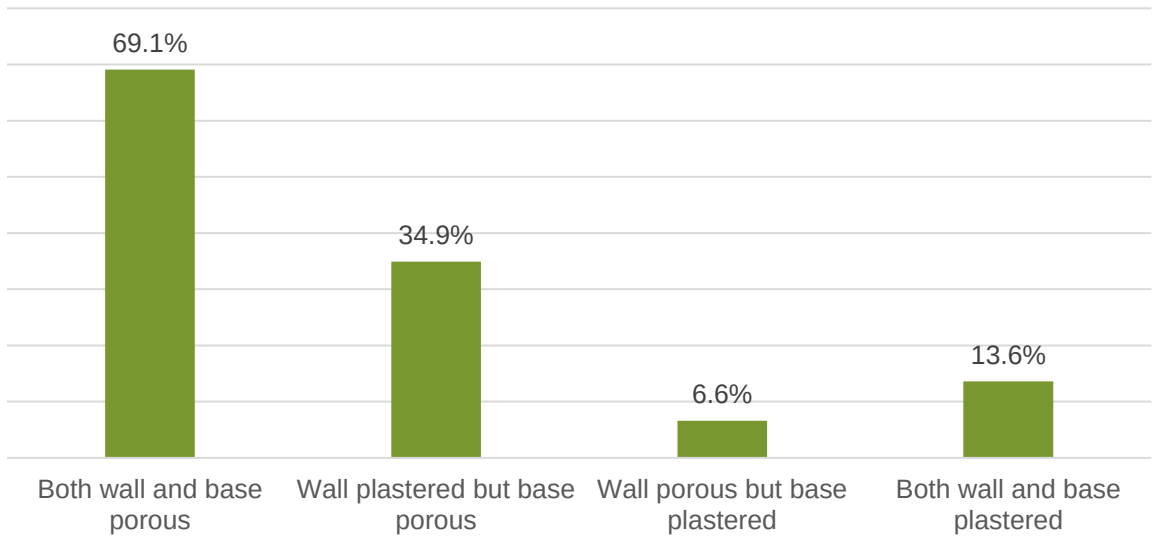
Sl. No.	Type	Total (n=341)
1	On-site (single/twin pit)	42.9%
2	Septic tank	37.0%
3	Not connected (hole in the ground/bucket/pan is manually removed)	14.1%
4	Direct discharge (drain/open areas)	5.3%
5	DEWATS treatment system (Community septic tank)	0.9%
	Total	**100.0%**

Source: TNUSSP Primary Study, Kodaikanal, 2017

Majority of the containment structures had both walls and base that were porous in nature (69.1 per cent). Just over one-third (34.9 per cent) of containment structures had walls that were plastered but with a porous base and 6.6 per cent had porous walls and plastered base.

Overall, only 11.8 per cent or 32 establishments had containment systems with both walls and base plastered (n=272).

Figure 3.18: **Pit/septic Tank Infrastructure in Establishments**



N=272 (Toilets connected to single/twin pits or septic tank)
Source: TNUSSP Primary Study, Kodaikanal, 2017

Table 3.21: **Pit/septic Tank Infrastructure in Establishments**		
Sl. No	**Type**	**Total (Nos)**
1	Both wall and base porous	188
2	Wall plastered but base porous	95
3	Wall porous but base plastered	18
4	Both wall and base plastered	32
Source: TNUSSP Kodaikanal Baseline Study, 2017		

Of the septic tanks which had both walls and base plastered (n=32), only nine (3 per cent) were partitioned and had more than one chamber. Of this, just five (1.8 per cent) establishments had their septic tank (with both walls and base plastered and with more than one chamber) connected to a soak/leach pit.

3.2.4. Collection, Conveyance and Disposal

Majority of the containment systems in establishments with reported septic tanks or single/twin pits/bio-tanks (n=275) were located in the front of the building or behind the building or on the side of the building facilitating easy and direct access to the containment system by a truck. Mostly, the containment system was located behind the establishment.

Table 3.22: **Location of the Containment System**		
Sl. No.	**Location**	**Total**
1	Behind the house	36.0%
2	In front of the house	32.0%
3	On the side of the house	27.6%
4	Below the pan/platform (below the building)	3.6%
5	Along the road	0.6%
6	Don’t know/can’t say	0.4%
	Total	**100.0%**
Source: TNUSSP Kodaikanal Baseline Study, 2017		

It was observed that in the majority of establishments (57.9 per cent) the approach road was either 5 to 10 feet or more than 5 feet with sufficient space for a desludging truck to park. However, in 42.2 per cent establishments, the approach road was too narrow for a truck to access the containment system.

Table 3.23: **Width of the Nearest Road to the Containment System in Establishments**		
Sl. No.	**Type**	**Total**
1	Less than 5 feet	42.2%
2	5–10 feet	25.5%
3	Greater than 5 feet	32.4%
	Total	**100.0%**
Source: TNUSSP Kodaikanal Baseline Study, 2017		

More than half (55.1 per cent) of the establishments had a containment system with an opening such as a manhole or a pipe to facilitate cleaning and emptying. However, in 45 per cent establishments, the containment systems were sealed and needed to be broken to access the system.

Table 3.24: **Top Slab of the Containment in Establishments**		
Sl. No.	**Type**	**Total**
1	Manhole opening with cover	32.6%
2	Pipe with cap	22.5%
3	Sealed	45.0%
	Total	**100.0%**
Source: TNUSSP Kodaikanal Baseline Study, 2017		

The practice of cleaning the septic tank or pit among establishments was reportedly low with only 19.3 per cent or 53 establishments reported to have ever emptied the containment system. Across establishments who have emptied their septic tank or pit or bio tank, more than half or 58.2 per cent clean their tank either once a year or once in two years.

Table 3.25: **Frequency of Desludging**		
Sl. No.	**Frequency**	**Total**
1	Once a year	47.2%
2	Once in 2 years	11.3%
3	Once in 3 years	5.7%
4	Once in 4 years	15.1%
5	Once in 5 years	9.4%
6	Once in 6 years and above	20.9%
	Total	**100.0%**
N=53 *Source:* TNUSSP Kodaikanal Baseline Study, 2017		

Most establishments were dependent on private operators to empty or clean the septic tank/pit (84.9 per cent). Some establishments reported that they used desludging services offered by the municipality (9.4 per cent). Establishments also used their own resources to clean the septic tank/pit/bio tank (5.7 per cent).

Table 3.26: **Who Emptied Septic Tank/pit/bio-tank in Establishments**		
Sl. No.	**Type**	**Total**
1	Municipality	9.4%
2	Private	84.9%
3	Self	5.7%
	Total	**100.0%**
Source: TNUSSP Kodaikanal Baseline Study, 2017		

4

Way Forward

4. Way Forward

The study has shown that of the 6,978 households just one per cent have proper septic tanks that are water tight and connected to a soak pit. Majority of the households do not follow any guidelines or standards in constructing the OSS. Though households consider the OSS to be septic tanks, in reality they are just holding tanks which are poorly constructed. Further, there are several misconceptions on the impact of septage infiltration into the ground. Many believe that seepage improves groundwater levels. This highlights the need for clear information and communication among households on the guidelines to construct proper septic tanks. Findings also prove that in majority of the households, the OSS is considered to be the end point of the sanitation chain. Desludging practice is observed to be low among households and their current perception on desludging reflects their poor knowledge of septage management. Open dumping of septage is currently practiced due to the absence of a designated treatment plant. These gaps in the sanitation chain if left neglected will have adverse effects on health and environment.

Based on the findings, the following recommendations are suggested along the sanitation chain.

4.1. Access and Containment

- At the household, there is a need for the municipality to address the issue of open defecation and also, ensure that those toilets that directly discharge in the open are converted into sanitary toilets.

- CT/PTs that have poor OSS infrastructure require immediate attention. Further, septic tanks need to be built in PT blocks that are currently connected to the open drain.

- Focussed information and education on septage management, especially on regular desludging is required both at the household and establishment level.

- There exists a gap on how fecal sludge is managed in large resorts and hotels. The ULB can undertake a detailed study on the current practices.

4.2. Conveyance

- Currently, there is a monopoly in the desludging market and the ULB could look at other potential players to operate within the town which would in turn result in competitive prices for the service.

- ULB could invest in smaller-sized trucks to access narrow and steep roads.

4.3. Treatment

- The possibility of co-treatment of fecal sludge at the existing wastewater treatment plant at Kallaraimedu could be explored.

- A standalone fecal sludge treatment plant could also be constructed.

Annexures

Annexure 1 – Household and Establishment Questionnaire

Household and Establishment Survey—FSM Interventions

Namaste! My name is _____. I work for the organization_____ on behalf of **Indian Institute of Human Settlements** that intends to carry out Survey to ascertain Feasibility of carrying out Full Cycle Sanitation (FSM) interventions in Kodaikanal and Keezhakarai in Tamil Nadu. I would like to ask you some questions related to the sanitation facilities in your house/ institution to understand and improve the urban sanitation situation in the state. I would very much appreciate your participation in this survey.

Consent given 1 Continue

Consent not given 2 Thank and Terminate

Schedule No:							Date:	D	D	M	M	Y	Y	Y	Y

PART A – GENERAL and SOCIO-ECONOMIC DETAILS

Instructions:

1. *Circle the appropriate number in the coding categories given*
2. *Write in the space provided for each question*

Q. No	Questions	Categories		Skip to
001	Name of town			
002	Is this a household or establishment?	Household.....1 Establishment 2		
003	Household/establishment unique ID—*EB Card No.*			
004	Household/establishment number—door number			
005	Ward no.			
006	Slum/non-slum	Slum.....1 Non-Slum 2		→Q.007
a.	Slum name			
b.	If slum, notified or non-notified	Notified.....1 Non-notified.....2		
007	Street name			
008	GPS coordinates	a. Latitude		
		b. Longitude		

Q. No	Questions	Categories	Skip to
Q.009 TO BE FILLED FOR ESTABLISHMENTS ONLY			
009	Type of establishment	Hotel/guest house/lodges.....1 Office .....2 Hospital/clinic/nursing home .....3 Departmental store/shop.....4 School/college/other educational institution .....5 Manufacturing industry.....6 Cottage industry .....7 Others (Specify) .....8 _____	
Q.010 TO Q.020 TO BE FILLED FOR HOUSEHOLDS ONLY			
010	Name of the head of household		
011	Contact number		
012	Gender of respondent	Male.....1 Female .....2 Transgender.....3	
013	No. of adults in the family (age >18 years)	☐☐	
014	No. of children (1- 18 years)	☐☐	
015	No. of infants (Less than 1 year)	☐☐	
016	Frequency of property tax paid	Monthly .....1 Quarterly.....2 Half-yearly.....3 Annually.....4	
017	Frequency of Water tax/ bill paid	Monthly .....1 Quarterly.....2 Half-yearly.....3 Annually.....4	
018	Others (private party)	Monthly .....1 Quarterly.....2 Half-yearly.....3 Annually.....4	
019	Frequency of electricity bill paid	Monthly .....1 Quarterly.....2 Half-yearly.....3	

		Annually....4	
020	Frequency of fee for garbage collection	Monthly ....1 Quarterly....2	
PART B – WATER SUPPLY AND ACCESS TO TOILET DETAILS *Instructions:* 1. *Circle the appropriate number in the coding categories given* 2. *Record 'Others' and units in the space provided*			
Q. No	**Questions**	**Categories**	**Skip to**
021	What are the main sources of drinking and cooking (potable) water for the household/ establishment? **MULTIPLE CODING POSSIBLE**	Piped water into dwelling/yard .... 1 Own hand pump/own tube well .... 2 Own well, protected .... 3 Own well, unprotected .... 4 Public tap water .... 5 Public hand pump/tube well .... 6 Public open well .... 7 Surface water (river/stream) .... 8 Tanker/Truck .... 9 Spring .... 10 Bottled water .... 11 Don't know/ Can't say 12	
022	Where is the greywater (wastewater from kitchen and bathroom) disposed?	To soak pit/leach pit within premises .... 1 To plants within premises .... 2 To the drain outside house .... 3 To septic tank/pit (constructed for the toilet) .... 4 Others, specify .... 5 _____	
023	Do you have a toilet in your house/establishment?	Yes .... 1 No 2	→Q.025
024	If the household/establishment does not have a toilet, where do members defecate?	Open defecation .... 1 Community toilet .... 2 Shared toilet [neighbours/relatives] 3	**Thank & Terminate**
025	How many toilets do you have in your house/establishment?	□□	
026	Which year was the toilet constructed in? YYYY [Year]	□□□□	

027	Where is the toilet located?	Inside the house/building ..... 1 Outside the house/building but attached .... 2 Outside the house/building but detached/ standalone..... 3 Others (Please specify) ..... 4 _____	
028	Is there drainage facility outside house?	Yes, open drain ..... 1 Yes, Closed drain..... 2 No drain 3	
Q. No	**Questions**	**Categories**	**Skip to**
029	Do you share any of these toilets with other households?	Yes ..... 1 No..... 2	
030	What are the improvements in your toilets that you would like to see?	No improvement needed..... 1 Increase number of toilets/ Build new toilets ..... 2 Change fixtures inside toilets (eg. pan seat, cistern, basin, mirror, bathing etc.) ..... 3 Change toilet containment structure type (eg. make a 2-pit, septic tanks)..... 4 _____ Make other changes (specify) ..... 5 _____ Don't know/can't say 6	
031	Predominant material of roof of toilet	Reinforced Cement Concrete (RCC) ..... 1 Burnt brick/stone ..... 2 Asbestos..... 3 Bamboo/Wood..... 4 Thatch/Biomass..... 5 Tin/metal sheet..... 6 Tarpaulin/cloth..... 7 Earthen tiles ..... 8 Plastic/PVC sheets..... 9 No roof ..... 1 0 Others (specify) ..... 1 1 _____	
032	Predominant material of wall of toilet	Burnt brick/stone/concrete block..... 1 Mud/earth 2	

		Bamboo/wood ..... 3 Thatch/other biomass..... 4 Tin/metal sheet..... 5 Plastic/cloth ..... 6 Others (specify) ..... 7 _____	
033	What kind of flushing facility does your toilet have?	Cistern flush ..... 1 Pour flush ..... 2 Automatic flush ..... 3 No flush required ..... 4 Don't know..... 5	

Q. No	Questions	Categories	Skip to
034	What is the pan/platform type in your toilet(s)?	Slab with a hole (dry toilet) ..... 1 Squatting pan (with water seal intact—Indian toilet) ..... 2 Western commode (with water seal intact) ..... 3 Urine Diversion Dry Toilet (UDDT)/EcoSan ..... 4 Others (specify) ..... 5 _____	

PART C – ACCESS TO CONTAINMENT DETAILS

Instructions:

1. *Circle the appropriate number in the coding categories given*
2. *Record 'Others' and units in the space provided*

Q. No	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
035	What is the outlet of the pan/platform of the toilet(s) connected to: [PREDOMINANT CONTAINMENT SYSTEM]	Sewer system (UGD) .....1 On-site system (single pit) .....2 On-site system (twin pit).....3 Septic tank.....4	

		Drain (direct discharge) .....5 Open areas (direct discharge) .....6 Water bodies (canal, pond, lake, river etc.) 7 DEWATS treatment system (Community septic tank) .....8 Not connected (hole in the ground) .....9 Not connected (Bucket/pan is manually removed) .....10 Connected to bio tank (DRDO) .....11 Do not know .....12 Others (specify).....13 _____	

Q. No	Questions	Categories	Skip to
Q.036 TO Q.038 ONLY THOSE CODED 2 OR 3 OR 4 OR 11 IN Q.035 – REST THANK AND TERMINATE			
036	Where is the pit/septic tank/bio tank located?	In front of the building.....1 Behind the building.....2 On one side of the building .....3 Along the road.....4 Below the pan/ platform (below the building) .....5 Others (specify).....6 _____ Don't know.....7	
037	What were the material(s) used for construction of walls of the on-site system?	Stone or rubble .....1 Burnt brick .....2 Plain Cement Concrete (PCC) .....3 Reinforced Cement Concrete (RCC) .....4 Pre-cast RCC slabs .....5 RCC rings .....6 Stone slabs .....7 Others (specify).....8 _____	
038	What were the material(s) used for construction of the top slab of the on-site system?	Reinforced Cement Concrete (RCC) .....1 Pre-cast RCC slabs .....2 Stone slabs .....3 Metal sheet .....4 Wood or thatch.....5 Others (specify) 6	

		_____	
THOSE CODED 4 IN Q.035 – CONTINUE **THOSE CODED 11 IN Q.35 – SKIP TO Q.043** **THOSE CODED 2 OR 3 IN Q.035 – SKIP TO Q.052**			
039	Is your septic tank made of fiber reinforced plastic or hard plastic like Sintex?	Yes .....1 No.....2	→Q.039
040	If No, what is the material used for the base of the tank?	No material—just ground ..... 1 Brick bats or aggregates or sand ..... 2 Brick with cement ..... 3 Stone/rubble with cement..... 4 PCC or RCC..... 5 Others, specify (provide space for details) . 6 _____	→Q.042

Q. No	Questions	Categories	Skip to
041	Is the base floor of the septic tanks plastered?	Yes .....1 No.....2	
042	Is the wall of the septic tank fully plastered and non-porous?	Yes .....1 No.....2	
043	Are there partition walls in your on-site system?	Yes .....1 No.....2	
044	If yes, how many chambers are there?	One .....1 Two .....2 Three .....3 Four.....4	
045	Is the top slab provided with a manhole (opening and cover) or a Pipe with cap for easy access?	No.....1 Yes, manhole opening with cover .....2 Yes, Pipe with cap.....3	
046	Where does the wastewater from the septic tank/bio tank go in to?	No outlet .....1 Soak/leach pit.....2 Open/surface drains .....3 Open areas .....4 Water bodies .....5 Sewer system.....6 Reed bed.....7 Others (specify) .....9 _____ __	→Q.048 →Q.048

047	Is there space to construct a soak away?	Yes .....1 No.....2	
048	Is your septic tank/bio tank water tight?	Yes .....1 No.....2	
Q.049 TO Q.051 THOSE CODED 4 IN Q.035			
049	Septic tank length (feet) *(Not more than 2 digits before and 2 digits after decimal point to capture feet and inches)*	☐☐feet.☐☐inches	
050	Septic tank breadth (feet) *(Not more than 2 digits before and 2 digits after decimal point to capture feet and inches)*	☐☐feet.☐☐inches	
051	Septic tank depth (feet) *(Not more than 2 digits before and 2 digits after decimal point to capture feet and inches)*	☐☐feet.☐☐inches	→Q.059

Q. No	Questions	Categories	Skip to
Q.052 TO Q.058 THOSE CODED 2 OR 3 IN Q.035			
052	What is the material used for constructing the wall of the pit ?	Burnt brick .....1 Stone/rubble .....2 RCC concrete rings .....3 Others, specify (provide space for details) ..4 _____	
053	Is the wall of the pit plastered?	Fully plastered .....1 Minimal plastering with holes/gaps left in the wall .....2 Plastered to a certain depth from ground level 3	
054	If plastered, to what depth (feet)?	☐☐feet	
055	What is the material used for the base of the pit?	No material – just ground .....1 Brick bats or aggregates or sand .....2 Others, specify (provide space for details) ..3 _____	
056	Is the base of the pit plastered?	Yes .....1 No.....2	
057	Pit diameter (feet) *(Not more than 2 digits before and 2 digits after decimal point to capture feet and inches)*	☐☐feet.☐☐inches	

058	Pit depth (feet) *(Not more than 2 digits before and 2 digits after decimal point to capture feet and inches)*	☐☐feet.☐☐inches	
Q.059 TO Q.069 THOSE CODED 2 OR 3 OR 4 OR 11 IN Q.035			
059	What is the distance of the pit/septic tank/bio tank to the nearest access road? Distance (in feet)	Less than 10 feet.....1 10–20 feet .....2 Greater than 20 feet 3	
060	What is the width of the nearest access road?	Less than 5 feet.....1 5–10 feet .....2 Greater than 10 feet 3	
061	What is the distance between the septic tank/pit/bio tank and the nearest location that a truck can park? (Considering a truck of 5000 L capacity, the road width at parking should be at least 3 m.) (meters)	Less than 5 feet.....1 5–10 feet .....2 Greater than 10 feet 3	

Q. No	Questions	Categories	Skip to
062	Is there a rise or fall between the truck parking location and the septic tank/pit?	Yes .....1 No.....2	→Q.062
063	If yes, what is the height difference (in meters)?	☐☐meters	
064	Distance of drinking water source within the household/ establishment premises to the pit/ septic tank (metres)	☐☐meters	
065	Has the septic tank/ pit ever been emptied?	Yes .....1 No.....2	**→Thank & Terminate**
066	When was the toilet pit/septic tank last emptied (year)? Write as YYYY [Year]	☐☐☐☐	
067	Who emptied septic tank/Pit?	Government/ULB .....1 Private .....2 Self .....3 Not applicable 4	

068	How much did you spend on emptying? [record in rupees] *Not more than 4 digits*	☐☐☐☐	
069	What is the interval of emptying (years or months)? *Not more than 2 digits*	Emptied only once.....1 Interval in months ☐☐ .....2 Interval in years ☐☐ 3	

PART D- Photographs	
070	Top view of containment on the ground—one gets two dimensions in visible and whether access ports are there

Annexure 2 – Waste Water Treatment Plant

The Waste Water Treatment Plant (WWTP) maintenance is carried out by Eco-Protection Engineer Limited, who also constructed the plant. There is one operator on site for routine operations and management. The sewer network, though the responsibility of the Kodai ETP Company, is maintained by the municipality. This is because the operator does not have the sufficient manpower to address any problems in the network, and citizen complaints force the municipality to service any blockages. The company charges all users connected to the network monthly, and the charges are based on the size of the connected unit. Some hotels have to use pumps to discharge their sewage into the network, on account of significant elevation differences. These pumps are the responsibility of the hotels, located within their premises, and owned and maintained by the hotels. The sewer network owned by the company does not have any pump stations and all flow in the network is through gravity flow to the WWTP. There is no water supply connection at the plant. The Tamil Nadu Pollution Control Board (TNPCB) does monthly checks at the plant and collects samples for water quality assessment. The reports for the same are tabulated below. These were collected by submitting a request to the Dindigal TNPCB office.

Figure A2.1: **Wastewater Treatment Plant at Kallaraimedu**

Source: TNUSSP Primary Study, 2017

A2.1. Headworks

The headworks consist of a rectangular receiving chamber, with two sets of grates at one end to allow flow of wastewater into the screens. The inlet pipe is buried under the receiving tank. There are two parallel channels with screen and grit removal chamber. One of the grates on the receiving chamber allows more flow to pass through than the other, and there is unequal flow distribution between the two screen/grit chamber channels, with one receiving less flow than the other, and at low flow times (early morning), not receiving any flow at all.

Figure A2.2: **Headworks—Two Parallel Chambers**

Source: TNUSSP Primary Study, 2017

- The screens are coarse screens which have been supplemented by an additional mesh to improve screening.

- There is significant silt build-up in the grit channels—almost half the total depth appears to be filled with slit reducing the available capacity and decreasing grit removal efficiency of the channels.

- There is a parshall flume which has never been used by the operator. There are no records of incoming flow volumes maintained for the STP. There is no documentation available on the specifications of the parshall flume. However, measurements made by the IIHS team indicated the parshall flume to have a 3” neck at the narrowest section. There are no markings to indicate the location where depth measurement should be made to quantify flow using the parshall flume. The downstream portion of the parshall flume has a step decrease in the flow level.

- The plant does not have any primary settling clarification unit.

Figure A2.3: **Parshall Flume**

Source: TNUSSP Primary Study, 2017

A2.2. Aeration and Secondary Clarifier

- There are three circular aeration tanks at the STP, provided with mechanical surface aerators. One of the aeration tanks is not functioning. The aerators were in operation during the day. But they were not working when the team visited the STP unannounced during the morning time for the flow measurement exercise.

- Effluent from the aeration tanks flow to a single secondary clarifier unit. The secondary clarifier has a single pump and line for return sludge and waste sludge. The actual pipelines were buried and could not be viewed. The operators indicated that sludge is returned and disposed in the sludge drying beds on a periodic basis.

- The moving rake on the primary clarifier is not working due to motor breakdown.

- The effluent from the clarifier appears to be overflowing through a specific location on one side of the clarifier, which could be resulting in short-circuiting. There appeared to be minor erosion of the effluent baffle wall at this location (minimally decreasing the height), and most of the overflow was observed to be occurring over this location.

A2.3. Secondary Clariflocculator

- The effluent from the secondary clarifier flows to the clariflocculator. The effluent is dosed with alum through a dosing unit prior to entering the clariflocculator.

- The clariflocculator also receives the effluent that percolates through the sludge drying beds that receive sludge from the secondary clarifier.

- The effluent from the clariflocculator also appeared to be overflowing through a specific location on one side of the clarifier, which could be resulting in short-circuiting. The cause was similar to the clarifier unit where the wall appeared to have been marginally eroded at the particular location decreasing the height.

A2.4. Disinfection

The effluent from the clariflocculator flows into a fish pond, and on to a baffled reactor for chlorination. The fish pond appeared to have significant scum and floating matter on the surface. Chlorination occurs through a dosing pump at the inlet to the baffled chlorination chamber.

The final effluent is discharged for landscape irrigation on the adjoining slopes.

Table A2.1*:* **Common Effluent Treatment Plant Units, Name and Size**

Sl. No	Unit Name	Nos	Unit Size
1	Receiving sump	1	1,320*1,700*80+300
2	Screen chamber	2	1,750*370*140+400
3	Grit channel	2	5,000*610*430*650
4	Parshall flume	1	2,500*767
5	Aeration tank	3	9,000*9,000*3,250+500
6	Secondary clarifier	1	10,000dia*3,000 SWD +300
7	Clariflocculator flocculation compartment	1	10,000dia*2,500+300
8	Fish pond	1	8,500*2,000*1,500+800
9	Chlorine contact tank	1	8,500*2,000*1,450+350
10	Biological sludge drying bed	8	6,000*5,000
11	Chemical sludge drying bed	2	6,000*6,000
12	Chemical house	1	6,000*10,000*3000
13	Diesel generator room	1	6000*10000*3001
14	Office room	1	6000*10000*3002
15	Outlet chamber	1	1000*1000*750+300
16	Alum tank	2	Sintex tank
17	Chlorine tank	1	Sintex tank

Notes: Measurements as per drawing
Source: TNUSSP Primary Study, 2017

TN US SP

TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

Tamil Nadu Urban Sanitation Support Programme (TNUSSP) supports the Government of Tamil Nadu and cities in making improvements along the entire urban sanitation chain.

The TNUSSP is implemented by a consortium of organisations led by the Indian Institute for Human Settlements (IIHS), in association with CDD Society, Gramalaya and Keystone Foundation.

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