TN US SP
TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

REPORT

KILAKARAI BASELINE STUDY FOR URBAN SANITATION

January 2019

KILAKARAI BASELINE STUDY FOR URBAN SANITATION

January 2019

TN US SP
TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

iihs®
INDIAN INSTITUTE FOR HUMAN SETTLEMENTS

Kilakarai Baseline Study for Urban Sanitation

January 2019

For Citation: TNUSSP, 2019. Kilakarai Baseline Study for Urban Sanitation.

DOI: https://doi.org/10.24943/tnusspkbs.20190102

This document is produced as part of Tamil Nadu Urban Sanitation Support Programme (TNUSSP). TNUSSP supports the Government of Tamil Nadu (GoTN) and cities in making improvements along the entire urban sanitation chain. The TNUSSP is being implemented by a consortium of organisations led by the Indian Institute for Human Settlements (IIHS), in association with CDD Society, Gramalaya, and Keystone Foundation.

Document Team: Reeba Devaraj, Navamani Ramasamy, Sancy Sebastian, Sasikumar Eswaramoorthy, Suneethi Sundar, Rajiv Raman

Editing: Word Lab, IIHS, Bengaluru

Design and Layout: Divya Dhayalan

Production: Shaheena Manoj, Krishnapriyaa P., Govardhan Seshachalam

Team Leader: Kavita Wankhade

Project Director: Somnath Sen

2. BMGF funding acknowledgment: This Research / Work was supported by Bill & Melinda Gates Foundation.

3. Acknowledgement: We thank GfK Mode Pvt. Ltd. for the primary data collection.

CONTENTS

Abbreviations V

Executive Summary E1

E1.1. Methods E3

E1.2. Key Findings E3

E1.2.1. Location E3

E1.2.2. Demography and Socio-economic Profile E3

E1.2.3. Water Supply E4

E1.2.4. Sanitation E4

E1.2.5. Community and Public Toilets E4

E1.2.6. Containment E4

E1.2.7. Collection, Conveyance and Disposal E5

E1.2.8. Drainage and Greywater Management E5

E1.2.9. Solid Waste Management E5

E1.2.10. Establishments E5

E1.3. Way Forward E6

1. Background 1

1.1. Preliminary reconnaissance 3

1.2. Baseline study 4

1.2.1. Coverage and response rate 5

2. Profile of Kilakarai 7

2.1. Overview 9

2.1.1. Location of Kilakarai 9

2.1.2. Linkages and connectivity 9

2.1.3. Climate and physical features 9

2.1.4. Spatial growth pattern 11

2.2 Demographic and socio-economic profile 11

2.2.1 Literacy 12

CONTENTS (contd)

2.2.2 Socio-economic profile 12

2.3. Institutions and commercial establishments 12

2.4 Administration 13

2.5 Housing typologies 13

3. Study Findings 17

3.1. Household settlement pattern 19

3.2. Water supply 20

3.2.1. Municipal Water Supply and Infrastructure 20

3.2.2. Household arrangements for potable water 21

3.3. Household Sanitation Arrangements 22

3.3.1. Individual household toilets 23

3.3.2. Community/public toilets 24

3.3.3. Open defecation 25

3.3.4. Containment 26

3.3.5. Collection, conveyance and disposal 28

3.3.6. Treatment 32

3.3.7. Grey water management 33

3.3.8. Drainage 34

3.3.9. Solid waste management and storm water drains 35

3.4 Establishments 36

3.4.1 Water supply 37

3.4.2 Sanitation arrangements 38

3.4.3 Containment 38

3.4.4. Collection, conveyance and disposal 39

4. Way Forward 43

Annexure A1

Annexure I – Household and Establishment Questionnaire A3

Tables

Table 1.1: Distribution of households and establishments covered across wards 3

Table 1.2: Distribution of households and establishments covered across wards 5

Table 1.3: Distribution of households covered across slums 6

Table 2.1: Institutional/commercial establishments 12

Table 3.1: Household socio-economic classification 20

Table 3.2: Yield from various sources 21

Table 3.3: Water distribution in Kilakarai 21

Table 3.4: Household sanitation arrangements in Kilakarai 22

Table 3.5: Location of toilet facility in households 23

Table 3.6: Location of toilet facility and predominant material of the roof in households 24

Table 3.7: Location of toilet facility and predominant material of the wall in households 24

Table 3.8: Predominant containment systems in households 26

Table 3.9: Location of containment system in households 29

Table 3.10: Width of the nearest road to the containment system in households 29

Table 3.11: Frequency of desludging in households 31

Table 3.12: Who emptied septic tank/pit in households 31

Table 3.13: Drainage facility outside house 34

Table 3.14: Location of toilet facility in establishments 38

Table 3.15: Predominant containment system in establishments 38

Table 3.16: Location of the containment system in establishments 39

Table 3.17: Width of the nearest road to the containment system in establishments 39

Table 3.18: Frequency of desludging 40

Table 3.19: Who emptied pit or septic tank in establishments 40

Figures

Figure 1.1: Interaction with community members 4

Figure 2.1: Average rainfall amount and rainy days 10

Figure 2.2: Maximum, minimum and average temperature 10

Figure 2.3: Population and growth rate 11

Figure 2.4: Kilakarai institutional structure 13

Figure 2.5: Housing ownership status 14

Figure 2.6: Housing typologies – Material of the roof (%) 14

Figure 2.7: Housing typologies – Material of the wall 15

Figure 3.1: Settlement pattern 19

Figure 3.2: Socio-economic Classification Grid 19

Figure 3.3: Municipality overhead tank and sump 20

Figure 3.4: Water tanker trucks and small tanks pulled by cattle 21

Figure 3.5: Household Watersupply Arrangements 22

Figure 3.6: Individual household toilet 23

Figure 3.7: Public toilet in Muthuswamipuram, Kilakarai 25

Figure 3.8: Open defecation site near the shore 25

Figure 3.9: Pit/septic tank infrastructure in households 26

Figure 3.10: Pit/septic tank volume 27

Figure 3.11: Illustration and description of type of OSS 28

Figure 3.12: Location of a single pit 30

Figure 3.13: Narrow roads in Kilakarai 32

Figure 3.14: Fecal sludge disposed of in a vacant area 33

Figure 3.15: Grey water pumping stations and outfall points 34

Figure 3.16: Solid waste management in Kilakarai 35

Figure 3.17: Absence of storm water drains 35

Figure 3.18: Nature of business in Kilakarai 36

Figure 3.19: Commercial establishments on municipal road 37

Figure 3.20: Main source of potable water in establishments 37

Figure 3.21: Pit/septic tank infrastructure in establishments 39

Abbreviations

BMGF	Bill and Melinda Gates Foundation
CDP	City Development Plan
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organisation
CWSS	Combined Water Supply Scheme
EO	Executive Officer
FSM	Fecal Sludge Management
GIS	Geographic Information System
GoTN	Government of Tamil Nadu
HSC	House Service Connections
IIHS	Indian Institute for Human Settlements
MAWS	Municipal Administration and Water Supply
MLD	Millions of Litres Per Day
MSL	Moisture sensitivity level
NNP	Narasimhanaicken-Palayam
OHT	Over Head Tank
OSS	On-site sanitation
PCC	Plain Cement Concrete
PF	Public Fountain
PNP	Periyanaicken-Palayam
PVC	Polyvinyl Chloride
RCC	Reinforced Cement Concrete
SBM-U	Swachh Bharat Mission (Urban)
SEC	Socio Economic Classification
SSC	Secondary School Certificate
TNUSSP	Tamil Nadu Urban Sanitation Support Programme
TSU	Technical Support Unit
UGD	Underground drainage
WHO	World Health Organisation
YTD	Year-to-date

Executive Summary

E1.1. Methods E3

E1.2. Key Findings E3

E1.3. Way Forward E6

Executive Summary

The Tamil Nadu Urban Sanitation Support Programme (TNUSSP) carried out a baseline study in Kilakarai municipality to understand the current situation of access to sanitation and arrangements for FSM in households and establishments. The findings from the study will provide an overview of the gaps and challenges across the sanitation chain which would ensure effective implementation and monitoring of the Operative Guidelines for Septage Management.

E1.1. Methods

The baseline study was implemented in two phases. The first phase included a preliminary reconnaissance to understand the current arrangements and practices across the full chain of sanitation involving different stakeholders, and scoping the survey exercise. During the reconnaissance visit, the team had discussions with selected stakeholders in Kilakarai and also engaged in spatial mapping. This helped understand the community in terms of topography, settlement patterns, housing typology, availability of public water and sanitation amenities, and helped design the baseline survey.

In the second phase, a household and establishment baseline survey was carried out. During the reconnaissance visit, the team had discussions with selected stakeholders in Kilakarai and also engaged in spatial mapping. Although the survey attempted to cover 100 per cent of the households in Kilakarai, 11,866 out of 13,775 households (86 per cent) and 692 establishments participated in the interview and responded to the structured questionnaire.

E1.2. Key Findings

E1.2.1. Location

Kilakarai is a coastal town in Ramanathapuram district of Tamil Nadu located 558 km south of Chennai, 132 km east of Madurai and 18 km south of Ramanathapuram. Kilalarai municipality is spread over an area of 2.45 sq. km and it is divided into 21 wards. 30 per cent of its geographical area is covered by sandy soil. The town receives rains from the northeast monsoon, which is often irregular, scanty and occurs mainly in the months of October, November and December.

The earlier settlement was near the light house due to the presence of shipping transport facilities. Gradually people started moving around the Kilakarai mosque. The newly developed areas are to the north-west and north-east direction along the Ramanathapuram and Dargah roads.

The nearest airports are Madurai (136 km), Tuticorin (129 km) and Trichy (196 km). The nearest railway stations are Rameswaram railway station, which is 16.7 km north of Kilakarai, Valantavarai railway station (80 km), and Dindugul railway junction which is 100 km east.

E1.2.2. Demography and Socio-economic Profile

The town has a population of 38,355 with a density of 15,655 persons per sq km. Kilakarai, being a coastal municipality, is a fishing landing centre in southern Tamil Nadu. Kilakarai has three major industries namely seaweed, fisheries and pearl industries. It is also a centre for trade and commerce for the neighbouring villages. Kilakarai is renowned for its educational institutions like Kannadi Vappa International School and Mohamed Sathak Engineering College. As a social and religious institution, the Jamaaths in Kilakarai play a vital role in the progress and development of the community and the municipality.

Among the households interviewed, 91 per cent, reside in non-slum areas and the rest reside in slum areas. The socio-economic status of the households was assessed using inputs on educational achievement of the chief wage earner and the number of consumer durables. Data revealed that while most slum households belonged to illiterates to some college education (not graduates) and owned four

to seven durables, most non-slum houses were literate, with no formal schooling to some college education and owing four to seven durables.

E1.2.3. Water Supply

The Kilakarai municipality relies on two main water sources for supplying water to its residents including piped water supplied under the Combined Water Supply Scheme (CWSS) and a local source, that is three municipality wells at Malangondu and ten wells at Sethukarai. The groundwater yield drawn from in-use bore wells and open wells is 0.58 MLD. The yield along with the limited surface water sources cannot effectively serve the current population of the municipality. This has been due to indiscriminate extraction of groundwater through numerous tube wells in the area, leading to groundwater depletion and seawater intrusion in the coastal areas. The seawater intrusion has also led to increased concentration of dissolved salts like chlorides, sulphates and nitrates in the groundwater, gradually deteriorating its quality.

At the time of the study, the Urban Local Body (ULB) was facing acute water shortage. With intermittent municipal water supply and increased salt content in the groundwater, households depended heavily on private vendors for potable water especially for drinking and cooking purposes. The study data corroborated the above findings with 86.8 per cent households reporting their dependence on private water tankers/trucks for drinking and cooking purposes (potable). This practice is more prevalent among slum households (94.8 per cent). Over one-fourth or 30 per cent of the households depend on water sources within their dwelling such as own hand pump/tube well, own well that may be protected or unprotected, for potable water.

E1.2.4. Sanitation

Access to an individual household toilet is reported to be high in Kilakarai. Majority of households (over 90 per cent) in both slum and non-slum areas have access to individual household toilets, although open defecation is also practiced and is more prevalent among the slum households. All households with individual household toilets reported that the predominant containment system is a single/twin pit. Very few households have septic tanks (n=96) and of those, only six have both walls and base plastered and more than one chamber.

E1.2.5. Community and Public Toilets

There are five community toilets and one public toilet. Community toilet usage is reportedly low, as a high proportion of households have individual toilets within their premises. The community toilet in Muthuswamipuram is used by a few households who do have an individual toilet. Bathing facilities are also available within the toilet complex. The public toilet is located inside the bus stop.

E1.2.6. Containment

Almost all households with individual household toilets reported that the predominant containment system used is a single/twin pit. The respondents were probed about the type of materials used to construct the walls and base of the septic tank or single/twin pit and this was validated with the existing infrastructure. The results revealed that a high proportion of OSS reported as septic tanks or single/twin pits did not follow any standards in terms of dimensions or infrastructure. The majority of the containment structures had plastered walls and porous bases (72.2 per cent) and over one-tenth (18.6 per cent) of containment structures had both porous walls and bases. Just 8 per cent or 913 households had containment systems with both walls and base plastered.

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. In Kilakarai, very few households

have septic tanks (n=96) and of those, only six have both walls and base plastered and more than one chamber.

E1.2.7. Collection, Conveyance and Disposal

The majority of containment systems in slum and non-slum households are located in front of the house facilitating easy and direct access by a truck to the containment system. However, in certain parts of Kilakarai, the lanes are narrow with tightly packed houses. In these areas, which constituted 25 per cent of the households interviewed, the width of the nearest road to the containment system is less than five feet posing a challenge for trucks to navigate and access the containment structures. Further, single pits are located below ground level and need to be broken to access the system.

As per Central Public Health and Environmental Engineering Organisation (CPHEEO) norms, septic tanks need to be cleaned periodically at intervals of two-three years. Across households that have emptied their septic tank or pit at least once, more than half or 52.9 per cent clean their tank once in two or three years.

The Kilakarai municipality does own a desludging truck; however, it is not functional. Households are heavily dependent on private parties to empty or clean the septic tank/pit. There are no desludging operators in Kilakarai and most of them operate out of neighbouring areas such as Ramanathapuram, Virudhunagar and Kadaladi in Madurai district. These operators face major challenges while servicing households in the municipality, the major challenge being presence of narrow roads. Some operators use long hose pipes to overcome this challenge.

Informal discussions with households revealed that the practice of manual cleaning of pits is prevalent in most houses. Owing to the narrow inaccessible roads and high desludging cost, households hire local resources to clean the pits. At present, there are no facilities available for septage treatment in Kilakarai and fecal sludge is disposed of in a vacant area near the highway.

E1.2.8. Drainage and Greywater Management

Majority of the households (94.6 per cent) reported that they have a drainage facility outside the premises, which essentially refers to the greywater underground network system. A closed drain facility is observed to be common in most slum and non-slum households. The presence of open drains is more prevalent in slum areas. Overall, 5.4 per cent of the households do not have any drainage facility.

E1.2.9. Solid Waste Management

There are 25 permanent and 25 temporary sanitary workers posted for sweeping, cleaning and collecting solid waste. Streets are provided with bins that are regularly cleared by the sanitary workers. The solid waste generated from the city is taken to a dump yard seven acres in area, located 7 km from the city.

E1.2.10. Establishments

Most of the commercial activities in the city are undertaken along the municipal road and near the Palaiya Jumma Masjid. The majority of the working population are employed as labourers in construction industries and work in different parts of the district. More than three-fourth of the establishments (76.2 per cent) surveyed are provision stores, petty shops or eateries, while 6.4 per cent are manufacturing industries, 5.9 per cent are offices. Almost all establishments are heavily dependent on private vendors for potable water.

In all, only 11.1 per cent or just 77 establishments have a toilet in the building. All these establishments are connected to some type of OSS system – to single or a twin pit (96.4 per cent) followed by septic tanks (2.6 per cent). Overall, only 11.7 per cent or nine establishments have containment systems with both walls and bases plastered. The majority of containment systems in establishments facilitated easy and direct access by a truck to the containment system. However, in 61 per cent of the establishments the approach road is too narrow for a truck to access the containment system. The practice of cleaning pits or septic tanks among establishments is reportedly moderate with 54.5 per cent reporting the same, with most of them depending on private service providers to empty pits/ tanks.

E1.3. Way Forward

The results of this study have important implications for designing an effective fecal sludge management plan to safely contain, convey and dispose sludge. The study highlights two big concerns, among several others, which need to be taken into account before developing a Fecal Sludge Management (FSM) plan for a city: discrepancy between reported structures and actual structures, and the low frequency of desludging. To make FSM truly effective, one needs to find a solution to retrofit or upgrade existing systems.

In conclusion, the following recommendations are suggested:

1. ULBs need to integrate FSM within their sanitation mandate and ensure that the system of collection and disposal of fecal sludge is regulated.

2. Options for desludging in locations with narrow roads and lanes need to be explored.

3. Existing markets for desludging need to be regulated by mandating registration of desludging trucks with the ULB.

4. Appropriate awareness programmes for households on regular desludging and the importance of safe disposal need to be designed.

1 Background

1.1 Preliminary reconnaissance 3

1.2 Baseline study 4

1. Background

Under the TNUSSP, a baseline study in Kilakarai municipality was carried out to understand the current situation of access to sanitation and arrangements for excreta management in households and establishments. Along with a survey of households, reconnaissance visits and stakeholder interactions were conducted among sanitary workers, masons, builders, households and Urban Local Bodies (ULBs) officers, to understand the current practices, challenges faced and the perceived gaps in sanitation arrangements. In addition, an assessment was conducted of sampled community and public toilets in the city to identify gaps and challenges in the provision of public conveniences.

The baseline study comprised of the following elements in Kilakarai town: a) Preliminary reconnaissance for understanding the current arrangements and practices across the full-chain of sanitation, involving different stakeholders and scoping the survey exercise, b) Household and establishment baseline survey.

1.1. Preliminary reconnaissance

Based on secondary data, a primary study was carried out in Kilakarai municipality to gain an in-depth understanding of the current arrangements and practices for the full chain of sanitation ranging from design and construction practices of OSS systems to septage collection and waste disposal. The primary study used a mix of spatial mapping and discussions with selected stakeholders in the study location. The purpose of the reconnaissance visit was to observe and gain understanding on the town in terms of the following:

- Topography
- Settlement pattern: dense neighbourhoods, less dense and plotted neighbourhoods, newly developing areas, commercial ribbon, etc.
- Housing typology
- Arrangements for black water and grey water disposal
- Location of public conveniences

Dense residential areas were selected for physical observation and discussion. The team walked around the area and held informal discussions with households to understand the sanitation arrangements in the community and the prevalence of open defecation.

In addition, observations and documentation of built OSS systems was also undertaken. For this purpose, a semi-structured questionnaire was used.

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

Table 1.1: Distribution of households and establishments covered across wards

Sl. No	Stakeholder	Details
1	Municipal officers	The team met with the Kilakarai municipality officers including the commissioner, sanitary inspector, municipal health officer, engineer and sanitary workers
2	Residents	Informal interviews with households were conducted to understand sanitary arrangements and desludging practices

Table 1.1: Distribution of households and establishments covered across wards		
Sl. No	**Stakeholder**	**Details**
3	Masons	Relevant details on OSS systems, construction practices, material used and other locally prevalent construction methods were elicited from masons through informal interviews
4	Desludging operators	Discussions were carried out with desludging operators to understand the demand for desludging services in Kilakarai, the process of desludging and the challenges they face while cleaning the OSS system
5	Sanitary workers	Informal discussions were carried out with municipal sanitary workers to understand their roles and responsibilities in solid waste management in Kilakarai
Source: TNUSSP Baseline study, Kilakarai, 2017		

Figure 1.1: Interaction with community members

Source: TNUSSP Baseline Study, Kilakarai, 2017

1.2. Baseline study

The primary objective of the baseline study was to provide quantitative data on the sanitation practices and situation in Kilakarai municipality, specifically across the full sanitation chain. The baseline study was designed to collect sanitation related details from all households and establishments including

shops, eateries, clinics, etc. spread across the 21 wards in Kilakarai. Indicators measured in the study included access to toilets, type and dimension of OSS systems and frequency of desludging among others. Besides collecting field-level data, spatial data was collected for all surveyed households and establishments, and photographs were taken of the toilets and visible portion of the containment structures.

The questionnaire was designed by 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 system
e. Infrastructure and dimension of OSS system
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

The total number of households in Kilakarai municipality as per Census 2011 was 7,448. During the time of the survey, the municipality records showed that there were 13,775 households. There was no existing data available with the municipality on the existing number of establishments. The study attempted to cover 100 per cent of households and establishments in Kilakarai. Of the total 13,775 households, successful interviews were carried out in 11,866 households and 692 establishments. The backlog was due to reasons such as refusals and door lock even after three visits. Overall, 24.5 per cent of respondents were male and 75.5 per cent were female.

Table 1.2 shows the actual coverage of households and establishments across the 21 wards.

Table 1.2: Distribution of households and establishments covered across wards

Wards	Households (no.)	Establishments (no.)
1	366	31
2	847	54
3	1,251	25
4	649	32
5	531	23
6	329	135
7	451	58
8	735	9
9	316	2
10	313	28
11	475	16
12	378	16
13	508	11
14	357	7
15	929	22

Table 1.2: Distribution of households and establishments covered across wards		
Wards	**Households (no.)**	**Establishments (no.)**
16	413	10
17	463	16
18	374	40
19	500	16
20	13,12	107
21	369	34
Total	**11,866**	**692**
Source: TNUSSP Kilakarai Baseline Study, 2017		

Of the 11,866 households covered, 9.3 per cent were slum households and the rest 90.7 per cent were non-slum households. In Kilakarai municipality, there are seven slums out of which four are notified slums and three are non-notified slums.

Table 1.3: Distribution of households covered across slums			
Sl. No.	**Slum Name**	**Status**	**Households covered (no.)**
1	Muthusamipuram	Notified	102
2	Anna Nagar	Notified	159
3	Meenavarkuppam	Notified	85
4	Thattanthoputheru	Notified	197
5	Pudhu Kizhaku Theru	Non-Notified	424
6	Pannathar Theru	Non-Notified	75
7	Panampattu Adi Dravidar Theru	Non-Notified	64
		Total	**1,106**
Source: TNUSSP Kilakarai Baseline Study, 2017			

2

Profile of Kilakarai

2.1 Overview	9
2.2 Demographic and socio-economic profile	11
2.3 Institutions and commercial establishments	12
2.4 Administration	13
2.5 Housing typologies	13

2. Profile of Kilakarai

2.1. Overview

2.1.1. Location of Kilakarai

Kilakarai is a coastal town in Ramanathapuram district of Tamil Nadu. The municipal area coverage is 2.45 sq km and it is divided into 21 wards. In the year 1985 Kilakarai was constituted as a town panchayat and later in 2004 it was upgraded to a third-grade municipality. The Kilakarai municipality is located at 10° 37' north and 77° 20' east and 8 m above mean sea level (MSL). The coastal town is located 558 km south of Chennai, 132 km east of Madurai and 18 km south of Ramanathapuram. Kilakarai has multiple fishermen colonies and is surrounded by small islands or theevu such as Appa theevu, Nallathanni theevu, Shuli theevu, Upputhanni theevu, Thalari theevu, Musal theevu, Kachcha theevu.[1]

2.1.2. Linkages and connectivity

The municipality has a total road length of 23 km. In the municipality there is one main road which traverses from mukku road to the beach and another main road which diverts to the bus stand. The road next to the Kilakarai market is congested and the roads adjacent to the bus stand in the core area are also heavily congested. A large volume of traffic exists between Eravadi Dharga Junction and the bus stand during Muslim festivals.

The state highway SH49 Rameswaram-Ramanathapuram road connects Manamadurai, Paramakudi, and Ramanathapuram run across the town for a length of 1.5 km. The road traverses across the major commercial areas of the town and narrows down at the Dharga road and municipal road due to commercial encroachment, thereby experiencing heavy traffic.

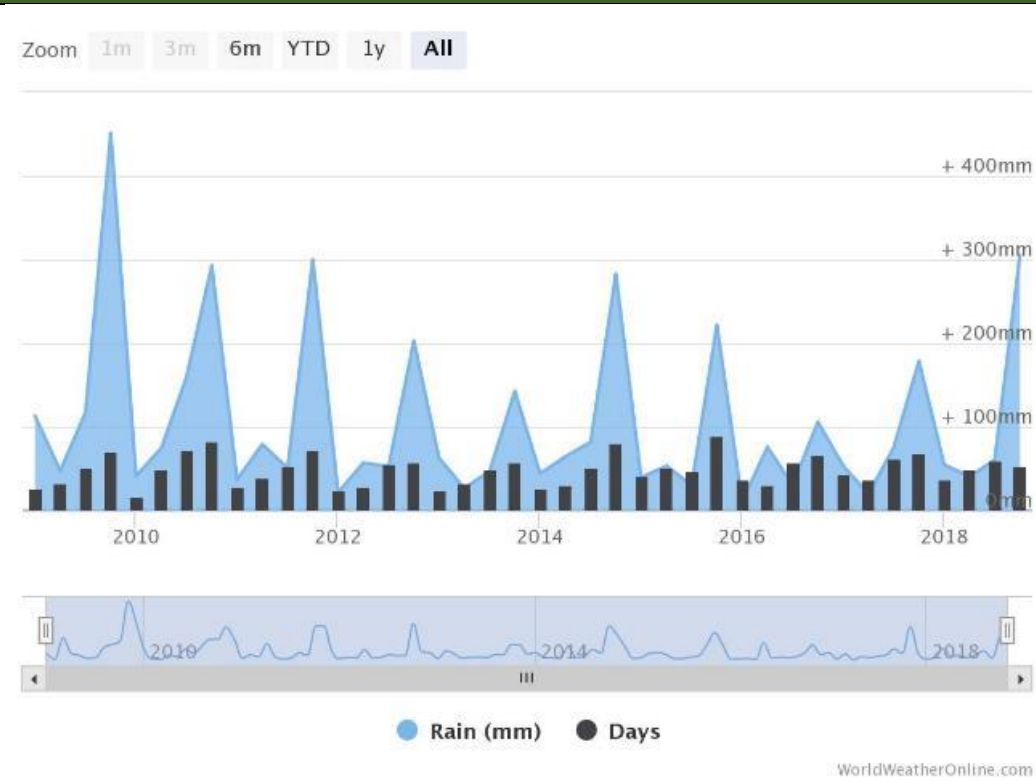
The nearest airports are Madurai (136 km), Tuticorin (129 km) and Trichy (196 km). The nearest railway stations are Rameswaram railway station which is 16.7 km north of Kilakarai, Valantavarai railway station (80 km) and Dindugul railway junction which is 100 km east.

2.1.3. Climate and physical features

A majority 30 per cent of the geographical area of Kilakarai is covered by sandy soil. Kilakarai experiences a hot and dry climate with low humidity. However, the 200-metre areas surrounding the sea experience cooler temperatures due to the sea breeze. The average highest temperature is 30ºC in summer and lowest is 25ºC in winter. The town receives rains from the northeast monsoon, which is often irregular and scanty. The monthly average rainfall in the town is 75.73 mm, which increases in the months of October, November and December.

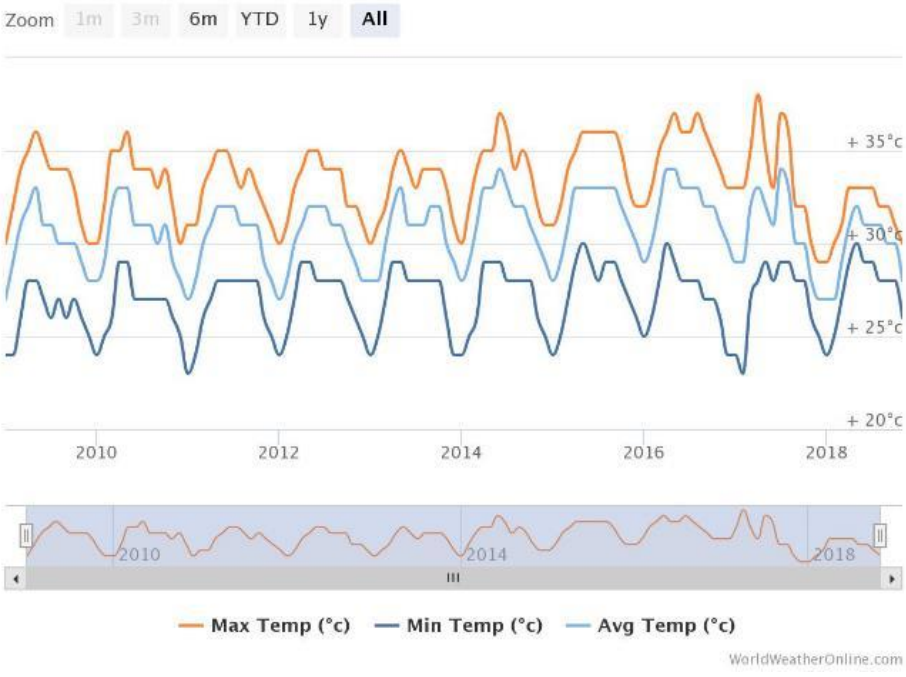
[1] City development plan Kilakarai,2009

Figure 2.1: **Average rainfall amount and rainy days**



Source: https://www.worldweatheronline.com/lang/en-in/kilakarai-weather-averages/tamil-nadu/in.aspx

Figure 2.2: **Maximum, minimum and average temperature**



Source: https://www.worldweatheronline.com/lang/en-in/kilakarai-weather-averages/tamil-nadu/in.aspx

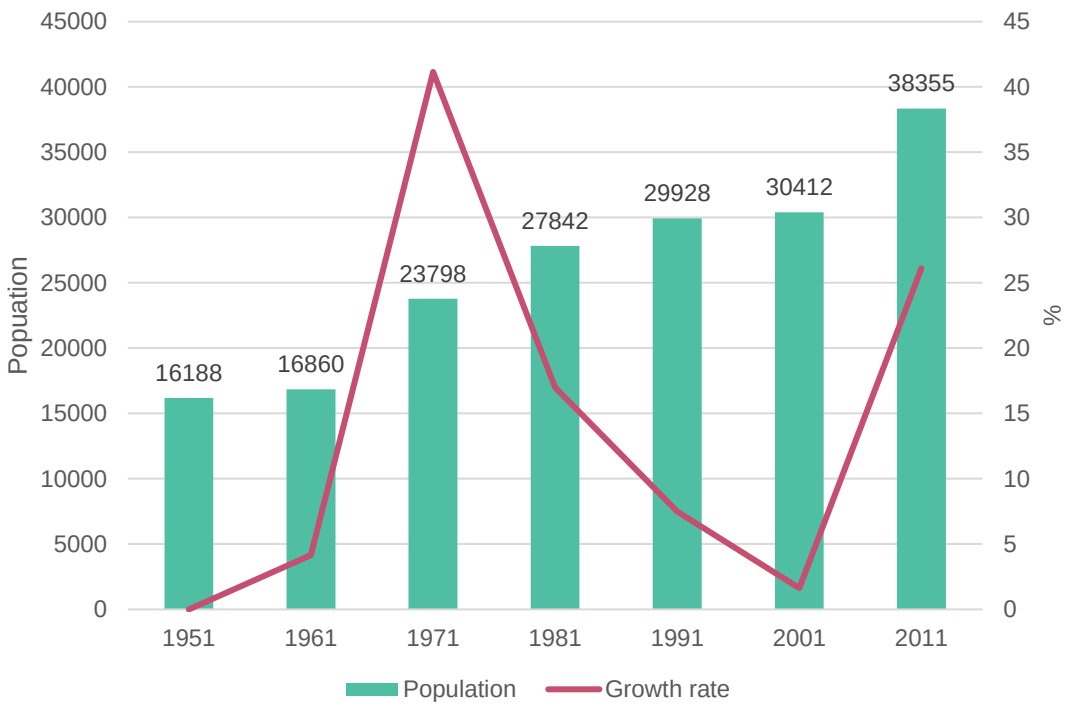
2.1.4. Spatial growth pattern

The earlier settlement was near the light house due to the presence of shipping transport facilities. Gradually people started moving around the Kilakarai mosque. The newly developed areas are to the north-west and north-east direction along the Ramanathapuram and Dargah roads. The town depicts two different types of development patterns—it is compact towards the centre (Thatcher street) and has scattered new developments in the peripheral areas. The spatial growth trend of the municipality is presented in Figure 2.3. [2]

2.2. Demographic and socio-economic profile

The town has a population of 38,355 in which 19,685 are males and 18,670 are females as per Census 2011. The growth rate was nearly 42 per cent from 1961 to 1971 and then suddenly declined later, the reason for which was stated as decline in economic activity in conch and coral industries and a gradually increasing growth trend after 2001. The percentage growth of population during 1991-2001 was less when compared to the population growth rate of the state (42.79 per cent) and the district (20.03 per cent). The present density of Kilakarai is 15,655 persons per sq km. [3]

Figure 2.3: **Population and growth rate**



Source: Census of India, 2011

[2] City development plan Kilakarai,2009

[3] Census of India, 2011

2.2.1. Literacy

The literacy rate in Kilakarai at 82 per cent is higher than the state average of 80 per cent[4], with male literacy rate being higher (85 per cent) than female literacy rate (80 per cent).

2.2.2. Socio-economic profile

As per the census of 2011, the population in Kilakarai comprises of 17.6 per cent Hindus (Thevar-Nadar), 79.92 per cent Muslims (Sunni), 1.16 per cent Christians, 0.01 per cent Sikhs, 0.01 per cent Jains, and 1.31 per cent of the population follow other religions.[5]

Kilakarai, being a coastal municipality, is a fishing landing centre in southern Tamil Nadu. The main occupations of its people were once pearl, conch and coral diving, sea trade and transport. The mid-20th century saw a decline in economic activity: the development of land transport caused the sea trade and transport industries to fade away, while the growth of the cultured pearl industry damaged the diving sector.

Kilakarai is also a centre for trade and commerce for the neighbouring villages. This makes it a commercial hub of the region. Along the municipal road and near the mosque a variety of service centres exist. Kilakarai has three major industries namely, the seaweed, fisheries and pearl industries. The municipality uses around 112 fishing crafts of which there are mechanised equipment such as trawlers, gillnetters and other motorised and non-motorised fishing equipment as per the Marine Fisheries Census 2010, Tamil Nadu. The total working population is 31 per cent and non-working population is 68.6 per cent[6].

2.3. Institutions and commercial establishments

Kilakarai is renowned for its educational institutions like Kannadi Vappa International School and Mohamed Sathak Engineering College. As a social and religious institution, the Jamaaths in Kilakarai play a vital role in the progress and development of the community and the municipality[7].

As per the Kilakarai City Development Plan (CDP) 2009, the institutional and commercial establishments in the municipality are presented below:

Table 2.1: **Institutional/commercial establishments**

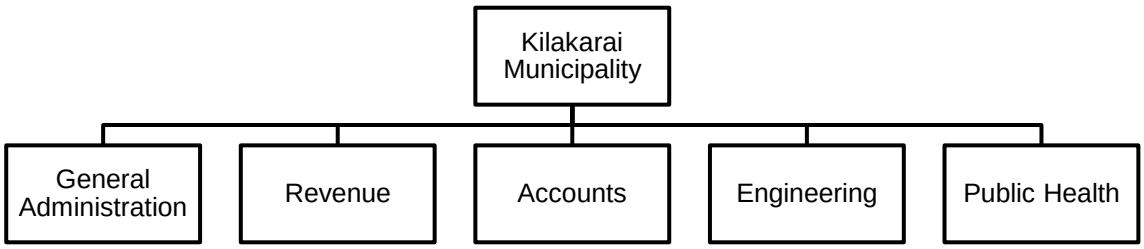
Sl. No.	Institutions	Number and details
1	Schools	4 Primary, 3 High School, 5 Anganwadi
2	Colleges	2
3	Hospitals/dispensary	1 Government, 2 Private
4	Parks	1
Source: Kilakarai CDP, 2009		

[4] Census of India, 2011
[5] Census of India, 2011
[6] Census of India, 2011
[7] Kilakarai municipality website: http://123.63.242.116/keelakarai/

2.4. Administration

The administration has five departments which are as follows:[8]

Figure 2.4: **Kilakarai institutional structure**



Source: Kilakarai Municipality

Kilakarai municipality is a third grade municipality headed by an Executive Officer (EO). The head clerk is the head of administration next to the EO in the branch of general administration, and he is responsible for general supervision and administration of the office. All establishment matters are dealt with in the general administration.

Revenue: This department is headed by two revenue inspectors to assist the commissioner.

Accounts: The accounts section is included in general section. The head clerk is the head of the wing and controls financial matters. The section involves preparation of budget and financial discipline and also looks after the accrual-based accounting system.

Engineering: This department is headed by the municipal engineer. The engineering department is responsible for undertaking development works, maintenance of roads, water supply, drainage, and street lights.

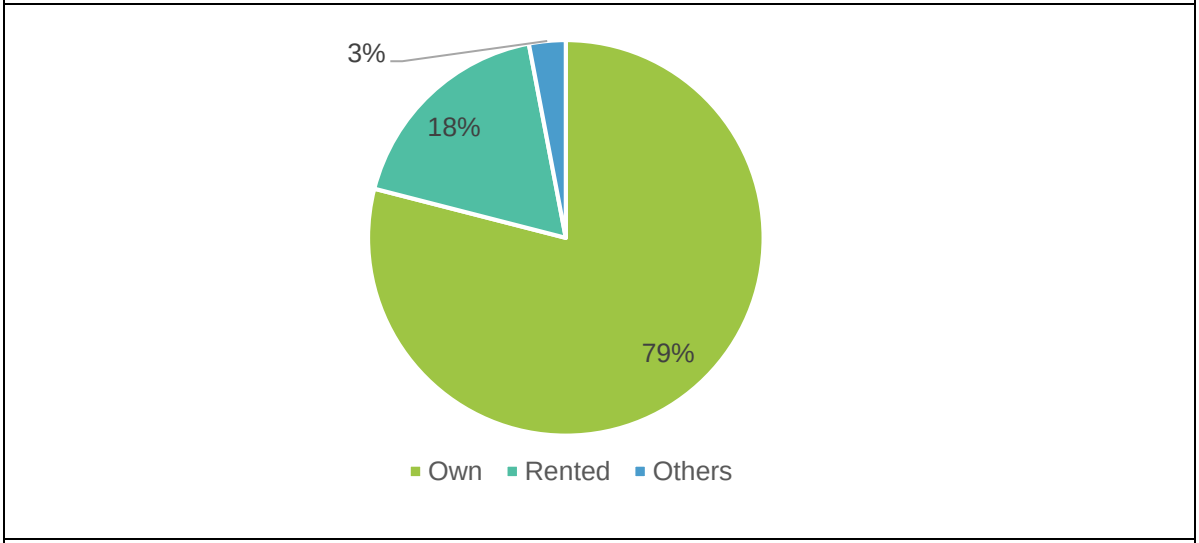
Public health: The public health section is headed by the sanitary inspector to assist the EO. This section also looks after birth and death registrations, vaccinations, and anti-malaria operations. It is also responsible for the removal of dead animals and deals with the problem of stray animals. Prevention of food adulteration activities are monitored by sanitary inspectors[9].

2.5. Housing typologies

Majority of the houses in Kilakarai have one or two rooms. Nearly 69 per cent of the households (HHs) have roofs made from concrete. In the sample, 79 per cent of the respondents reported to own their house, while 18 per cent were living in rented premises.

[8] Kilakarai municipality website: http://123.63.242.116/keelakarai/
[9] Kilakarai municipality website: http://123.63.242.116/keelakarai/

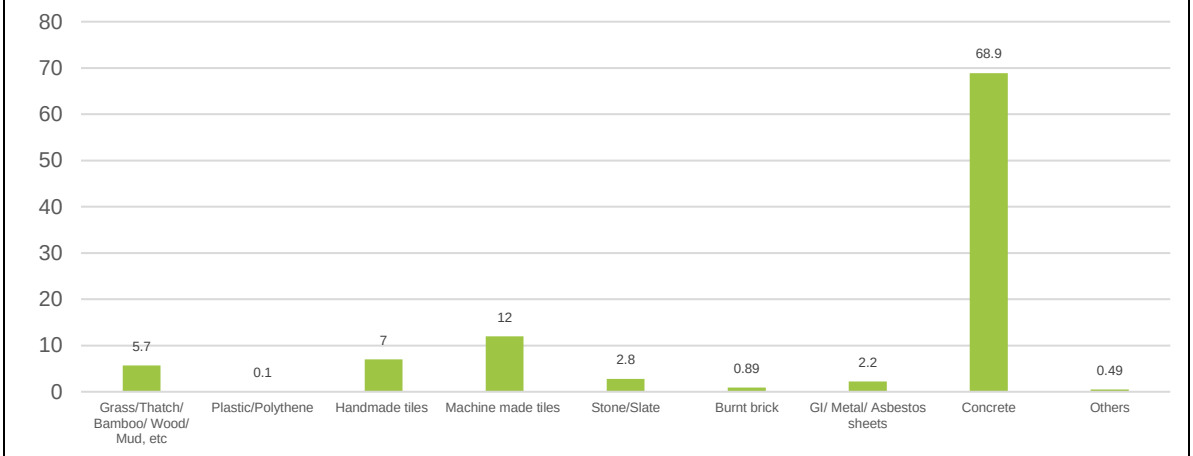
Figure 2.5: **Housing ownership status**



Source: Census of India, 2011

The material of the roof was mostly RCC followed by tiles. Around 7 percent of the houses had roof made of materials such as grass/thatch/ bamboo/ wood/ mud, etc

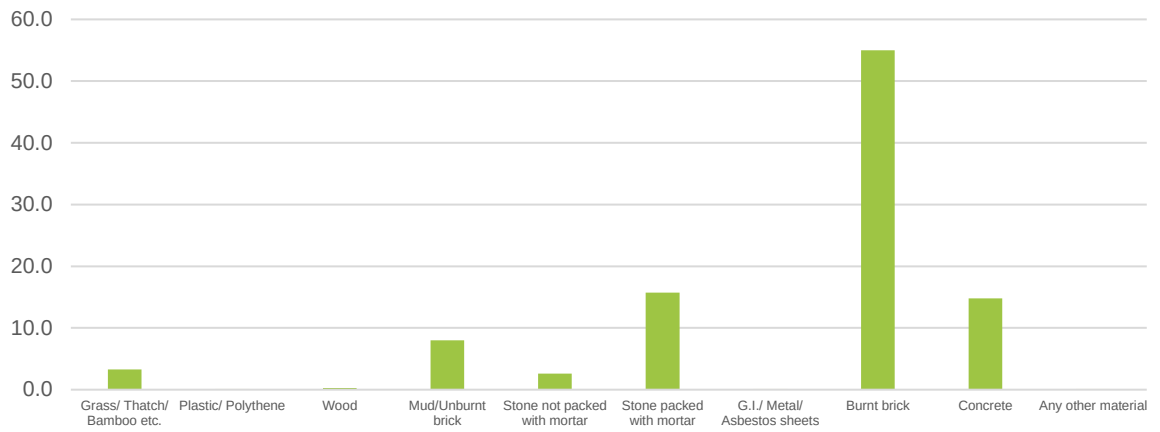
Figure 2.6: **Housing typologies – Material of the roof (%)**



Source: Census of India, 2011

The walls are usually built from stone packed with mortar and burnt bricks of which 55 per cent is burnt brick.

Figure 2.7: **Housing typologies – Material of the wall**



Source: Census of India, 2011

The flooring material is usually mosaic/floor tiles and cement. The plastic/polythene house type belongs to slum settlements or people with very low income[10].

[10] Census of India, 2011

3 Study Findings

3.1 Household settlement pattern	19
3.2 Water supply	20
3.3 Household Sanitation Arrangements	22
3.4 Establishments	36

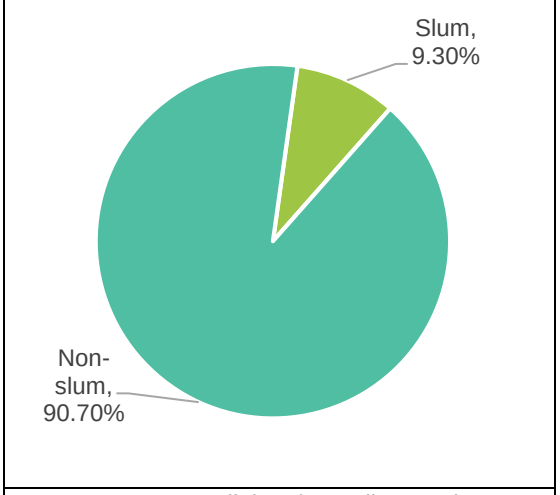
3. Study Findings

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

3.1. Household settlement pattern

Majority of the households interviewed, that is 90.7 per cent, reside in non-slum areas and the rest 9.3 per cent of the households reside in slum areas. The average household size is five.

Figure 3.1: **Settlement pattern**



Source: TNUSSP Kilakarai 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 Figure 3.2.

Figure 3.2: **Socio-economic Classification Grid**

	Chief Earner: Education (Q2)						
No. of Durables (TRANSFER FROM Q1)	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 are within the socio-economic classification C1/C2 illiterates to some college (not graduates and owing four to seven durables), most non-slum houses have been classified as B1/B2 (literate, no formal schooling to some college and owing four to seven durables).

Table 3.1: **Household socio-economic classification**			
SEC	**Slum**	**Non-Slum**	**Total**
A1	0.9%	1.7%	1.6%
A2	1.1%	4.6%	4.2%
A3	7.2%	9.1%	8.9%
B1	9.4%	14.8%	14.3%
B2	16.3%	29.1%	21.4%
C1	23.1%	21.0%	21.2%
C2	19.7%	12.2%	12.9%
D1	7.8%	5.9%	6.0%
D2	6.2%	4.5%	4.7%
E1	4.4%	3.6%	3.7%
E2	2.8%	0.4%	0.7%
E3	1.1%	0.3%	0.4%
Total	**100%**	**100%**	**100%**
Source: TNUSSP Kilakarai Baseline Study, 2017			

3.2. Water supply

3.2.1. Municipal Water Supply and Infrastructure

The Kilakarai municipality relies on two main water sources for supplying water to its residents including piped water supplied under the Combined Water Supply Scheme (CWSS) and a local source that is, three municipality wells at Malangondu and ten wells at Sethukarai.

Figure 3.3: **Municipality overhead tank and sump**

Source: TNUSSP Baseline Study, Kilakarai, 2017

The groundwater yield drawn from in-use bore wells and open wells is 0.58 MLD. The yield along with the limited surface water sources cannot effectively serve the current population of the municipality. This has been due to indiscriminate extraction of groundwater through numerous tube wells in the area, leading to groundwater depletion and seawater intrusion in the coastal areas. The seawater intrusion has also led to increased concentration of dissolved salts like chlorides, sulphates and nitrates in the groundwater gradually, deteriorating its quality.

Table 3.2: Yield from various sources			
Sl.No.	**Ground Water Resources**	**Average Yield (both seasons MLD)**	**Total (per cent)**
1	Sethukarai	0.40	69
2	Malangondu	0.18	31
	Total	**0.58**	**100**
Source: CDP, 2009			

In Kilakarai, water sourced from CWSS and the municipality wells are pumped into a common sump and stored in two overhead tanks (OHT) with a capacity of 4 litres and 1.80 litres respectively. Water is pumped between 6 am and 7 am. The water storage and distribution details in Kilakarai are given in Table 3.3.

Table 3.3: **Water distribution in Kilakarai**		
Sl.No.	**Source**	**lpcd supplied**
1	CWSS	31 lpcd
2	Local source	12 lpcd
Source: Kilakarai Municipality		

Additionally, the municipality has provided 792 house service connections (HSC) and 92 public fountains (PF) to cater to the water needs of the residents. The length of the water distribution pipeline is 35 kilometres and it was laid 30 years back. With age, these pipes require high maintenance due to which regular water supply is sometimes interrupted. Moreover, Kilakarai is expanding and some of the new residential areas.

3.2.2. Household arrangements for potable water

Interactions with households brought to light the current water shortage persistent in Kilakarai. With intermittent municipal water supply and increased salt content in ground water, households are forced to depend on private vendors for potable water. Water tanker trucks and small tanks pulled by cattle are a common sight in the municipality. Households pay between ₹7 and ₹10 for one pot of potable water. Having an own well within is also a dependable source of potable water for a few households.

Figure 3.4: **Water tanker trucks and small tanks pulled by cattle**

Source: TNUSSP Baseline Study, Kilakarai, 2017

The study data corroborated the above findings with 86.8 per cent households reporting their dependence on private water tankers/trucks for drinking and cooking purposes (potable). This practice is more prevalent among slum households (94.8 per cent). Over one-fourth or 30 per cent of the households depend on water sources within their dwelling such as own hand pump/tube well, own well that may be protected or unprotected for potable water. Bottled or can water is also a preferred source for 12.6 per cent households.

Kilakarai has two *ooranis* or dug-out ponds that trap and store rainwater run-off. The two sources, Uppukkulam oorani and Indhukkal Mayanam oorani, are accessed by 2.1 per cent of households for potable water.

3.3. Household Sanitation Arrangements

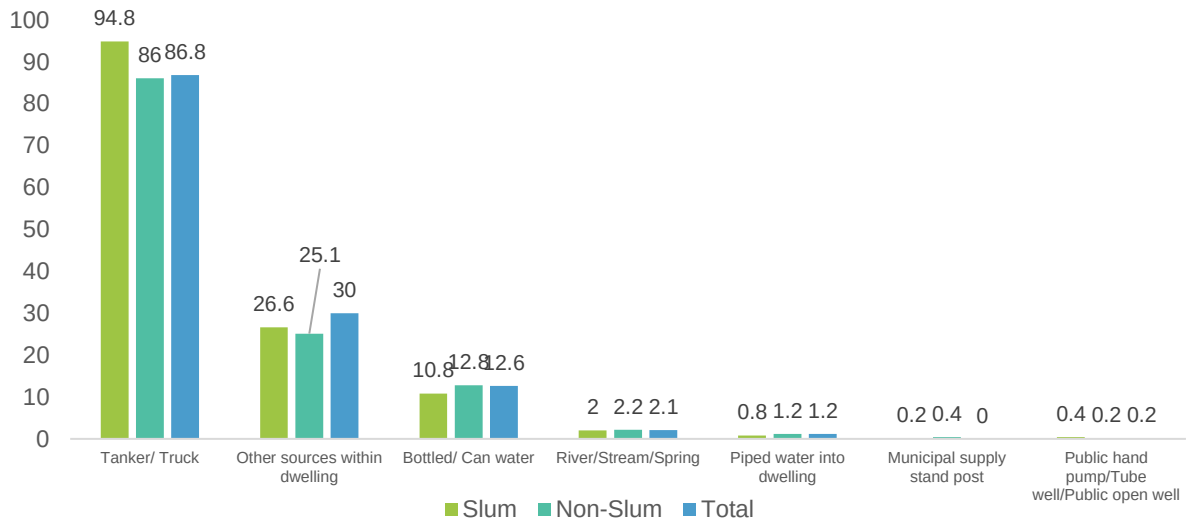
To understand the defecation patterns across the municipality, all households surveyed were asked to share information about their place of defecation.

Table 3.4: **Household sanitation arrangements in Kilakarai**

Sl.No.	Access	Slum	Non-Slum
1	Individual Household toilets	93.6%	98.0%
2	Open Defecation	3.3%	1.1%
3	Community Toilets	2.9%	0.6%
4	Shared toilets	0.1%	0.2%
5	No response	0.2%	0.0%
	Total	**100%**	**100%**
	N	**1,106**	**10,760**

Source: TNUSSP Kilakarai Baseline study, 2017

Figure 3.5: **Household Watersupply Arrangements**



Total exceeds 100 due to multiple response
Source: TNUSSP Kilakarai Baseline Study, 2017

3.3.1. Individual household toilets

Access to an individual household toilet is reportedly high in Kilakarai. A high proportion of households (97.6 per cent) in both slum and non-slum areas have access to individual household toilets. Comparatively, the proportion of households with an individual household toilet is higher in non-slum areas (98.0 per cent). Many households, mostly in non-slum areas access community toilets. Data reveals that open defecation is practiced by a few households in both slum and non-slum households, but this practice is more prevalent among slum households.

Figure 3.6: **Individual household toilet**

Source: TNUSSP Baseline study, Kilakarai, 2017

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

In almost all households in slum and non-slum areas, the toilet facility is inside the house (98.4 per cent). This arrangement is observed to be more prevalent among households in non-slum areas. In few slum households (5.5 per cent), the toilet facility is located outside the house but attached to the house.

Table 3.5: **Location of toilet facility in households**

Sl. No.	Location	Slum	Non-Slum	Total
1	Inside the house	94.0%	98.9%	98.4%
2	Outside the house but attached	5.5%	0.9%	1.3%
3	Outside the house but detached/ stand-alone	0.5%	0.2%	0.3%
	Total	**100%**	**100%**	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

Irrespective of the location, the predominant material of the roof is reinforced cement concrete (RCC) for most of the toilets. This is followed by burnt brick/stone for facilities inside the house (7.2 per cent) and asbestos for toilet facilities outside the house but attached and outside the house but detached/ stand-alone (28.8 per cent and 31.0 per cent respectively). Tin/metal sheet is the predominant roof material for toilets in 20.7 per cent households that have the facility outside the house but detached/ stand-alone.

Table 3.6: **Location of toilet facility and predominant material of the roof in households**				
Sl.No.	**Predominant material of the roof**	**Inside the house**	**Outside the house but attached**	**Outside the house but detached/stand-alone**
1	Reinforced Cement Concrete (RCC)	91.2%	40.5%	41.4%
2	Burnt brick/Stone	7.2%	17.6%	3.4%
3	Asbestos	1.2%	28.8%	31.0%
4	Bamboo/Wood	0.0%	2.0%	0.0%
5	Thatch/Biomass	0.1%	1.3%	0.0%
6	Tin/Metal Sheet	0.2%	8.5%	20.7%
7	Earthen tiles	0.0%	0.7%	0.0%
8	Plastic/PVC sheets	0.1%	0.7%	3.4%
9	No roof	0.0%	0.0%	0.0%
	Total	**100%**	**100%**	**100%**
Base: HHs with toilets = 11,582 *Source:* TNUSSP Kilakarai Baseline Study, 2017				

The predominant material of the wall is burnt brick/stone/concrete block for majority of the toilet facilities. Few toilets that were outside house but attached and outside the house but detached/stand-alone have walls made of tin/metal sheet.

Table 3.7: **Location of toilet facility and predominant material of the wall in households**				
Sl.No.	**Predominant material of the roof**	**Inside the house**	**Outside the house but attached**	**Outside the house but detached/stand-alone**
1	Burnt brick/Stone/ Concrete block	99.4%	91.5%	93.1%
2	Mud/Earth	0.3%	1.3%	0.0%
3	Bamboo/Wood	0.0%	2.0%	0.0%
4	Thatch/Other biomass	0.0%	0.7%	0.0%
5	Tin/Metal sheet	0.2%	4.6%	6.9%
Total		**100%**	**100%**	**100%**
Source: TNUSSP Kilakarai Baseline Study, 2017				

3.3.2. Community/public toilets

As per the Kilakarai municipality records, there are five community toilets and one public toilet. Community toilet usage is reportedly low as a high proportion of households have an individual toilet within their premises. The community toilet in Muthuswamipuram is used by a few households who do have an individual toilet. Bathing facilities are also available within the toilet complex. The public toilet is located inside the bus stop.

Figure 3.7: **Public toilet in Muthuswamipuram, Kilakarai**

Source: TNUSSP Baseline Study, Kilakarai, 2017

3.3.3. Open defecation

Open defecation was reported in Meenavarkuppam. A few hutments have no toilet facilities and one possible site for open defecation is near the seashore.

Figure 3.8: Open defecation site near the shore

Source: TNUSSP Baseline Study, Kilakarai, 2017

3.3.4. Containment

All households with individual toilets were asked about their toilet outlets and their responses are presented in Table 4.8. As reported, all households are connected to any type of OSS system. Among them, almost all households with individual household toilets (N=11,582) reported that the predominant containment system is single/twin pit. A marginally higher proportion of non-slum households (98.5 per cent) than non-slum households (96.6 per cent) reported their containment systems as single/twin pit.

Table 3.8: **Predominant containment systems in households**

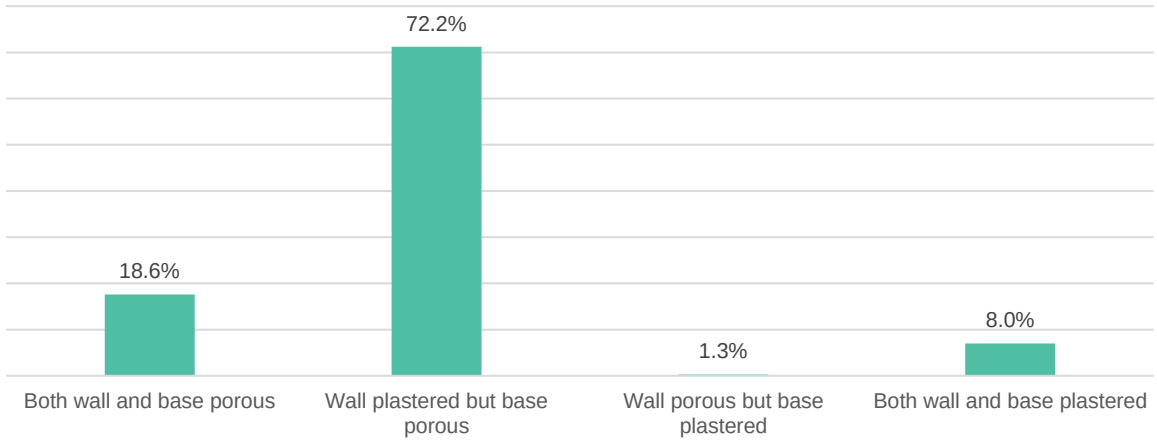
Sl.No.	Type	Slum	Non-Slum	Total
1	On-site (Single/Twin pit)	96.6%	98.5%	98.3%
2	Septic tank	3.0%	0.6%	0.8%
3	Underground drainage	0.3%	0.8%	0.8%
Total		**100%**	**100%**	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

During the study, the respondents were probed about the type 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 systems reported as septic tanks or single/twin pits are just crude structures that did not follow any standards in terms of dimensions or infrastructure. Data reveals that majority of the containment structures have the walls plastered and base porous (72.2 per cent). Over one-tenth (18.6 per cent) of containment structures have both walls and base porous.

Overall, only 8 per cent or 913 households have containment systems with both walls and base plastered.

Figure 3.9: **Pit/septic tank infrastructure in households**



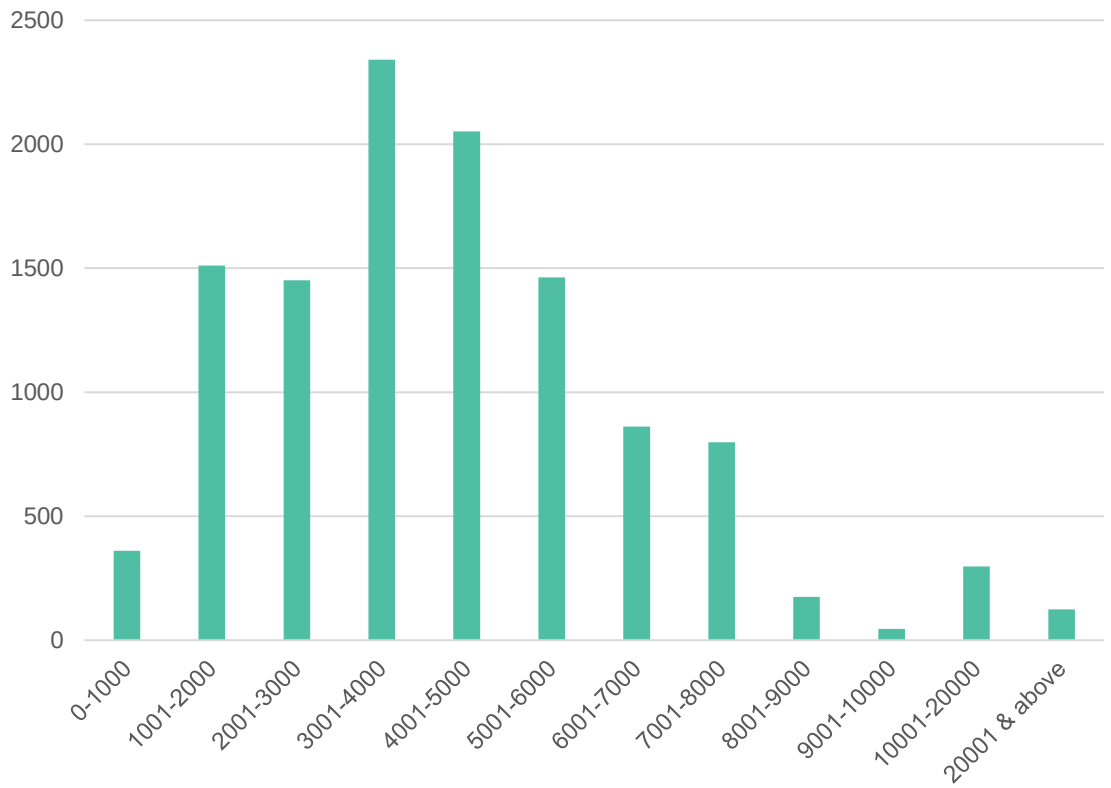
Source: TNUSSP Kilakarai Baseline Study, 2017

As per the WHO standards[11], 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.

In Kilakarai, very few households have septic tanks (n=96) and of them, only six have both walls and base plastered and have more than one chamber.

Reported data on the volume of the containment system indicate that most have a capacity of 3,000 to 4,000 litres.

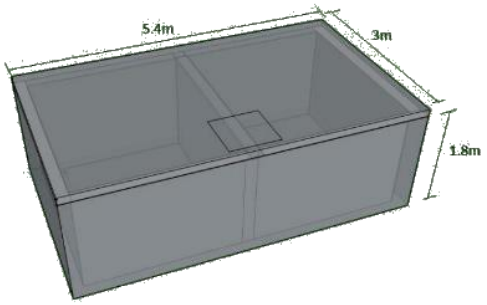
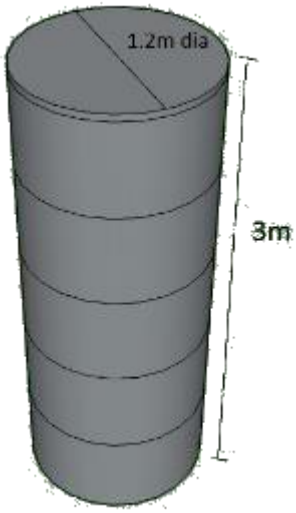
Figure 3.10: **Pit/septic tank volume**



Source: TNUSSP Kilakarai Baseline Study, 2017

Interactions with masons and builders on the OSS system specifics revealed that most of the large residential buildings, schools, hotels, mosques and public and community toilets are connected to septic tanks. As presented in Table 4.10 – Type 1 these structures are almost in line with the WHO specifications with both the base and walls non-porous, plastered and two-chambered. However, at the household level, the OSS was mostly reported as a circular structure with pre-cast RCC rings. The base is porous with a depth of 3 m and diameter of 1.2 m.

[11] The World Health Organisation 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 3.11: Illustration and description of type of OSS	
Type 1	**Type 2**
	
Dimension(LxBxD): 5.4m x 3m x 1.8m (approx.) Chambers: 2 (separated by baffle wall at the center with holes) Base: Non-Porous, Plain Cement Concrete (PCC) (a mixture of sand, cement and crushed stones). Walls: Non-Porous, Brick work Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Mostly observed in public and community toilets, mosques, schools, hotels and bungalows Septic tank constructed with support walls made of brick and the base was made of PCC	Dimension: 3m depth and 1.2 diameter (approx.) Base: Porous Walls: RCC rings Top Slab: RCC Access Cover (Y/N): Yes Other details: Mostly observed in middle and low income households. The precast RCC rings are locally made
Source: TNUSSP Baseline Study, Kilakarai, 2017	

3.3.5. Collection, conveyance and disposal

Direct and easy access to the containment system for desludging depends on three components of accessibility including location of the OSS system, width of the road to accommodate desludging vehicles and if the OSS 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=11,482) are located in front of the house facilitating easy and direct access by a truck to the containment system. Just over one-tenth of households in both slums (27.3 per cent) and non-slum areas (27.5 per cent) have the containment system on the side of the house. Less than one-tenth households (4.5 per cent), have the containment system below the pan/platform or below the building.

Table 3.9: **Location of containment system in households**				
Sl.No.	**Location**	**Slum**	**Non-Slum**	**Total**
1	In front of the house	82.0%	81.2%	81.3%
2	Behind the house	14.9%	16.4%	16.3%
3	On the side of the house	3.1%	2.2%	2.3%
4	Along the road	0.0%	0.1%	0.1%
Total		**100%**	**100%**	**100%**
Source: TNUSSP Kilakarai Baseline Study, 2017				

It was observed that in three-fourth of the households (74.9 per cent) the approach road was five to ten feet wide with sufficient space for a desludging truck to park. However, in 25 per cent of the households, the width of the nearest road to the containment system was less than five feet. Such narrow roads/lanes were observed in the old part of the town around the Sathakathullah Appa Dargha. The spatial growth pattern reveals a densely populated core town area around the Dargha with narrow lanes and tightly packed houses. This, being the old part of the town, has no open or adequate spaces for large vehicles to navigate or park.

Table 3.10: **Width of the nearest road to the containment system in households**				
Sl.No.	**Type**	**Slum**	**Non-Slum**	**Total**
1	Less than 5 feet	20.7%	25.5%	25.1%
2	5-10 feet	48.4%	45.2%	45.5%
3	Greater than 5 feet	30.9%	29.3%	29.4%
Total		**100%**	**100%**	**100%**
Source: TNUSSP Kilakarai Baseline Study, 2017				

The containment system in almost all the households is single pit. These pits below ground level are sealed and need to be broken to access the system.

Figure 3.12: Location of a single pit

Source: TNUSSP Baseline Study, Kilakarai, 2017

The practice of cleaning a septic tank or pit is reported in 66 per cent households with septic tank/pit. Of the non-slum households, 67 per cent have emptied their septic tank or pit at least once and among the slum households, 63 per cent reported the same.

As per CPHEEO norms septic tanks need to be cleaned periodically at an interval of two-three years. Across households that have ever emptied their septic tank or pit, more than half or 52.9 per cent cleaned their tank once in two or three years.

Table 3.11: **Frequency of desludging in households**				
Sl.No.	**Frequency**	**Slum**	**Non-Slum**	**Total**
1	Once a year	13.3%	10.3%	10.5%
2	Once in 2 years	22.9%	24.1%	24.0%
3	Once in 3 years	24.3%	29.3%	28.9%
4	Once in 4 years	11.9%	10.3%	10.5%
5	Once in 5 years	15.6%	12.9%	13.1%
6	Once in 6 years & above	11.7%	13.1%	13.0%
	Total	**100%**	**100%**	**100%**
Source: TNUSSP Kilakarai Baseline Study, 2017				

Households are heavily dependent on private parties to empty or clean the septic tank or pit. This was observed among both slum (94.0 per cent) and non-slum households (98.9 per cent).

Table 3.12: **Who emptied septic tank/pit in households**				
Sl.No.	**Type**	**Slum**	**Non-Slum**	**Total**
1	Municipality	0.2%	0.2%	0.2%
2	Private	98.9%	94.0%	94.4%
3	Self	0.9%	5.8%	5.4%
	Total	**100%**	**100%**	**100%**
Source: TNUSSP Kilakarai Baseline Study, 2017				

The Kilakarai municipality owns a desludging truck; however, it is not functional. There are no private desludging operators in Kilakarai and most operate out of neighbouring areas such as Ramanathapuram, Virudhunagar and Kadaladi in Madurai district. Informal discussions with desludging operators revealed that in Kilakarai, households and establishments desludge once in two or three years. The operators charge around ₹2,000 to ₹5,000 per trip. The presence of narrow roads is one of the major challenges that the operators face while desludging. In addition, the location of the OSS system which is mostly in front of the house makes it difficult to access the containment structure. Some operators use long hose pipes to overcome this challenge.

Informal discussions with households revealed that the practice of manual cleaning of pits is prevalent in most houses. Owing to the narrow inaccessible roads and high desludging cost, households hire local resources to clean the pits. Further interactions with pit cleaners divulged the manner in which the pits are cleaned and the contents emptied. Manual cleaning is usually done during the night time and requires three to four people. While one person gets into the pit using a rope, others assist in emptying the contents. Buckets are used to empty the contents which are then transferred to a large barrel. The sludge is disposed in open land or in the burial ground located in the outskirts of the town.

Figure 3.13: **Narrow roads in Kilakarai**

Source: TNUSSP Baseline Study, Kilakarai, 2017

3.3.6. Treatment

At present, there are no facilities available for septage treatment in Kilakarai. Informal discussions with private desludging operators indicate that the fecal sludge collected from residential and public/community toilets are disposed in a vacant area around 7 km from Ramanathapuram on the East Coast road.

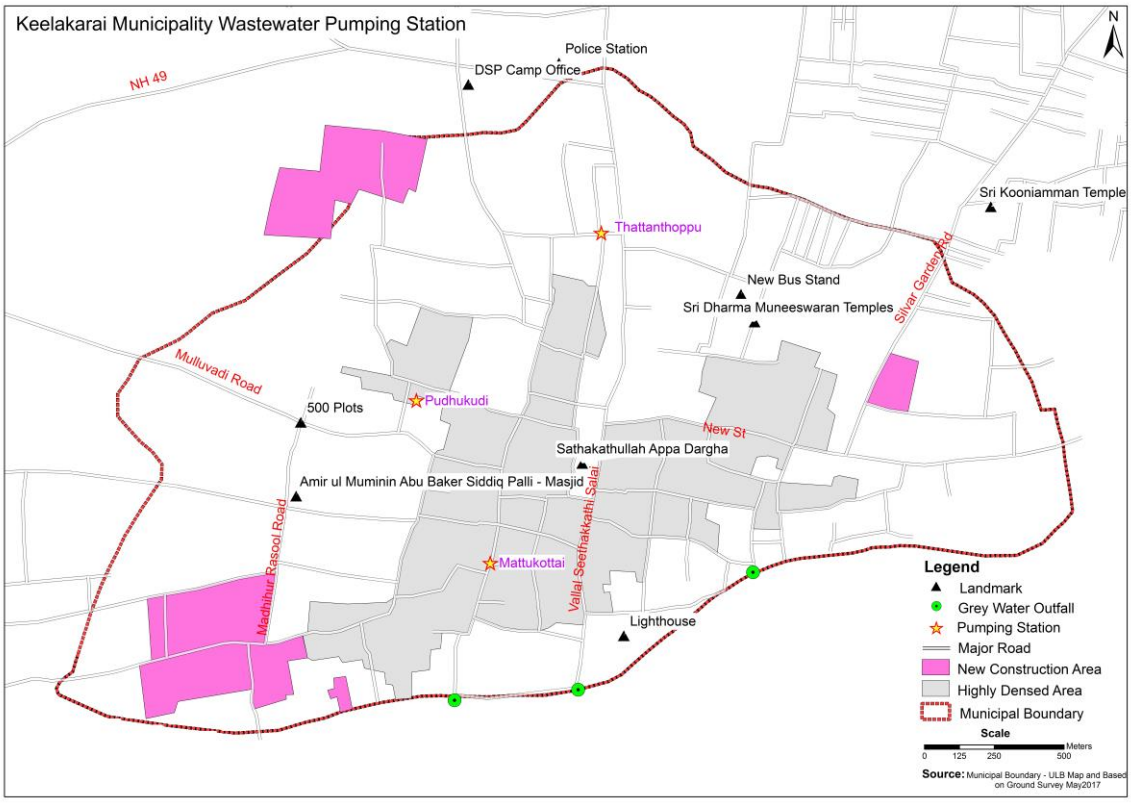
Figure 3.14: **Fecal sludge disposed of in a vacant area**

Source: TNUSSP Baseline Study, Kilakarai, 2017

3.3.7. Grey water management

Kilakarai municipality has an underground network system that carries grey water through PVC pipes. The grey water from households is channelled through the underground pipes and is collected at three mid-section pumping stations at Thattan Thoppu, Pudukudi and Mattu Kottai (Map 4) for partial treatment where solid waste is separated through a net. The partially treated grey water is pumped using a 5-10 hp motor through which it is directed to the sea. There are three outfall points, all leading to the sea.

Figure 3.15: **Grey water pumping stations and outfall points**



Source: TNUSSP Baseline Study, Kilakarai, 2017

3.3.8. Drainage

The total length of the storm drain is only 10 km. The town has kuccha open drains that covers 44 per cent of the total road length. The length of the open drains is about 78.25 km.[12]

To the question on drainage facility, households referred to the grey water underground network system and majority of the households (94.6 per cent) reported that they have a drainage facility outside the premises. A closed drain facility is observed to be common in most slum and non-slum households. The presence of open drains is more prevalent in slum areas. Overall, 5.4 per cent of the households do not have any drainage facility.

Table 3.13: **Drainage facility outside house**

Sl.No.	Type	Slum	Non-Slum	Total
1	Yes, open drain	8.5%	5.8%	6.0%
2	Yes, closed drain	87.1%	88.8%	88.6%
3	No drain	4.4%	5.4%	5.4%
	Total	**100%**	**100%**	**100%**

Source: TNUSSP Kilakarai Baseline study, 2017

[12] City development plan Kilakarai,2009

3.3.9. Solid waste management and storm water drains

There are 25 permanent and 25 temporary sanitary workers posted for sweeping, cleaning and collection of solid waste. Streets are provided with bins that are regularly cleared by the sanitary workers. The solid waste generated from the city is taken to a dump yard (seven acres) that is 7 km from the city. It has been operative from the year 2012. [13]

Figure 3.16: **Solid waste management in Kilakarai**

Source: TNUSSP Baseline Study, Kilakarai, 2017

Figure 3.17: **Absence of storm water drains**

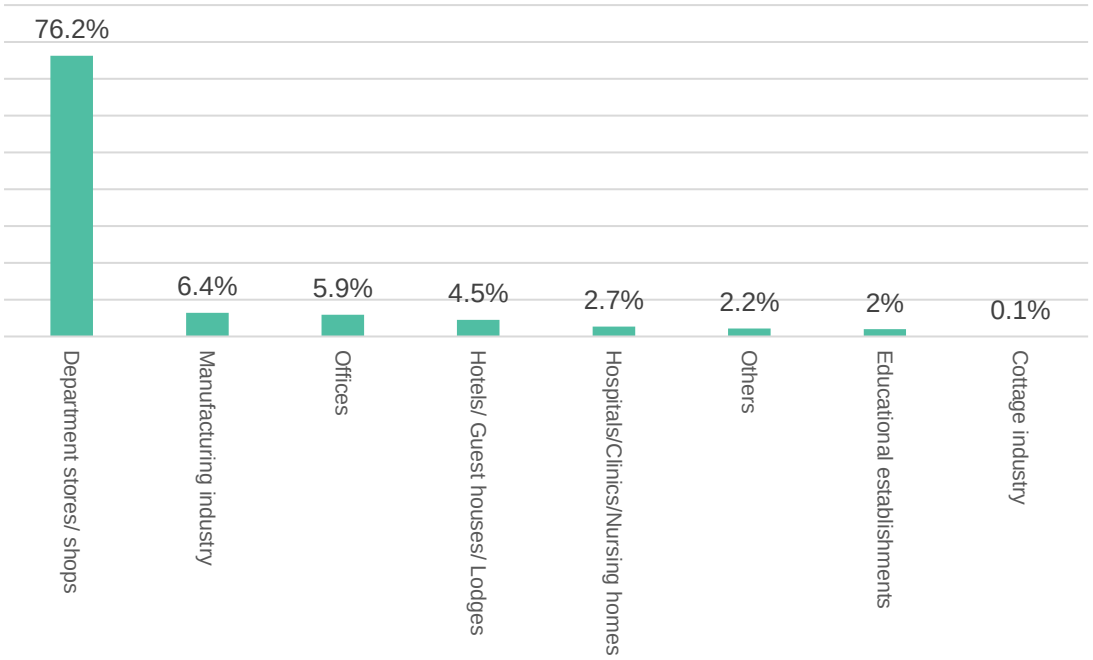
Source: TNUSSP Baseline Study, Kilakarai, 2017

[13] City development plan Kilakarai,2009

3.4. Establishments

More than three-fourth of the establishments (76.2 per cent) surveyed are provision stores, petty shops or eateries. While 6.4 per cent are manufacturing industries, 5.9 per cent are offices. Hotels, guest houses, and lodges constitute 4.5 per cent of the total establishments in Kilakarai.

Figure 3.18: Nature of business in Kilakarai



Source: TNUSSP Baseline Study, Kilakarai, 2017

Kilakarai is a centre for trade and commerce for the neighbouring towns and villages. Being a coastal town, the predominant industry is fishing. Majority of the working population are employed as labourers in construction industries and work in different parts of the district. Majority of the commercial activities in the city are undertaken along the municipal road and near the Palaiya Jumma Masjid, where a variety of service centres exist making it a commercial hub of the region.

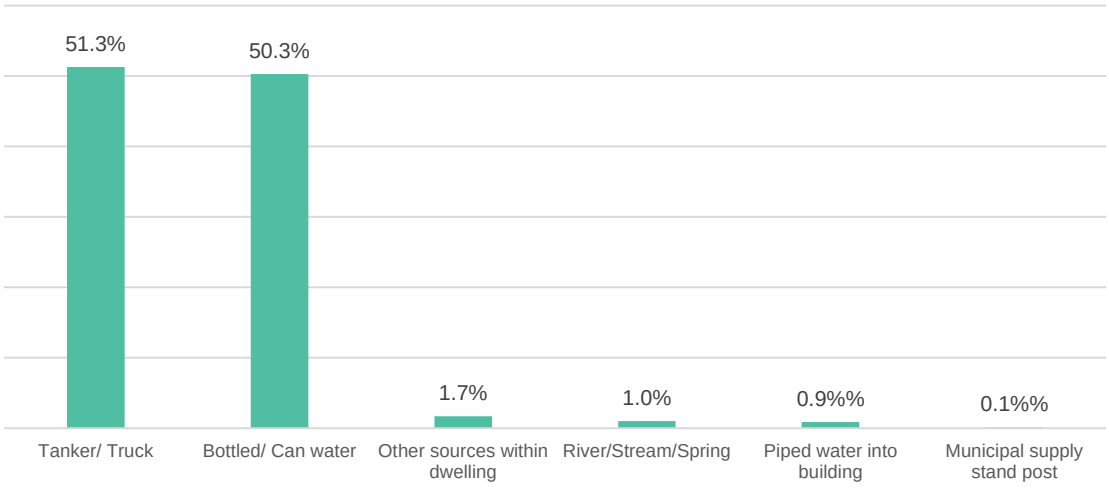
Figure 3.19: **Commercial establishments on municipal road**

Source: TNUSSP Baseline Study, Kilakarai, 2017

3.4.1. Water supply

Almost all establishments are heavily dependent on private vendors for potable water. Both tankers or trucks (51.3 per cent) and bottled or can water supplies (50.3 per cent) are equally preferred by establishments.

Figure 3.20: **Main source of potable water in establishments**



Source: TNUSSP Kilakarai Baseline Study, 2017

3.4.2. Sanitation arrangements

In all, only 11.1 per cent or just 77 establishments have a toilet in the building. In most establishments, the toilet facility is inside the building (87 per cent). In more than one-tenth of establishments, the toilet facility is located outside the building but remains attached to the building (11.7 per cent). Very few establishments have the toilet outside the building but detached/stand-alone (1.3 per cent).

Table 3.14: **Location of toilet facility in establishments**

Sl.No.	Location	Total
1	Inside the establishment	87.0%
2	Outside the establishment but attached	11.7%
3	Outside the establishment but detached/ stand-alone	1.3%
	Total	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

3.4.3. Containment

All establishments with individual toilets (n=77) were asked about their toilet outlets and their responses are presented in Table 5.2. As reported, all establishments are connected to some type of OSS system. Mostly, the toilets are connected to single or a twin pit (96.4 per cent) followed by septic tanks (2.6 per cent).

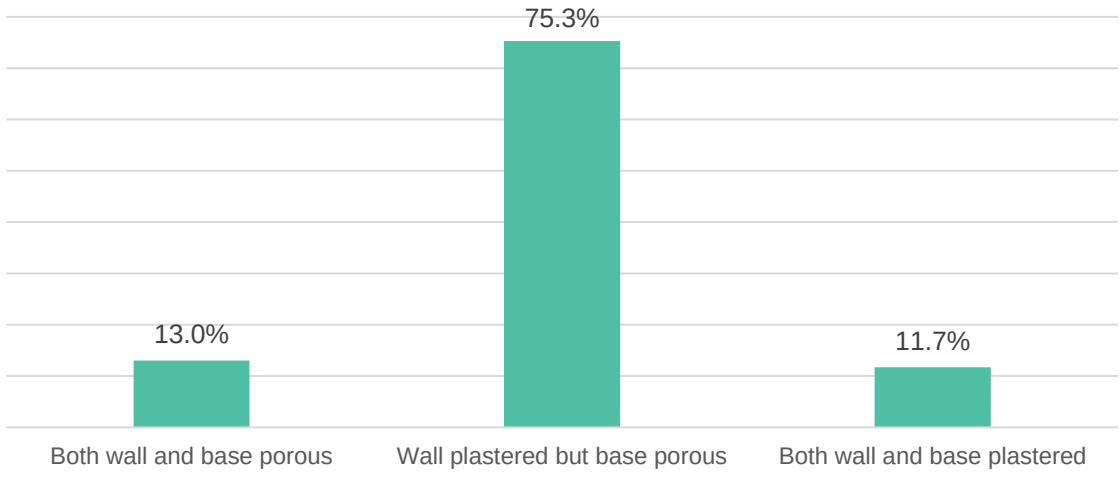
Table 3.15: **Predominant containment system in establishments**

Sl.No.	Type	Total
1	On-site (Single/Twin pit)	96.4%
2	Septic tank	2.6%
	Total	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

Three-fourth (75.3 per cent) of containment structures have walls that are plastered but with a porous base. Around 13 per cent containment structures have both walls and base that are porous in nature. Overall, only 11.7 per cent or nine establishments have containment systems with both walls and base plastered.

Figure 3.21: **Pit/septic tank infrastructure in establishments**



Source: TNUSSP Kilakarai Baseline Study, 2017

3.4.4. Collection, conveyance and disposal

Majority of the containment system in establishments with reported OSS systems (n=77) are located in front of the building or behind the building or on the side of the building facilitating easy and direct access by a truck to the containment system. Mostly, the containment system is located in front of the establishment.

Table 3.16: **Location of the containment system in establishments**

Sl.No.	Location	Total
1	In front of the establishment	72.7%
2	Behind the establishment	27.3%
	Total	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

It was observed that in majority of the establishments (61 per cent) the approach road is too narrow for a truck to access the containment system. In more than one-third of the establishments, the approach road is five to ten feet wide with sufficient space for a desludging truck to park.

Table 3.17: **Width of the nearest road to the containment system in establishments**

Sl.No.	Type	Total
1	Less than 5 feet	61.0%
2	5-10 feet	31.2%
3	Greater than 5 feet	7.8%
	Total	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

The practice of cleaning pits or septic tanks among establishments is reportedly moderate with 54.5 per cent or 42 establishments reported to have emptied the containment system at least once. Across establishments that have emptied their pit or septic tank at least once, more than half or 54.7 per cent clean their tank either once in two or three years.

Table 3.18: **Frequency of desludging**

Sl.No.	Frequency	Total
1	Once a year	16.7%
2	Once in 2 years	33.3%
3	Once in 3 years	21.4%
4	Once in 4 years	7.1%
5	Once in 5 years & above	21.5%
	Total	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

Most establishments are dependent on private service providers to empty or clean the septic tank/pit (95.2 per cent). The rest use their own resources to clean the pit or septic tank (4.8 per cent).

Table 3.19: **Who emptied pit or septic tank in establishments**

Sl.No.	Type	Total
1	Private	95.2%
2	Self	4.8%
	Total	**100%**

Source: TNUSSP Kilakarai Baseline Study, 2017

Similar to the findings at the household level, the contents are disposed by the pit cleaner either in open spaces or at burial grounds.

4

Way Forward

4. Way Forward

The study findings have brought the sanitation situation in Kilakari highlighting key gaps across the sanitation chain.

1. Access: Kilakarai has a high coverage of individual household toilets. Almost all or 97.6 per cent households reported having a toilet within the premises.

2. Containment: A high proportion of households use single or twin pits as containment systems. These pits are fitted with pre-cast concrete rings, which are plastered together and the base is left open to facilitate percolation into the ground.

3. Conveyance: Owing to the lack of space, in most households, the OSS system is located in front of the house. Regular desludging is not a common practice among in least one-third of the HHs which have never desludged their OSS systems before. Among households that have desludged at least once before, over 50 per cent empty it once in two to three years. households are heavily dependent on private desludging operators who operate out of Kilakarai. The presence of narrow roads is one of the major challenges that the operators face while desludging. Added to it, the location of the OSS makes it even more difficult to access the containment structure. Some operators use long hosepipes to overcome this challenge.

4. Treatment and re-use: At present, there are no facilities available for septage treatment in Kilakarai and the fecal sludge collected from residential toilets is disposed in a vacant area on the highway. The grey water from the households is released into the storm water drains, lifted through four pumping stations before finally being let out into the sea.

The results of this study have important implications for designing an effective fecal sludge management plan to safely contain, convey and dispose sludge. The study highlights some concerns that need to be taken into account before developing a Fecal Sludge Management (FSM) plan for a city: discrepancy between reported structures and actual structures and the low frequency of desludging among others. The realities on ground (particularly regarding OSS systems) are often different from ‘textbook’ FSM, and have implications on planning.

To make FSM truly effective, one needs to find a solution to retrofit or upgrade existing systems. In conclusion, the following recommendations are suggested:

5. ULBs need to integrate FSM within their sanitation mandate and ensure that the system of collection and disposal of fecal sludge is regulated.

6. Explore options on desludging in locations with narrow roads and lanes; for example use a smaller truck.

7. Regulate the existing market on desludging by mandating registration of desludging trucks with the ULB.

8. Design appropriate awareness programmes for households on regular desludging and the importance of safe disposal.

Annexure

Annexure I – Household and Establishment Questionnaire A3

Annexure I – 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 is/ 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 grey water (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/ stand-alone..... …...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 ..... ….10 Others (Specify) ..... ….11 _____	
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)	☐☐feet.☐☐inches	

	(Not more than 2 digits before and 2 digits after decimal point to capture feet and 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)	☐☐feet.☐☐inches	

	(Not more than 2 digits before and 2 digits after decimal point to capture feet and 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

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.

iihs®
INDIAN INSTITUTE FOR HUMAN SETTLEMENTS

IIHS CHENNAI: Floor 7A, Chaitanya Exotica, 24/51, Venkatnarayana Road, T.Nagar, Chennai-600017.

044-6630 5500 tnussp@iihs.ac.in www.tnussp.co.in www.facebook.com/TNUSSP