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Solid and Liquid Waste Management and Resource Recovery in Sri Lanka: A 20 city analysis

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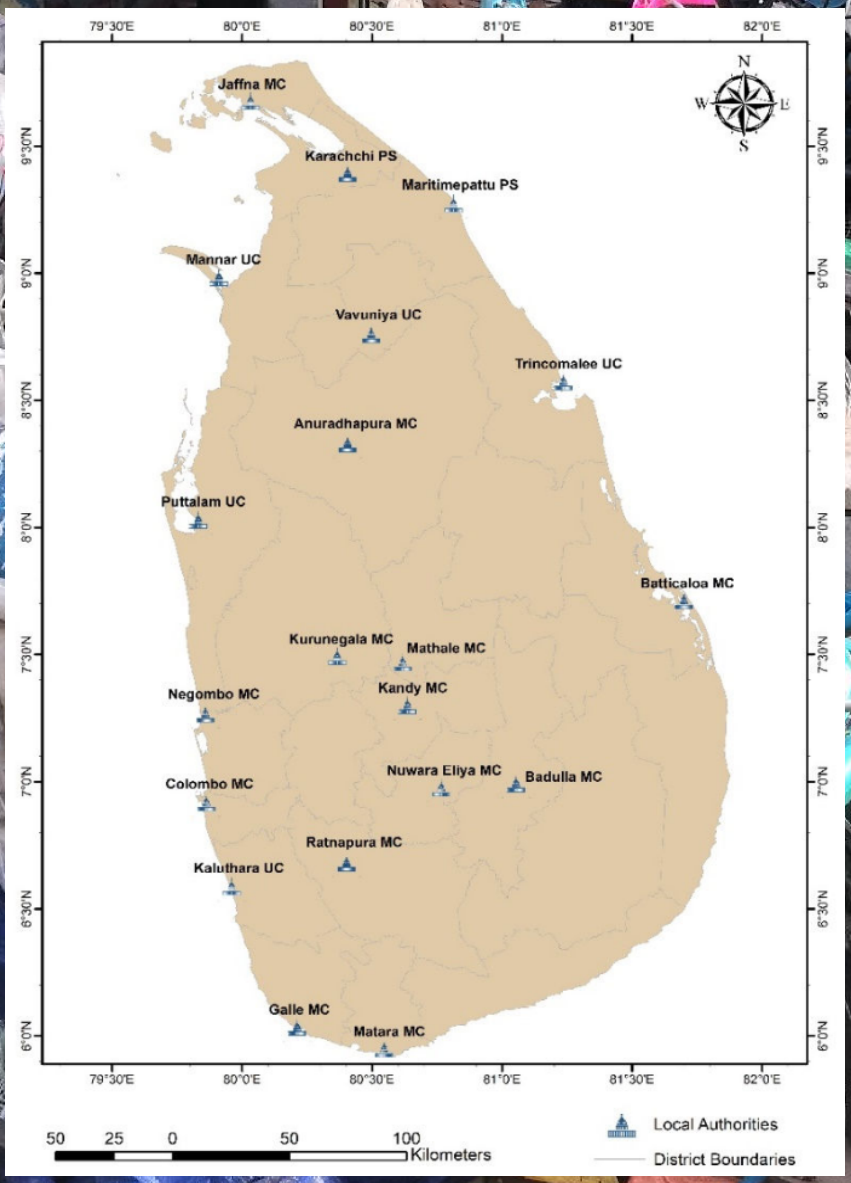

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Cover photo: Kaduwela Waste Recycling Centre, Sri Lanka, taken by P. Drechsel, IWMI

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Contents

List of Acronyms

CEA	Central Environmental Authority
IWMI	International Water Management Institute
JICA	Japan International Cooperation Agency
LA	Local Authority
MC	Municipal Council
MSW	Municipal Solid Waste
MT	Metric Tonne
NSWMSC	National Solid Waste Management Support Center
NWSDB	National Water Supply and Drainage Board
PS	Pradeshiya Sabha
RDF	Refuse-Derived Fuels
RRR	Resource Recovery and Reuse
SDG	Sustainable Development Goals
SWM	Solid Waste Management
UC	Urban Council
WMA	Waste Management Authority

List of Tables

List of Figures

Introduction

Waste management issues are increasing in developing world mainly due to the rapid population growth and urbanization. Proper management of solid and liquid wastes is an important determinant of improved sanitation in any community (Ministry of Drinking Water and Sanitation 2015). The Sustainable Development Goals (SDGs), essentially focuses on addressing the key issues of waste management. The target of SDG11.6 is to reduce the adverse per capita environmental impact of cities, including by paying special attention to municipal and other waste management. SDG 12 on "Sustainable Production and Consumption" targets among other things, environmentally sound management of all waste through prevention, reduction, recycling, reuse and the reduction of food waste (UN-Habitat 2018).

Cities should aim to become *'Waste-Wise Cities'* by identifying and integrating appropriate strategies to improve the waste management and subsequently to reduce the expenditure on managing waste to see a systematic change in the waste problem. Globally, the thinking is shifting from merely removing waste before it becomes a health hazard to creatively minimizing its environmental impact. Waste reduction is desirable; but, typically, it is not monitored anywhere (UN-Habitat 2010).

Urban waste challenge can offer immense and scalable opportunities through transforming waste from domestic and agro-industrial sources into low- carbon assets for use in agriculture and other sectors (Otoo and Drechsel 2018). The initiatives of Resource Recovery and Reuse (RRR) could create livelihoods, enhance food security and contribute to cost recovery in the sanitation and waste management sector. However, globally most waste products either end-up in landfills or pollute the environment posing environmental and health risks.

Sri Lanka, as many other developing countries, still lack of proper mechanisms to manage waste and is under tremendous pressure to take immediate actions to address this issue. Effective waste management has been identified as a priority area in the development plan of the government. However, translating these national government commitments to practical and sustainable actions at the local level remains a big challenge. On the other hand, lack of availability of primary data is one of the major barriers to make effective strategies on waste management; and also, to budget for them.

To augment the available data of the current waste management scenario in the country, International Water Management Institute (IWMI) has endeavoured to collect information on waste management in Municipalities and major towns in Sri Lanka. The inventory demonstrates the current status of waste management, efforts implemented by the local authorities (LAs) and other responsible entities to manage waste and their successes and failures. Information gathered in this exercise would contribute to identify areas that need further improvements, and to improve the existing policies and assist in formulating new strategies and guidelines with respect to sustainable waste management. This report is aimed at profiling information on the existing 'waste' (solid and liquid) management in twenty municipalities or urban/LAs. While discussing the current scenario of the waste management in the selected local authorities, this report also highlights on the attempts and interventions made at the local level to bring solutions to the waste problem including resource recovery and reuse.

Solid Waste (SW)

Without an effective and efficient Solid Waste Management (SWM) program, the waste generated from various human activities, both industrial and domestic, can result in health hazards and have a negative impact on the environment (APO 2007). There are various measures and approaches available for solid waste management. Treatment methods such as composting, anaerobic digestion, and refuse-derived fuels (RDF) offer a more sustainable course of action which also produce value-added resources, including organic fertilizer and renewable energy, while generating environmental and economic benefits (ADB 2011). However, the solutions must be chosen carefully considering the appropriateness to the local context.

The quality of waste management services is a good indicator of the governance of the city (UN-Habitat 2010). Managing solid waste (SW) however is one of the biggest challenges of many countries, regions and cities and the pressure to handle the issue is increasing.

The waste generation amount in Sri Lanka has increased with the economic growth of the country from around 6,400 ton/day in 1999 to 10,786 ton/day in 2009 (JICA 2016). The most common practice of MSW disposal in the country is open dumping. In most of the cases, MSW was being dumped indiscriminately to the surrounding environment creating numerous environmental and health impacts.

There is no proper management of MSW except for few cases where compost and biogas are produced as resource recovery. Open dumping of waste was not a concern in the past because of the free availability of degraded land. However, due to the arising land scarcity problem and also due to the environmental and health issues, authorities are compelled to explore new solutions for the MSW disposal.

In response to the mismanagement of SW, the Ministry of Environment and Natural Resources launched a programme called “Pilisaru” in 2008 under Central Environmental Authority as a national approach to address the SW issue. The programme aimed at proper managing of organic waste by providing technical and financial assistance to construct and operate compost plants in different local authorities. Under this project, about 115 compost plants were established across the country in the recent past years (figure 1).

Despite the initiatives such as Pilisaru programme, solid waste still remains a major problem across the country. The project addresses only the compostable component of the solid waste and that also only in a number of selected LAs/ areas in the country. Hence, along with the responsible authorities and institutions, the government is constantly seeking solutions for the country.

Box 1: Composition of Municipal Solid Waste (MSW) in Sri Lanka

Almost all the scientific and technical literature refers to Sri Lanka’s municipal solid waste as being substantially organic and having a high moisture content as the following shows: “MSW of Sri Lanka typically consists of a very high percentage of perishable organic material which is about 65 – 66% by weight with moderate amounts of plastic and paper and low contents of metal and glass. The moisture content of MSW is also very high in the range of 70 – 80% on a wet weight basis” (Bandara 2008); “…Primary components on a weight basis are compostable organics; food and garden waste accounting for 89.2%” (Wijerathna, et al. 2012); and “…Sri Lankan MSW consists of 54.5% short-term bio-degradable waste ….. and 5.9% Long term bio-degradable waste” (Hikkaduwa , et al. 2015).

Source (Gunaruwan and Gunasekara 2016)

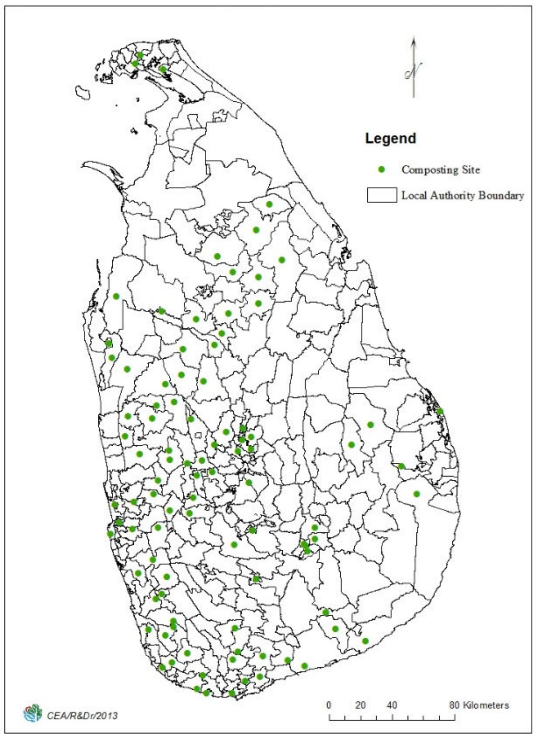

Figure 1: Spatial distribution of composting sites funded by Pilisaru project

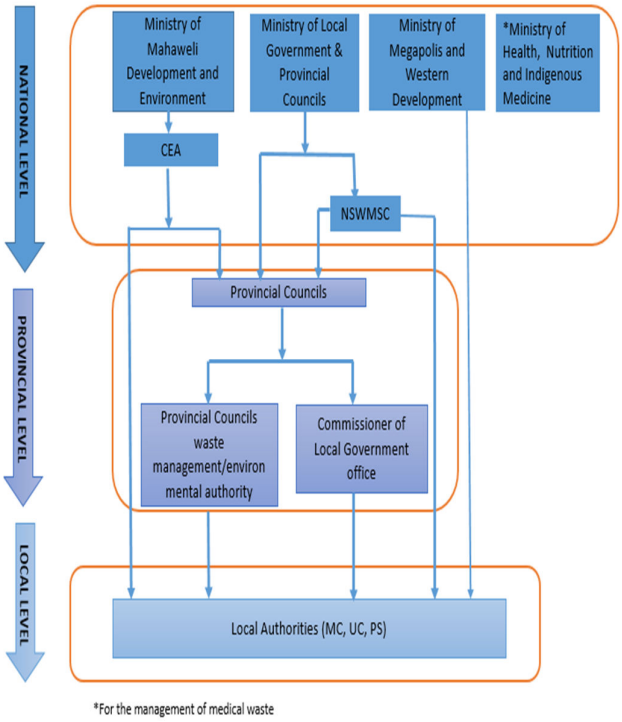

Figure 2: SWM hierarchy in Sri Lanka

Source: CEA

Waste management hierarchy in the country is divided into three tiers namely; (a) National (b) Provincial and (c) Local, in line with the governance system in Sri Lanka (figure 2). However, Local authorities (LAs) are statutorily responsible for the provision of municipal solid waste (MSW) collection and disposal services within their boundary. In most cases, budget allocation of LAs on solid waste management (SWM) is barely sufficient to meet the waste collection and transportation related costs. The real cost in most instances is much higher than what has been accounted.

The only waste management entity that operates at the provincial level is the Waste Management Authority (WMA) that functions within the Western Province. WMA engages in bringing solutions to the waste issue within the Western Province where the problem is much more critical. Among the nine provinces of Sri

Lanka, the waste collection amount of the Western Province including Colombo Municipal Council (CMC) is the largest, accounting for 52% of the total waste collection in the country (JICA 2016).

Sri Lanka experienced a major disaster in 2017, when the biggest SW dumpsite in the country located in Meethotamulla, that receives majority of waste from the CMC and suburbs collapsed causing human deaths and destroying houses. Proving how failure to manage waste in a proper way could have negative impacts, this was a wakeup call for the country highlighting the significance of having proper solid waste disposal practices in place.

As an attempt to going beyond the conventional open dumping of solid waste, the first ever sanitary landfill in the country was constructed at Dompe, Gampaha district and has been operational since 2015. The project was funded by Korean International Corporation Agency (KOICA) and implemented by CEA.

Having identified that mixed waste is a key barrier in implementing effective waste management strategies; the government recently introduced a new circular in order to encourage waste separation particularly in the municipal councils. Going beyond that, government has also taken further steps to reduce plastic waste consumption

in the country by issuing a gazette for regulations on polythene and plastic management in 2017. Even though such policy instruments are being introduced, solid waste management in the country still requires much more planning, strategizing and implementation at all levels; national, provincial and local level; to envision for better management.

Wastewater and Septage (Liquid waste management)

Wastewater and sewage, once generated have to be disposed of somewhere. Often, especially in developing countries, untreated wastewater and sewage will invariably find its way into streams, ponds, lakes and rivers of a town or city, consequently polluting the water resources, in addition to posing a health hazard. Moreover, with urbanization, the discharge increases; and proportionately with it, the pollution and health hazards.

Across the country, domestic wastewater has become one of the main contributors to the degradation of rivers, lakes, groundwater, and coastal waters. This in turn threatens the provision of safe water supply, especially to the poor. Without the provision of "back end" of sanitation service chain; collection, disposal and treatment, even so-called 'improved' sanitation facilities will remain a significant source of waterborne diseases and water pollution. Contamination from municipal sewage, septic tanks, latrines and unprotected dumping is one of the primary cause of diarrhea (Gunawardhana 2010) which is the fifth leading cause of hospitalization in Sri Lanka with 130,000-140,000 admissions annually and are the third leading cause of death among infants (Dayananda, Hewawasam and Lumbao 2006). On the other hand, when a polluted water body cannot be used; cities are compelled to turn to other sources of freshwater. Thus, more and more clean water must be brought in from long distances at greater expenses.

Cities in Sri Lanka face serious challenges in disposing liquid waste streams. Current sanitation scenario in Sri Lanka indicates that the national sewer coverage remains as 2.1% and septic tanks and pit latrines serve as the country's most prevalent urban sanitation system (table 2). However, the management of these onsite sanitation remains a neglected component of urban sanitation and wastewater management. Until recently, most sanitation programs have focused on toilet installation and sewerage development, viewing onsite sanitation as an informal, temporary form of infrastructure. (USAID 2010).

Table 1: Present sanitation situation in Sri Lanka

Total household	5,501,172	100%
Water sealed and Connected to pipe sewerage	127,077	2.1%
Water sealed & Connected to a septic tank/Pit	4,896,043	86%
Direct pit	264,056	4.8%
Shared	302,564	5.5%
No toilet	88,282	1.4%

Source: SACOSAN country paper, 2018

According to the Municipal and Urban council ordinances, Local Authorities (LAs) are responsible for the provision of drainage, sanitation, and waste disposal. However, LAs are seldom aware of the need for wastewater management or have national funding support for implementation.

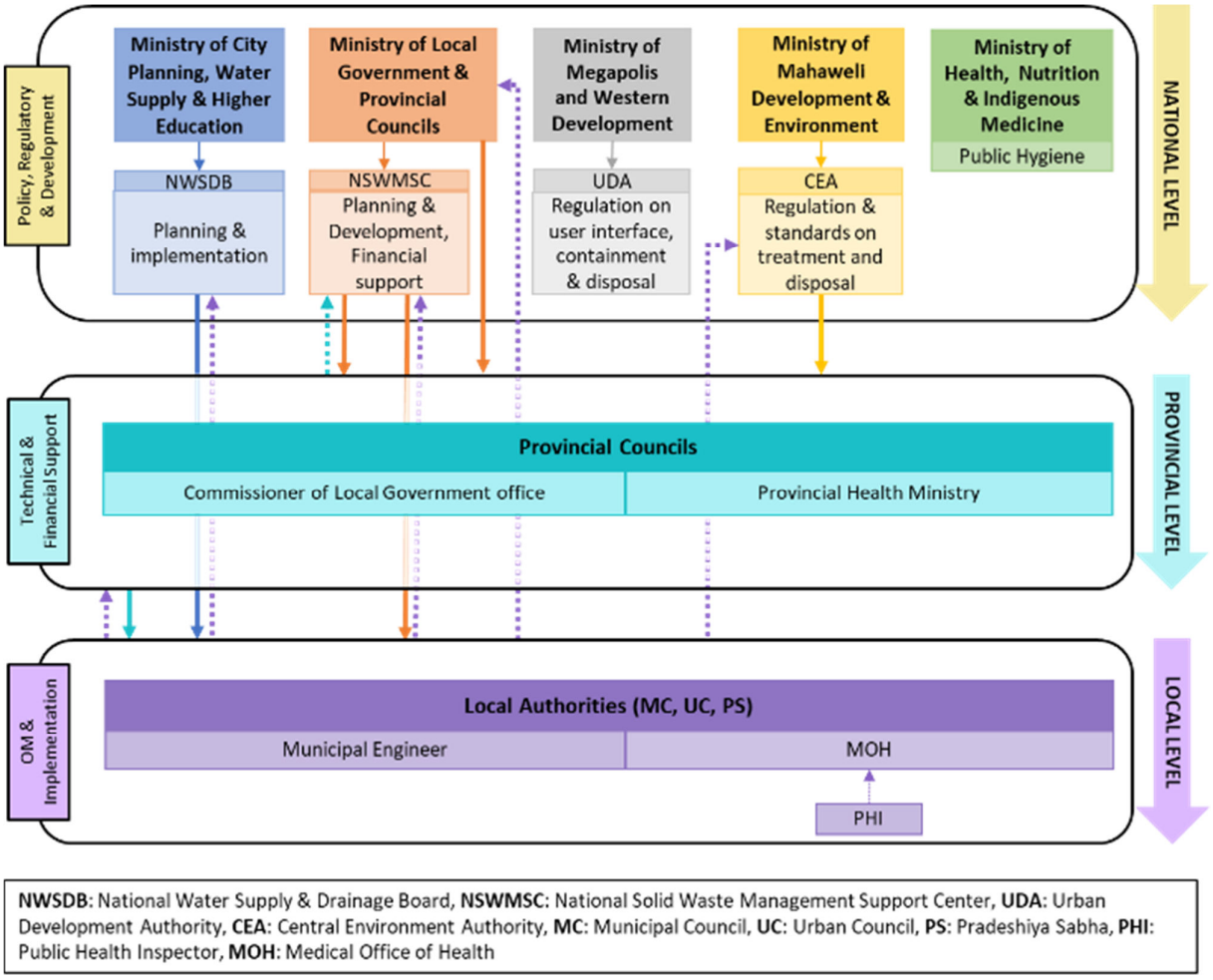

Figure 3: Institutional framework for sanitation sector

There are no policies in place at the national or local levels specifically requiring regular desludging of onsite sanitation systems. Typically, households will call the LA to request desludging of their sanitation systems, and the LA dispatches its septic trucks to the site. However, disposal remains a serious countrywide problem. Most cities lack septage treatment facilities. In cities with landfills, operators discharge the waste in designated areas of the facility.

For municipalities without landfills, operators typically discharge septage into nearby streams or rivers without any prior treatment. Manual de-sludgers working in low-income areas and squatter settlements, which are often inaccessible by truck, usually deposit the septage within the family's compound, in an excavated pit (USAID 2010)

As per the current institutional and regulatory framework related to water supply and sanitation in Sri Lanka, the National Water Supply and Drainage Board (NWSDB) under the Ministry of City Planning, Water Supply and higher education, is responsible for overall planning of sanitation programmes in coordination with other related agencies; local as well as foreign (National Policy on Sanitation in Sri Lanka 2017). The NWSDB essentially provides services in urban areas, while the Provincial Councils and Local Authorities plan, develop, and oversee the development of water supply and sanitation in peri urban, rural and smaller communities. Institutional set up related to sanitation sector in Sri Lanka is illustrated in the figure 3.

The National Environmental Act (NEA) stipulates that certain industries and commercial institutions should run treatment plants to treat the wastewater emanating from their activities in order to obtain the Environmental Protection License (EPL). Accordingly, many such entities operate their own wastewater treatment plants (WWTPs) installed within the premises. In addition, all the export processing zones (EPZs) under the Board of Investment (BOI), Sri Lanka have centralized treatment plant installed to ensure that the wastewater generated within the industrial zones are treated before discharging into the environment (table 3).

Table 2: Details of existing BOI wastewater systems

Source: NWSDB

Export processing zone	District	Capacity (m3/day)
Biyagama	Gampaha	21,000
Seethawaka	Colombo	9,900
Katunayake	Gampaha	3,000
Mirigama	Gampaha	400
Wathupitiwala	Gampaha	900
Polgahawela	Kurunegala	450
Koggala	Galle	675
Kandy	Kandy	1,000
Mawathagama	Kurunegala	500
Horana	Kalutara	1,000
Malwatta	Gampaha	450

On the contrary, only few wastewater management systems have been implemented in the country at the city level to treat the municipal wastewater (Table 4). These systems comprise of a sewer network covering a percentage of population residing in the city followed by either a treatment plant in some cases or sea outfall as the disposal point (in the case of Colombo, Dehiwama/Mt. Lavinia and Kolonnawa). Also, at the domestic level, a few numbers of housing schemes located in Colombo, Gampaha and Kandy districts have decentralized Sewage Treatment Plants (STPs) installed to treat the domestic WW generated within their schemes (Eg: Soysapura, Raddolugama, Hantana). A considerable progress in implementing STPs has been noted in recent past years under the funding from international agencies such as ADB, JICA and World Bank. The national target for offsite sanitation in line with SDG 6.2, safely managed sanitation, is to provide 25% of the local bodies with STPs by 2025 (SACOSAN 2018).

Table 3: Details of existing city/town sewerage systems/ STPs

Source: NWSDB

	Population	TP capacity	Coverage
Sewerage Systems			
Colombo	750,000	N/A (Sea-outfall)	80%
Dehiwala-Mt Lavinia	113,100	N/A (Sea-outfall)	10%
Kolonnawa	62,300	N/A (Sea-outfall)	10%
Sewerage systems+ Sewage Treatment Plants			
Kataragama	20,900	4,500	22.5%
Hikkaduwa	12,000+ hotels	3,000	10%
Rathmalana/ Moratuwa	Industries+ 20,000	17,000	3%
Jaela/Ekala	Industries+ 8,300	7,500	1%
Kurunegala	70,000	4,500	

Apart from the large scale municipal STPs, certain LAs operate small or medium scale fecal sludge treatment plants (FSTPs) to treat the fecal sludge collected through septic trucks.

Table 4: Fecal sludge Treatment Plants in Sri Lanka

Location	Capacity (m3/day)
Kurunegala	24
Nuwaraeliya	44
Balangoda	10
Rathnapura	40
Ampara	15
Tangalle	10
Batticaloa	40
Matale	21
Killinochchi	25
Mannar	28
Nawalapitiya	Unknown
Vavuniya	28
Puttalam	25
Chilaw	30
Kuliyapitiya	Unknown
Mawathagama	Unknown
Kegalle	20
Negombo	125
Trincomalee	15

Source: (IWMI FSM Assessment, WB, 2019)

The Sri Lankan government has declared water and sanitation to be an "inalienable right" and has set the goal of constructing infrastructure which would offer the entire country access to safe drinking water and sanitation facilities by 2025 (SACOSAN 2018). However, sanitation overall, particularly septage management, has been a low government and public priority, and sector investments continue to lag significantly behind water supply. On the other hand, the multiplicity and overlapping nature of existing regulations on wastewater confuses the roles and dilutes responsibility in developing new septage management policies and programs. Strengthening septage management by developing the enabling policies and physical infrastructure for septage collection and treatment is necessary in view of the sustainable sanitation.

The National Sanitation Policy introduced by the Ministry of City Planning & Water Supply in 2017 aims at achieving national sanitation targets by providing

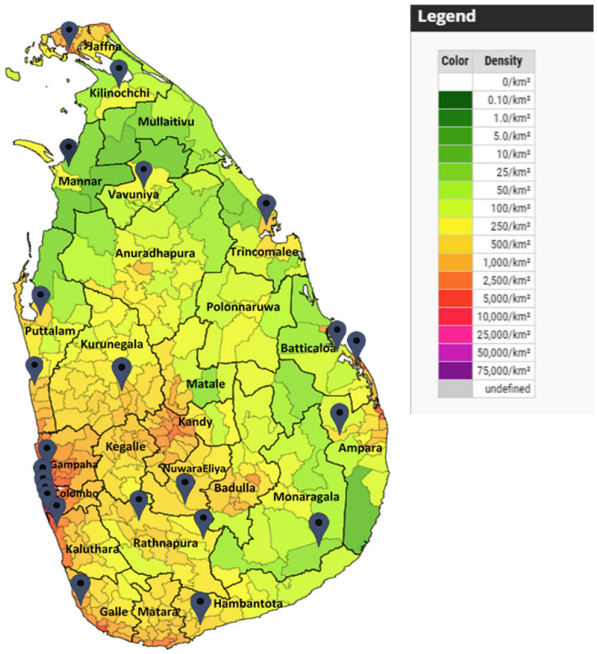

Figure 4: Location of wastewater and septage treatment plants in Sri Lanka

Source: (IWMI FSM Assessment, WB, 2019)

necessary facilities, educating public on good hygiene practices and ensuring environmental sustainability through proper household sanitation, and industrial wastewater and septage management.

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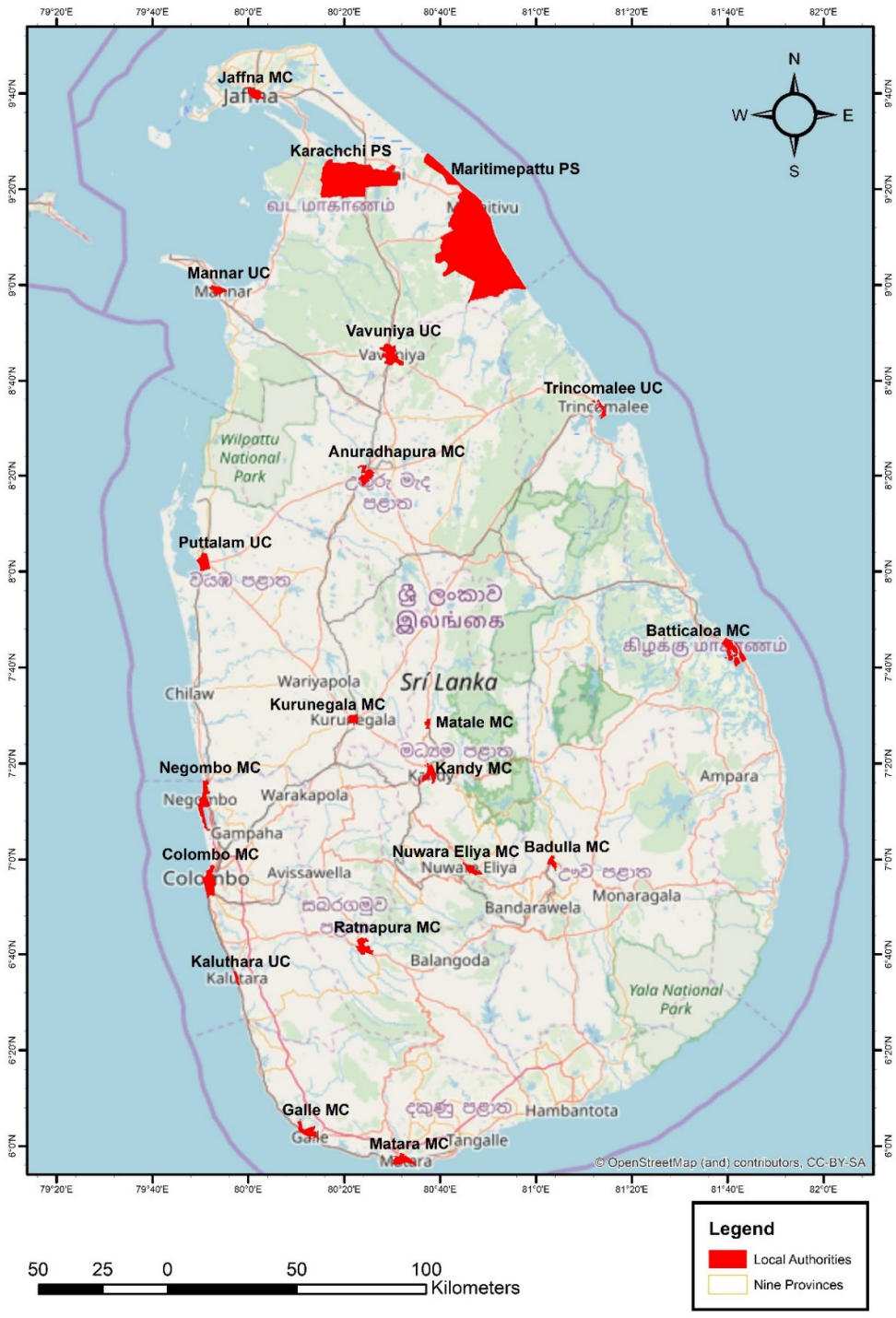
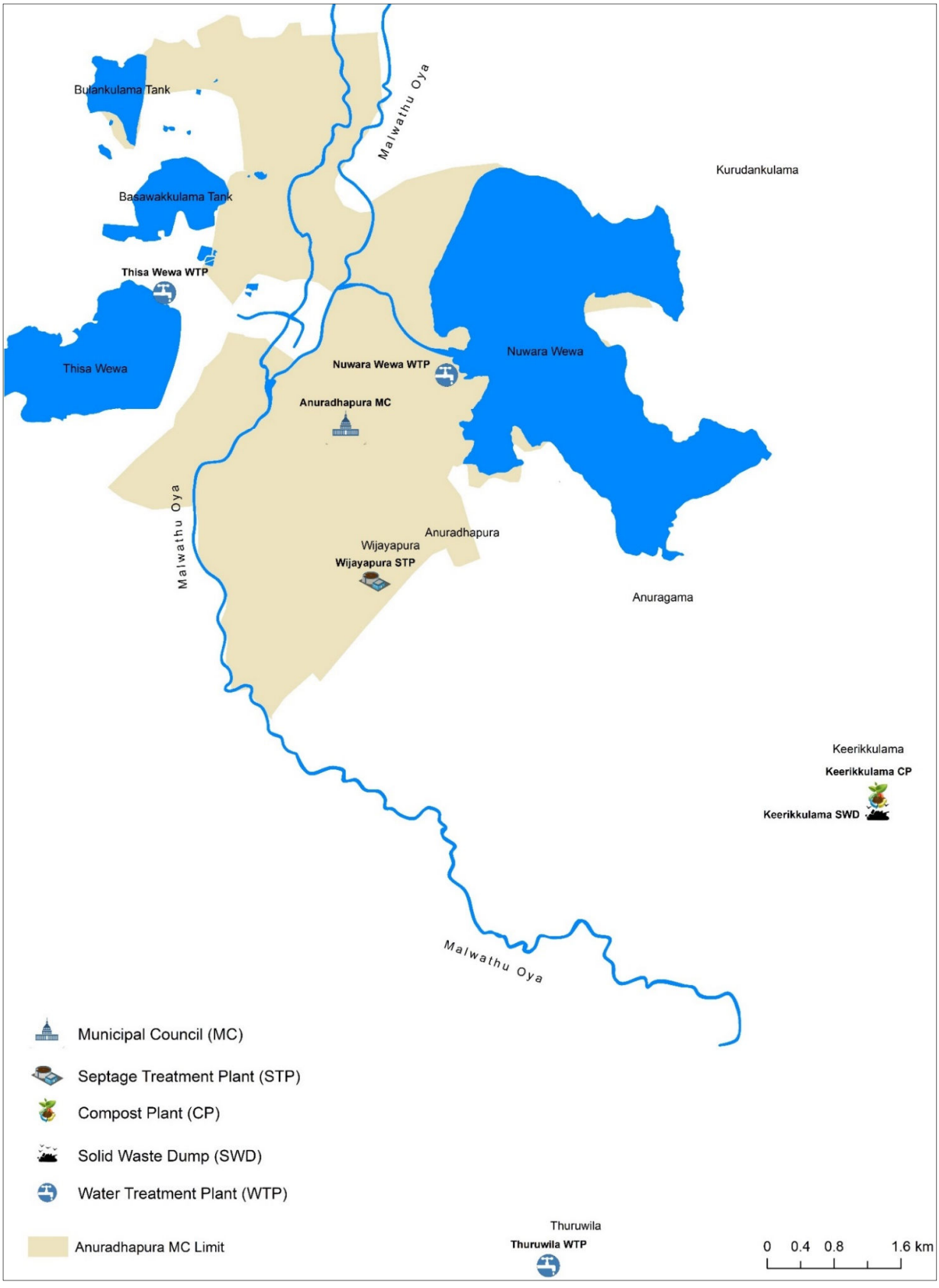
CITY PROFILES



Source: Open Street map

1. Anuradhapura



Anuradhapura City Profile

BACKGROUND

Anuradhapura, situated 205 km north of the Colombo along Puttalam and Trincomalee highway (A12) is one of the major towns in Sri Lanka and is the capital of North Central Province. The first civilization in Sri Lanka is believed to have originated from this city, hence Anuradhapura is considered the most ancient capital of the country. Anuradhapura area consists of thousands of ancient manmade tanks for irrigational purposes and many of them are still in operation. Cascade tank system is an example of ancient water reuse for which it is well known globally. For centuries, it has been the center of Theravada Buddhism. Since part of the city consists of ancient Buddhist temples, it is officially called the 'Sacred City of Anuradhapura'. As a result of the well-preserved ruins of the ancient Sri Lankan civilization, the city has been nominated as a UNESCO World Heritage site since 1982. Anuradhapura is a tourist and religious destination. During festival times, the city experiences a substantial floating population.

WATER

NWSDB extracts water from three reservoirs namely Nuwara Wewa, Tissa Wewa and Thuruwila for the supply of water to the city. In addition to that, residents use both shallow and deep groundwater as their water source by means of dug wells and tube wells fitted with hand pumps.

Located in the dry zone, the area faces acute water scarcity during most of the time in a year, particularly for agricultural uses. Government strived to improve the situation of farming communities in the dry zone by renovating the ancient network of man-made irrigation reservoirs. Groundwater through 'Agro-wells' is a main water sources for irrigation by small farmers, particularly during drought periods.

THE CITY	
Province	North Central
District	Anuradhapura
Local Authority	Anuradhapura Municipal Council
Municipal Area	36.32 km^2
Population	96 399 (2017) (source: UDA)
No of Households	28 000
Rate of Population Growth	1.2%
Climatic Zone	Dry Zone
Annual Rainfall	1500 mm (Rainy season: April to August and October to January)
Average Temperature	27 - 35 °C
Elevation	15.5 m above MSL
Major Industries	Paddy cultivation, Tourism
WATER	
Potable Water Sources	Tissa Wewa reservoirs, Nuwara Wewa reservoir, Thuruwila reservoir
Pipe Borne Water Coverage	90% (2003)
SOLID WASTE	
Waste Generation	72MT/Day (Estimated)
Waste Collection	31 MT/Day
Collection Coverage	43%
SW Treatment/ Disposal Method	Composting +Plastic Recycling centers
Total Cost for Waste Management	9 600 000 LKR (2013)
Available Area for Disposal	15 Acres (Keerikkulama)
Duration in Operation	8 years
WASTEWATER & SEPTAGE	
Sewerage Cover	0%
Septage Collection	24 m^3/day
Treatment & Disposal	Treatment Plant

SOLID WASTE MANAGEMENT

Generation and Collection

Typically, MC collects about 31 MT of solid waste in a day (UDA, 2018). It has been reported that 54% of the collected waste is short-term biodegradable waste. In principal, MSW collection service is provided by the MC at city center (covering commercial entities) daily and in residential areas with varying frequency, but at least twice a week. During festival seasons, thousands of people visit or reside in the city creating an enormous pressure on public services and MC to increase the waste collection turns of those areas as and when necessary. Consequently, MSW collection during peak season increases by 50%. Some peri-urban areas however are not provided with the waste collection service. Nevertheless, most of the residents in these areas have own sizable land plots enabling them to manage the waste within their own premises.

Table 5: Facilities available for the SWM of the Area (Anuradhapura MC)

Vehicle/ Machinery	Compactor (1), Tipper truck (1), Tractors (12), Hand tractors (2)
Workforce and level of skills (labourers, technicians, supervisors etc.)	Drivers (12), Labourers (87), casual labourers (53)

MC has imposed a tax system on commercial and industrial units in the MC area for solid waste collection About 70 institutions in the city have been registered under this system. Consequently, it is expected that the revenue from waste collection to be increased from 1.4 million LKR (in the year of 2013) to 5 million LKR per year.

Anuradhapura MC maintains a compost plant through which about 26% of the waste (8 MT/day) is treated. The waste collected is in mixed nature, therefore only 2% (0.7 MT/day) is recovered as recyclables and the balance 72% (22 MT/day) is openly dumped. The dumping site is located adjacent to the compost plant located at Keerikkulama in Nuwaragampalatha. Suitability of this disposal site is questionable as it is located within the catchment area of Nuwara-wewa reservoir and also the site is not an engineered landfill. Previously, the dump site has been used for the disposal of septage as well.

With the aim of minimizing the amount of indiscriminate dumping of waste, the MC is aiming at improving composting and recycling practices within the city. In view of that, MC is planning to improve infrastructure of the compost plant, adopt compost marketing strategies and promote home composting. MC has identified the potential in increasing recycling of the inorganic fraction from the waste and planning to increase recycling capacities of the existing facility in near future.

Figure 4: Keerikkulama Open Dumpsite (Anuradhapura)

Figure 5: Composting Facility at Keerikkulama (Anuradhapura)

Figure 6: Manual waste segregation by conveyor belts (Anuradhapura

Photo credit: IWMI

Compost Plant

Anuradhapura compost plant was established in 2010 under the Pilisaru project. The plant is located in Keerikkulama, 12 km away from the city. The capital investment on the compost plant was around 75 million LKR. Currently, the plant receives about 24 MT/day of mixed waste and processes only 8 MT/day of biodegradable waste. The reason for compost plant processing less amount of waste than it is designed for may be because of having to handle more mixed waste at the starting stage than it is designed for. It appeared that the composting process had been disturbed due to poor operations and lack of monitoring. Although, the Hospital has an incinerator for hazardous waste disposal, syringes and other sharp items continue to be sent along with other types of non-hazardous waste. Thus, there is a need to improve the source segregation to avoid such hazards at the compost plant, where manual sorting takes place.

Design Capacity	12 MT/day
SW quantity processed at the plant at present	8 MT/day
Vehicle/ Machinery	Tractor (01), skid steer loader (02), screening machine (02), sewing machine (01), weight scale (01), convey belts (03)
Workforce	Supervisors (03), workers (18), security (02)
Operating cost	649,000LKR/Month (2013)
Compost production	100 MT/Month (2013)
Average sales of compost	77 MT/Month (2013)
Selling price of compost	08 LKR/Kg

WASTEWATER AND SEPTAGE

The city is partly covered with a stormwater-drainage network (city centre and surrounding areas) which also receives most of the domestic greywaters generated from households and institutions. This drainage system and canals are ultimately directed to Malwathu Oya, hence there is a threat of occurring water pollution in the river (Madushanka et al., 2015).

Access to sanitation facilities within the MC area have been improved over time with the aid from government and non-government organizations such as ADB. However, there is no sewerage network in the municipality; hence, the institutes and households entirely depend on onsite sanitation systems (Jayakody et al., 2006).

Table 6: Types of Latrines used in Anuradhapura MC

Water sealed latrines	96%
Pit latrines	4%

Desludging of septic tanks are carried out by MC. Every week, MC receives about 40 requests for desludging from different entities including households. Domestic desludging rates vary from 3000 LKR to 3500 LKR whereas for commercial institutes the fees charged range from 3 000 LKR to 4 000 LKR. If the service receiver is out of the LA boundary, an additional 300 LKR and 800 LKR will be charged for domestic and commercial institutes respectively. Average monthly revenue of MC from septage collection services varies around 200 000 LKR/month depending on the season (rainy/dry).

Table 7: Resources for Septage management in Anuradhapura MC

Vehicle fleet	Gully bowser (2) (4000 L)
Workers	Driver (2), Laborers (2)

Treatment and disposal of collected septage is a major challenge to the MC. To address this issue, a small-scale treatment plant has been installed behind the central bus station in 2008. Nevertheless, the plant only treats the septage desludged from public latrines in the area (Marasinghe, 2014). In 2017, another treatment facility was installed at Wijayapura area to provide disposal and proper treatment of collected septage. At present septage from the city is transported to this plant for treatment.

LOOKING AHEAD

The city does not have a sewer network and MC is looking forward to developing a sewer network at least covering the areas that are anticipated to be highly populated. In addition to that, implementation of a properly designed storm drained system has been identified as a priority area under their proposed city development plan.

Having identified that the municipal dumpsite is a reason for several serious environmental issues of the area, MC is planning to establish a proper landfill to dispose waste.

Studies show that water scarcity would be a major problem in near future in Anuradhapura and suggest taking necessary measures immediately. Kidney diseases is one of the severe problems in the area and co-relation of it to the drinking water problems have led experts believe that the availability of good quality drinking water may contribute to the prevention of this issue

Kidney cases in Anuradhapura

Chronic Kidney Disease of Unknown Etiology (CKDu) continues to puzzle medical researchers, experts and doctors while spreading among the communities. CKDu is highly concentrated in North Central province. Besides, CKDu cases have been reported from Polonnaruwa, Ampara, Trincomalee, Kurunegala, Vavunia, Uva province and Northern Province. Among those, Anuradhapura is the worst affected. There were around 145 deaths and 18 281 CKDu patients have been reported for last 15 years from Anuradhapura district which records as the worst affected. According to the reports, there are around 15,000 persons register with the nephrology unit of the Anuradhapura Teaching Hospital and the numbers are growing.

There are number of suspected reasons have been declared by the researchers and still the researches are being conducted for solving the puzzles. The experts' suggestion is not to use water that used for irrigation purposes as drinking water and avoid other suspected causatives (Gunatilake et al, 2015).

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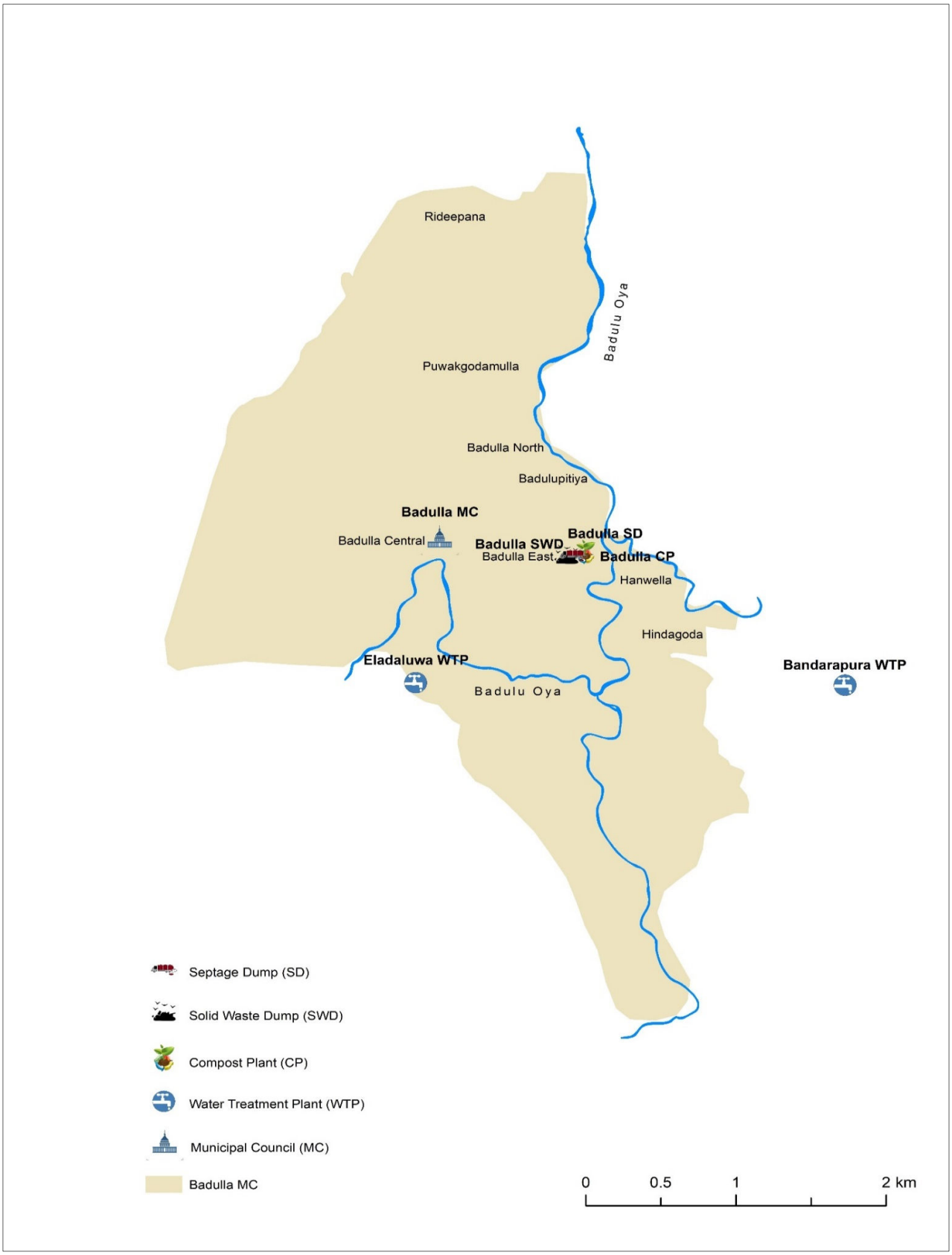
2. Badulla


Rideepana
Badulu Oya
Puwakgodamulla
Badulla North
Badulupitiya
Badulla MC
Badulla Central
Badulla SWD
Badulla East
Badulla SD
Badulla CP
Hanwella
Hindagoda
Eladaluwa WTP
Badulu Oya
Bandarapura WTP
Septage Dump (SD)
Solid Waste Dump (SWD)
Compost Plant (CP)
Water Treatment Plant (WTP)
Municipal Council (MC)
Badulla MC
0
0.5
1
2 km

Badulla City Profile

BACKGROUND

Badulla district is the capital of Uva province. Badulla Municipal Council, the main city of the district, is located in the southeast of central mountain region in Uva Province. The city is almost encircled by the 'Badulu Oya' River, which enriches Mahaweli River. Badulla used to be an agricultural district where tea, vegetable and paddy were cultivated. The city became one of the provincial administrative hubs of the British rulers when Sri Lanka was a crown colony and the city was the end point of upcountry railway line built by the British in order to transport mainly tea plantation products to Colombo. Daily about 100,000 of floating population comes to the city (UDA, 2018)

WATER

Badulu Oya river; one of the major tributaries of the Mahaweli River; is essentially the main water source of the Badulla city. There are several intakes constructed for water supply at possible streams of Badulu Oya river and three of those intakes situated at Westmoiand, Mederiya and Kumarasingha Mawatha supply water to the city via two pumping stations.Residents in areas where pipe water supply is not available depend on surrounding natural streams and springs for their water uses.
Badulla city is a hilly area, hence groundwater stratum of the area is very thin and there is less potential for groundwater abstraction. The groundwater level in the hilly slopes are not deep and also during dry season dug wells are getting almost dry. However, flat terrain close to Badulu Oya river, has more potential for both deep and shallow groundwater extraction (JICA, 2012).

THE CITY	
Province	Uva
District	Badulla
Local Authority	Badulla Municipal Council
Municipal Area	10.5 km^2
Population	48 641 (2016) (UDA, 2018)
No of Households	9105
Rate of Population Growth	1.07%
Climatic Zone	Wet zone
Annual Rainfall	1868 mm (Rainy season: May to August and October to January)
Average Temperature	25.2 ºC
Elevation	680 m above MSL
Major Industries	Tourism, Tea
WATER	
Potable Water Sources	Badulu Oya River
Pipe Borne Water Coverage	96%
SOLID WASTE	
Waste Generation	36 MT/Day (Estimated)
Waste Collection	13-15 MT/Day
Collection Coverage	41%
SW Treatment/ Disposal Method	Composting +Plastic Recycling+ open dumping
Available Area for Disposal	5 Acres (Badulupitiya)
Duration in Operation	40-45 years
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	40 m3/ day
Treatment & Disposal	Excavated pit at the SW dump

SOLID WASTE MANAGEMENT

Generation and Collection

Waste collection in the city is scheduled according to a plan developed by the MC under which the city has been divided into four zones. The highest waste generation within area is from the City Center, which is about 30% of the total. Waste collectors of the MC only accept the waste that is segregated into biodegradable and non-biodegradable. Present schedule is such that the biodegradable waste is collected for 5 days in a week whereas the non-biodegradable waste is collected only on 3 days in the city center. Within the peak seasons; mainly April (Sinhala and Hindu New Year season) and May (Deepavali season); the waste collection increases ranging from 20-25 MT/Day. In those seasons, the waste collection frequency of the city limit is increased. Except the MC, no other institutions are engaged in waste collection activities. However, there are some informal private collectors who are engaged in collecting recyclable waste such as paper, cloths, glass, metals and coconut shells etc. within the area.
The MC conducts a collection program twice a year with the collaboration of CEA for collecting the toxic waste such as e-waste, during which the public can hand over the e-waste to the MC. Nevertheless, the places that usually generate more e-waste such as electric equipment repairing shops etc. have dealers purchasing the e-waste on regular basis. In 2016, MC implemented numerous waste reduction strategies and subsequently, they were able to withdraw waste collection service from some of the municipal areas. This resulted in a remarkable reduction of the amount of waste collected, which was 3 MT/Day within one year.

Treatment and Disposal

Badulla MC maintains a compost plant through which about 30% of the waste (4.5MT/day) is treated. However, balance 70% of SW is being disposed at a land adjacent to compost plant located at Riverside road, Badulupitiya. There were no human settlements around at the time MC started to use this dumpsite to dispose waste. However, the place now has become populous. Essentially the dumpsite is now situated in an urbanized area where there are several government offices, a botanical garden and a sport complex located in the surrounding. It creates several environmental as well as socioeconomic issues including odor and aesthetic matters resulted by improper disposal of SW which has

become a huge issue in the area. On the other hand, there is a high possibility of contaminating the 'Badulu Oya' river (the main water body of the area) as the leachate coming out from the dumpsite flows through drains and collects to a channel which directly flows into the river (Dulmini, 2017). MC also buys recyclable waste such as paper, PET bottles, glass etc. from the households and brings to the recycling center.

Figure 6: Badulla Municipal Dumpsite

Compost plant

The MC has implemented an ambitious composting program to convert SW into compost. The composting program under JICA & "Pilisaru" National Solid Waste Management Project was initiated in 2010 in the land adjoining the SW disposal site. However, composting is not functioning well at present due to the inefficiencies in the process. The compost produced claimed to be of the poor quality. According the operators, sand & mud get into the compost piles during the process as the floor of the compost facility is not concreted resulting in high sand content in the final product. Thus, currently, most of the produced compost is merely used for Municipal Council's uses such as gardening in the town area.

Design Capacity	25-30 MT/day
SW quantity processed at the plant at present	4.5MT/day
Vehicle/ Machinery	BOB CAT (1), Lorry (1), Tipper (1), Sieving machine (1)
Workforce and level of skills	Supervisors (4), Laborers at the compost plant (26)
Operating cost	283,500 LKR/month
Compost production	25 MT/Month
Average Sales of compost	1MT/Month
Selling price of compost	6 LKR/Kg

Figure 7: Composting Facility of Badulla MC
Photo credit: IWMI

WASTEWATER AND SEPTAGE

With no sewerage scheme in place, onsite sanitation systems serve the sanitation needs in the area. 70% of the households in Badulla Township are having septic tanks. MC carries out de-slugging of these septic tanks based on requests made by the house owners or respective institutions. A payment has to be made to the MC for the de-sludging service, which is for domestic an amount of 2500 LKR whereas for a public or commercial entity 5000 LKR.

Table 8: Types of OSS systems used in Badulla MC

Septic Tanks	70%
Cesspits	20%
Pit Latrines	10%

MC collects about 10 septic trucks of septage on daily basis. However, the demand for desludging is much higher than the service MC is able to cater (about 20 requests). Major reason for limiting the desludging service is the unavailability of a proper septage disposal place. The collected septage is currently disposed in excavated pits located at the same SW disposal premises close to the Vincent Dias sport complex and the Municipal Compost Plant.

Table 9: Resources available for Septage Collection in Badulla MC

Fleet	Gully Bowser – 01 (4000 L)
Workers	Driver 01, Laborer – 01

On the other hand, about 30% of the households who are having pit latrines and cesspits, often have no proper means to dispose the overflows from their sanitation systems, thus direct the overflows along with the greywater into public drains especially during the rainy season. Street drains and drainage channels which conveys domestic and institutional wastewater along with wastewaters from hotels and slaughter houses discharges into Badulu Oya River that significantly affects the ecological health (JICA, 2012; Gunawardhana et al., 2018).

At the institutional level, Badulla hospital operates a WWTP that treats the WW emanating from the hospital. However, the plant is currently overloaded due to inadequate capacity of the plant.

LOOKING AHEAD

Solid waste management and wastewater management have been identified as two main priorities under the city development plan. MC urgently need to find a suitable location for the SW disposal. MC is also currently focusing on three options to establish proper waste Management,

- Switching the current disposal site to an alternative land at the fifth milepost on the Badulla-Mahiyangana Road, which belongs to the Wildlife Department.
- Upgrading the facilities available for SWM
- Reducing the waste collection with the initiation of a program to promote home composting by distributing 500 numbers of compost bins with the support of National Solid Waste Management Support Center (NSWMSC).
- Looking for the possibility of managing degradable waste with the collaboration of Badulla Pradeshiya Sabha.

Wastewater management has also become a significant burden to the city. It has been identified that combined sewer and greywater collection system with treatment facility is required at several wards of the municipality to prevent further deterioration of Badulu Oya water quality (JICA, 2012). In addition to that, surface water & groundwater pollution from the cesspits and pit latrine is also common in several areas in Badulla MC boundary such as Badulupitiya and Helagama that are densely populated.

The city has been identified as a potential city under a new urban sanitation project funded by World Bank in implementing proper sanitation solutions to the city area. Proposed project intends to address the prevailing improper wastewater disposal practices in the city.

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3. Batticaloa

Batticaloa City Profile

BACKGROUND

Batticaloa is a major commercial city in the Eastern Province, Sri Lanka. The city is built on a peninsula that consists of 12 km coastal strip and three islands that are formed by the lagoon that extends from Eravur to Kalmunai. Different parts of the city are connected through bridges at various locations of the lagoon. The city is generally flat with the exception of Puliyantivu area which is slightly elevated than the rest of the area. Batticaloa is well connected with the four highways connecting the city to Trincomalee, Arugam Bay Habarana and Badulla. Majority of the people residing in the area are Tamils. Agriculture is the primary economic base in the Batticaloa MC area including paddy, highland crop cultivations, vegetable cultivations, livestock production etc. And the second most predominant livelihood is fishing.

WATER

Majority of the households (about 76% of the population) in the municipal area use private dug wells for their day-to-day water need. Ground water is easily accessible within the municipality; hence, well water is available throughout the year.

Only 18% of the households consume pipe born water in the city. Unnichai reservoir is the present water source of the pipe water supply of the Batticaloa Township. However, during the dry period, certain parts of the city receive limited water supply. The authorities are now seeking for new water supply sources to cater the increasing demand of the municipality.

THE CITY	
Province	Eastern
District	Batticaloa
Local Authority	Batticaloa Municipal Council
Municipal Area	75.09 km^2
Number of Wards	19
Population	92 332 (2011)
No of Households	19,500
Rate of Population Growth	1.4 % per annum
Climatic Zone	Dry Zone
Annual Rainfall	568 - 2795 mm (Rainy season: April to August and October to January)
Average Temperature	24°C (high), 34°C (low)
Elevation	1.2- 4.0m above MSL
Major Industries	Paddy cultivation, Livestock production, fishing
WATER	
Potable Water Sources	Unichchi reservoir
Pipe Borne Water Coverage	18%
SOLID WASTE	
Waste Generation	69 tons/day (Estimated)
Waste Collection	52.5 tons/day
Collection Coverage	75.8%
SW Treatment/ Disposal Method	Composting, recycling and open dumping
Annual budget for Waste collection	LKR 30.0 million
Available Area for Disposal	10.35 Acres
Duration in Operation (open dump)	Since 1994
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	24 m^3/day
Treatment & Disposal	Batticaloa MC Septage Treatment Plant (2 X 3 facultative ponds). Plant is currently not in operation

SOLID WASTE MANAGEMENT

Generation and Collection

Municipal Council collects waste in its respective localities at least 6 days per week. However, waste collection coverage is limited to urbanized areas, city centers, and commercial areas. Daily waste collection of the MC is about 52.5MT (Otoo et al, 2016) . Due to the limited industrialized nature of the area, households are the major waste generators. Other major waste sources are markets, hotels, restaurants, institutions (e.g. hospitals, universities) and commercial entities. Although the Council has encouraged source segregation, it has not been well established so far. Currently on 23% of waste collected as segregated which amounts to about 12 MT/day.

Treatment and Disposal

Batticaloa MC was supported by North East Coastal Community Development Project (NECCDEP) for solid waste management which included the construction of dumpsite, compost plant & equipment and machinery required for recycling. Both dump site and the composting facility are located in Thiruperunthurai area. A fraction from the total waste collection i.e. the waste that are only segregated (about 12 MT) is transferred to composting station whereas the majority is being open dumped on the bare land adjacent to the composting facility. Although food waste has, a high potential for composting, larger proportion of it is being open dumped at present. Ground water pollution has been identified as one of the major issues associated with open dumping. MC faces many challenges in solid waste management including but not limited to lack of waste collection equipment, shortage of sanitary workers, outdated equipment and vehicles, lack treatment facilities, lengthy transportation for waste treatment and landfilling, insufficient land for treatment and disposal and lack of professionalism in management (Mahinthpayson, 2018).

Figure 8: Solid Waste Dump Site - Batticaloa MC (photo credit: IWMI)

Compost Plant

The compost plant has been designed to receive 12MT of MSW, and to process organic waste out of that as compost. However, the proportion of MSW composted is substantially low compared to the theoretically compostable amounts (i.e. total organic content) which is about 50% of the waste received at the plant. The plant receives bulky green waste and banana leaves/logs in large quantities. As these input waste takes long time decompose (long-term biodegradable waste), the compost plant cannot process/ use the waste on a daily basis. As a strategy to address this issue, shredding is practiced at the plant, which makes it more susceptible to bacterial activities or biodegradation.

Design Capacity	12 MT/day (mixed waste)
SW quantity processed at the plant	2.6 MT/day (2016)
Vehicle/ Machinery	Tractor (01), skid steer loader (01), screening machine (02), shredding machine (01), sewing machine (01), sealing machine (01), weight scale (01)
Workforce and level of skills	Supervisors (1), Laborers at the compost plant (9), security (2)
Operating cost	Rs. 171,824 LKR/month (2016)
Compost production	15 MT/Month
Average Sales of compost	4MT/Month
Selling price of compost	Rs. 8/kg – wholesale price; Rs. 12/kg – retail price

Figure 9: Composting Facility of Batticaloa MC (photo credit: IWMI)

WASTEWATER AND SEPTAGE

The City is not covered with a sewer network. At present, whole town depends on septic tanks and cesspits for the disposal of septage. In some places, the discharges of overflow of cesspits are connected to the nearby drains that directs to lagoon, thereby polluting the environment and posing health hazards. On the other hand, there is also a risk of groundwater contamination mainly due to wastewater & septic tanks soakage.

Table 10: Onsite sanitation systems in Batticaloa MC

Pit latrines	60%
Septic tanks	38%
No facilities	2%

Septage desluding service is provided by the MC on request. The MC owns two gully bowsers having a capacity of 4,000 liter each to cater the collection demand. Subsequently about six trucks of septage is collected on daily basis within the Batticaloa city. Households pay LKR 3000 for desludging service whereas for commercial institutions the charge is about LKR 5000. The collected gully is disposed at septage treatment plant located close to the solid waste dump site at Thiruperunthurai. Gully trucks from Army base also dispose their collected septage at the plant. The treatment plant comprises of series of ponds. However, currently the plant is not operating in a manner to treat the septage but serves as the dumping point. Dry weather that prevails in Batticaloa mostly throughout the year accelerates the drying process of sludge that remains in the ponds. Dried sludge from these ponds are sold to farmers.

The hospital also has a wastewater treatment plant. The plant collects and treats black water from the hospital, prison, nursing training school and quarters. Treatment process comprises of screening, aerator, clarifier and anaerobic digester. The clarified wastewater is chlorinated and sent to a grass wetland and is then released to the lagoon by gravity.

Figure 11: Fecal sludge unloading point (Batticaloa MC)

Photo credit: IWMI

Figure 10: Batticaloa MC Septage treatment plant

Photo credit: IWMI

LOOKING AHEAD

With the recent rapid development that has taken place, the city is becoming highly urbanized. However, Municipal services such as waste management needs to be improved largely in line with the other development projects to sustain the city development.

One of the critical environmental issue is not having a proper mechanism to treat wastewater, which is ultimately released into the lagoon. Improper wastewater disposal practices also lead to spreading of dengue and other health hazards and potentially cause groundwater pollution. Operationalizing the already existing septage treatment plant is much needed to avoid environmental and health hazards created by current disposal practice.

The city is comparatively clean compared to other cities in the eastern province. However, the city needs to bring solutions to improve waste management practices such as promoting source segregation, improving composting facility and increasing the recycling percentage.

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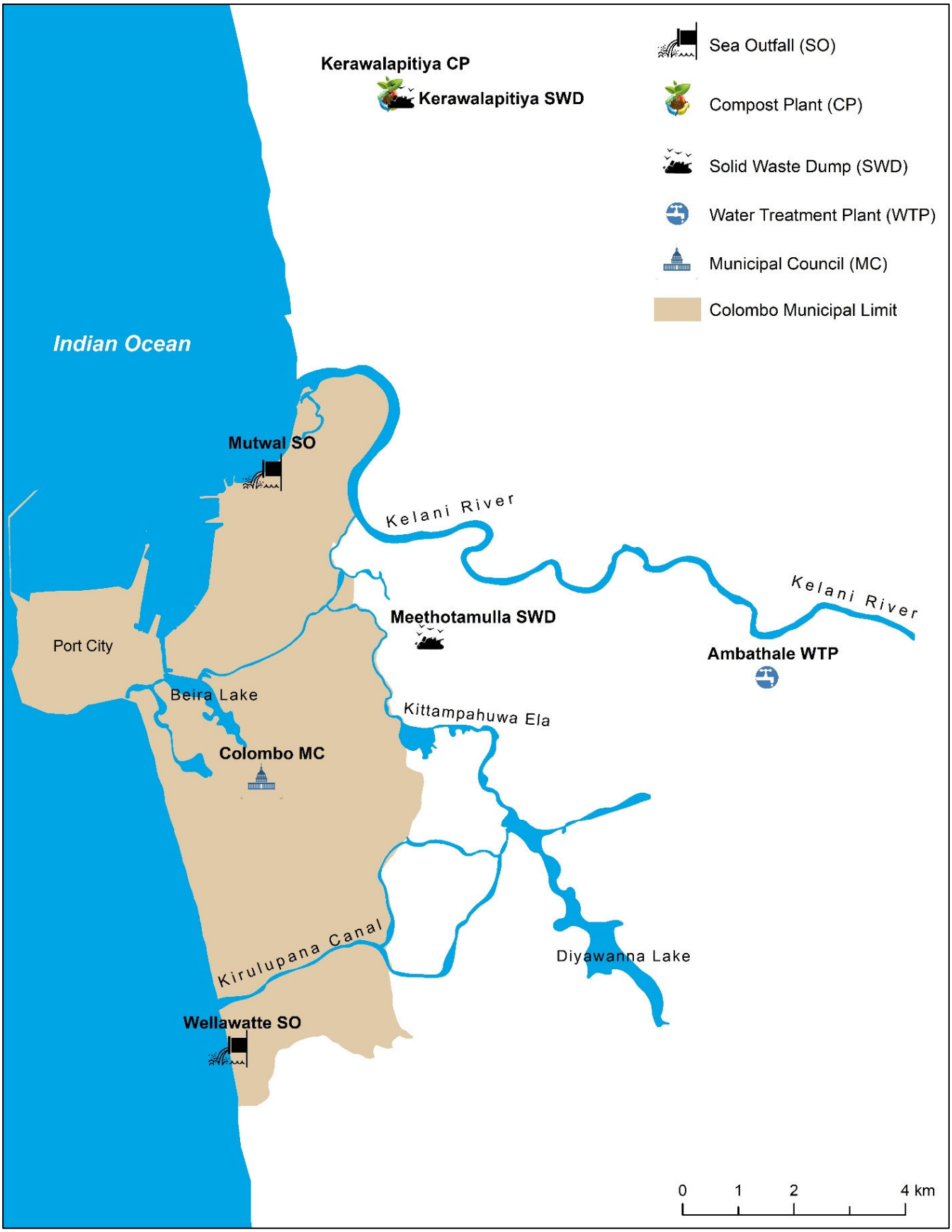
4. Colombo


Kerawalapitiya CP
Kerawalapitiya SWD
Sea Outfall (SO)
Compost Plant (CP)
Solid Waste Dump (SWD)
Water Treatment Plant (WTP)
Municipal Council (MC)
Colombo Municipal Limit
Indian Ocean
Mutwal SO
Kelani River
Kelani River
Meethotamulla SWD
Ambathale WTP
Port City
Beira Lake
Kittampahuwa Ela
Colombo MC
Diyawanna Lake
Kirulupana Canal
Wellawatte SO
0
1
2
4 km

Colombo City Profile

BACKGROUND

Colombo is the commercial capital of Sri Lanka. It is located on the west coast of the island and adjacent to Sri Jayawardenapura Kotte suburb or the parliament capital of Sri Lanka. The Northern and North-Eastern border of the city of Colombo is formed by the Kelani River, which meets the sea in a part of the city.

Over the past two decades population size and density within CMC area has shown a remarkable increase despite the declining population growth rates. Apart from that, the city is expanded by nearly 500,000 of daily floating population. Colombo's geography is a mix of land and water. The city has many canals and, in the heart of the city, the 65-hectare Beira Lake. The lake is one of the most distinctive landmarks of Colombo, and was used for centuries by colonists to defend the city.

WATER

Present drinking water sources of the Colombo city area are Ambathale intake (from Kelani River), Labugama (from Labugama impounding reservoir) and Kalatuwawe (from Kalatuwawe impounding reservoir). National Water Supply & Drainage Board (NWSDB) had considered the option of using groundwater to increase the supply of potable water to residents in the Greater Colombo area. However, due to the pollution of the ground water aquifers in the region, primarily caused by open dumping of solid waste, the NWSDB was not able to proceed with this option.

SOLID WASTE

Generation and Collection

The Colombo MC is entrusted to manage SW generated in the city. Essentially, the city has introduced a motto which is *"Keep Colombo Clean. It's our City*". For administration purposes and due to the complexity of the issue, the city limits of Colombo have been divided into six SWM zones namely District 1, 2A, 2B, 3, 4 and 5, as shown in the map [Figure 3]. Colombo MC has the highest amount of SW generated as compared to the other local authorities in the country. Since 1998, part of the garbage collection has been privatized in the MC territory and the companies that were given contracts for SW management are Abans Environmental Services (Pvt) Ltd (Under the new brand name "Clean Tech"), Carekleen (Pvt) Ltd and Burns Trading Company (Pvt) Ltd. Colombo MC carries out the collection and disposal of SW in District 2B, District 3 and District 4. However, the responsibilities of street sweeping and maintaining the storm water drains in entire area lies with Abans Environmental Services (Pvt) Ltd.

THE CITY	
Province	Western
District	Colombo
Local Authority	Colombo Municipal Council
Municipal Area	37.31 km^2
Population	561,314 (2012)
No of Households	122,314 (UN-Habital, 2018)
Rate of Population Growth	1.16%
Climatic Zone	Wet Zone
Annual Rainfall	2,000-2,500 mm (Rainy season: May to August and October to January)
Average Temperature	31.5 ºC (high), 22.3 ºC (low)
Elevation	30 m above MSL
WATER	
Potable Water Sources	Ambathale intake, Labugama and Kalatuwawe
Pipe Borne Water Coverage	90%
SOLID WASTE	
Waste Generation	800 MT/Day
Waste Collection	450 - 500 MT / day (Degradable) 150 - 200 MT / day (Non-degradable)
Collection Coverage	87.5%
SW Treatment/ Disposal Method	Open dumping + Composting
Available Area for Disposal	20 acres (Waste Management Park - Kerawalapitiya)
Duration in Operation	2.5 years
WASTEWATER & SEPTAGE	
Sewerage cover	58% (by population)
Septage Collection	147 000 L/day
Treatment & Disposal	Disposal method: Sea outfall

Figure 12: SW dump site at Meethotamulla (Before Collapse)

Figure 13: Meethotamulla Garbage Collapse (Daily news 17.04. 2017)

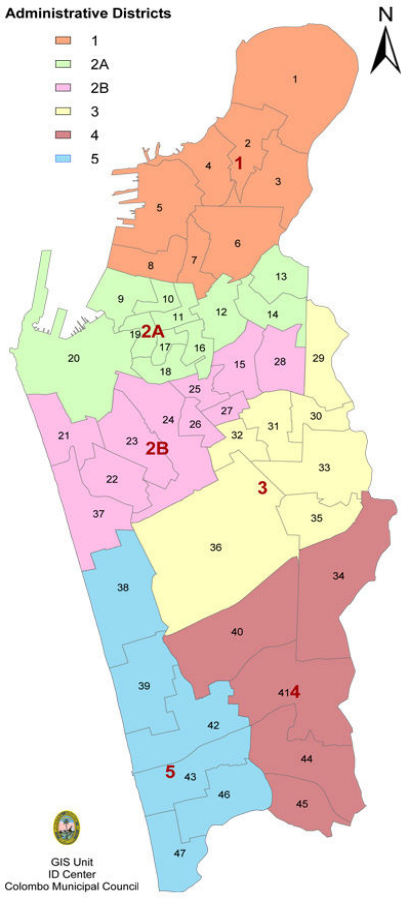


Figure 14: Administrative Districts in Colombo

Figure 15: Kerawalapitiya Compost Station (Photo credit IWMI)

Figure 16: Kerwalapitiya Dump Site (photo credit: IWMI)

The CMC has also increased the collection efficiency with the co-operation of Environmental Police & Army.

Generally, due to cyclical patterns of local climate, social activities and trade or commerce there is a variation of the waste composition during the year. Moreover, between 2004 and 2015, the biodegradable percentage of MSW has dropped considerably from 65 to 55 % while the percentages of plastics, paper and cardboard have been increased.

Table 11: Facilities available for the SWM of the Area – Colombo MC

Vehicle fleet	CMC - Compactors (63), Tippers (8), Loaders (3), Skip Hoist (7) , Tractors (9), Recycling Vehicles (5)
	Private Sector - Compactors (34), Tippers (15), Loaders (4), Tractors (12), Sweeping Machines (5), Recycling Vehicles (4)
Workforce and level of skills	CMC - Labors (401), Supervisors (32), Drivers (98)
	Private Sector - Labors (1249), Supervisors (91), Drivers (65)

Treatment and Disposal

Meethotamulla area in Kolonnawa (outside of the CMC governed area) was the backyard for Colombo SW disposal for many years. CMC was not the only institute that dumped garbage there, but also Kolonnawa Pradeshiya Sabha, Sri Lanka Army and Sri Lanka Navy used this dumpsite. Thus, in a total the dumpsite received about 800 metric tons of garbage per day. However due to improper disposal practices, this garbage dump was collapsed in April 2017. The disastrous failure of the dumpsite affected surrounding population significantly and LAs including CMC were under tremendous pressure to find an alternative final disposal facility.

As an immediate solution to this emergency situation, government decided to set up a waste management park in Kerawalapitiya (outside of the CMC governed area) in a land of about 20 acres area to counter the sudden rise of garbage. All the waste collected in the CMC now transported to this facility. Other than Colombo it also recieves waste from Wattala, Kelaniya and Kolonnawa areas. The facility is operated by Sri Lanka Land Development Corporation (SLLDC) under the Ministry of Urban Development, Water Supply and Housing Facilities. The Waste Park accepts only the segregated waste and degradable waste is processed to produce compost. Daily compost production at present is about 15 – 20 MT.

However, in long term, there is a necessity to find a permanent final disposal facility to manage the ever-increasing waste amounts in the CMC. Developing a Sanitary Landfill in Aruwakkalu is such a solution proposed to tackle this issue. Also, in the process of finding a strategy for the proper management of SW, CMC has started a waste to energy project with Aitken Spence (PVT) Ltd. The company was previously planned to set up a MSW Power Generation Project at Meethotamulla but after the collapse it is currently under construction at Muthurajawela. The power station will operate approximately 7500 hours a year, utilizing the 700 metric tons of fresh waste from the CMC area per day. The facility will generate 11.5 MW of power. It will be operated by Western Power Company Limited, a subsidiary of Aitken Spence.

Having identified the need for establishing sustainable SW management practices in the municipal area, CMC has launched several reuse and recycling programs.

Figure 17: Pumping station (Bambalapitiya)
Source: CMC

One of such initiatives is establishing two small scale biogas plants in the municipal limit. One is in the Welikada prison which produces the energy requirement to operate their hearths for cooking by processing 100Kg of biodegradable SW, however currently this plant is not operational due to poor maintenance. Other biogas plant is located in National Market, Narahenpita which transforms market waste into biogas but unfortunately this plant is also not functioning due to lack of supervision (Fernando, S.C., 2016). Moreover, CMC has implemented an awareness program named "Eco School Project" where SW segregation is practiced at school level by providing international colour code bins for separated solid waste.

WASTEWATER AND SEPTAGE

The Colombo MC is the only local Authority in Sri Lanka where sewerage system is practiced. The sewers were originally constructed between 1906 and 1913. Total length of the network is about 250 Km covering 80% of the CMC area excluding Kirulapana and Mattakkuliya area. The network consists of 18 pump stations which are operated by National Water Supply and Drainage Board and the CMC.

Final disposal of the sewer network is sea outfall. There are two sea outfalls which are located in Wellawatte and Modara, pumping sewage 2 km into the sea. The sea outlet at Wellawatte has a 1500 mm diameter pipe and is approximately 1400 m long. The second outlet in Mutwal, also has a diameter of 1500mm, was initially 2000 m long but after various incidents the pipe was badly damaged shortening to 1500 m. Sedimentation sands have accumulated up to 90 cm inside these pipes but wastewater can still flow through. However, Greater Colombo Wastewater Improvement Project funded by Asian Development Bank (ADB) loan is being implemented to rehabilitate two sea outfalls and pump houses, replacing of 10km sewer pipes and to investigate on the present conditions of 125km length of existing sewer pipes.

Areas which are not covered under the sewerage system, depend on the onsite sanitation systems (Ex: septic tanks or pit latrines) and septage collection from those systems is managed by both CMC and private sector service providers.

Collected septage is claimed to be disposed either at the pumping stations or the manholes in the network system which leads ultimately to the sea outfall. MC owns septic trucks having capacity about 4000 L and weekly receives about 40 requests for desludging from different entities including households.

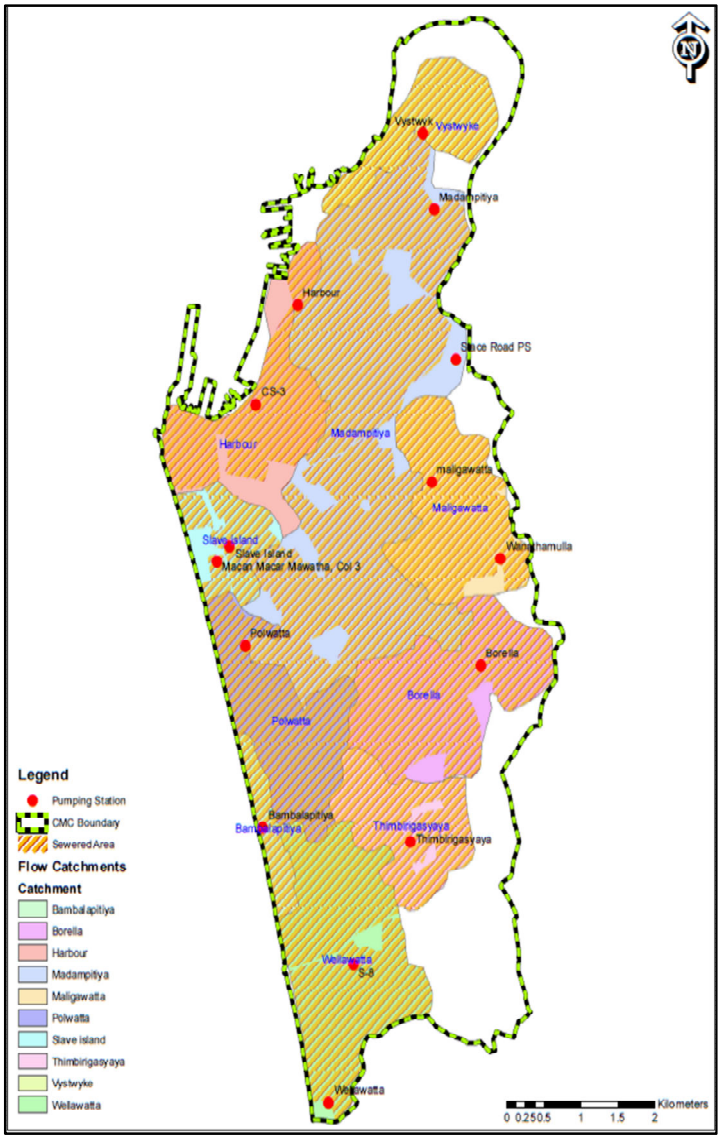


Figure 18: Sewered area of Colombo MC
Source: Greater Colombo Wastewater Management project

Table 12: Onsite Sanitation System - Colombo MC Area

Water seal connected to a pit	42%
Water seal connected to a piped sewer	58%

Table 13: Resources for Septage management in Colombo MC

Vehicle fleet	18 Gully bowsers
Workers	300

Despite the sewerage system is in place to manage sewage of the majority of the population, CMC is still lacking of the proper wastewater management system. It has been noted that the underserved settlement mostly in the Colombo North region who have settled near canals and marshlands discharge the wastewater directly into the waterways, thereby polluting the environment and posing health hazards. Also stagnated water sources in the area are highly threatened by nutrient pollution. Main wastewater receiving water bodies in Colombo area has been identified as Kelani River, Beira Lake and the Sea. Due to years of unauthorized discharge of wastewater, these water bodies are considered to be polluted. However, rehabilitation programs are currently being implemented by responsible authorities to restore these water bodies.

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5. Galle


Septage Treatment Plant (STP)
Septage Dump
Compost Plant (CP)
Solid Waste Dump (SWD)
Water Treatment Plant (WTP)
Municipal Council (MC)
Galle Municipal Limit
Hikkaduwa STP
Monroviawatta SWD
Monroviawatta CP
Wakwella WTP
Gin River
Gin River
Kepu Ela
Ginthota
Dadalle
Beekke Reservoir
Heenpendala SWD
Maha Modara Lake
Galle MC
Indian Ocean
0 1 2 4 km

Galle City Profile

BACKGROUND

Galle is the capital city in Southern Province of Sri Lanka, located about 116 km to the south of Colombo. Galle MC was established in 1867 by British. Tourism plays a major role in terms of economic aspects of the city. Galle fort is the largest remaining fortress in Asia built by European occupiers, thus, attracts thousands of visitors every year. The city has been declared as a World Heritage City by the UNESCO.

Agriculture (paddy), fishery, plantation (tea, Rubber), tourism, animal husbandry, and other medium scale industries such as cinnamon and black pepper are among the common livelihood of the people in the Galle.

WATER

Gin River is the main source of water supply to the municipal area. Water pumped from the Gin river intake is treated at Wackwella water treatment plant before distributing across the city. The plant supplies about 30,000m3 of water daily to the city. Current water supply meets the daily demand of water consumption of the city; hence the MC is considered to be covered by 100% of pipe borne water supply.

SOLID WASTE MANAGEMENT

Generation and Collection

Solid Waste Management in Galle is handled by the Galle Municipal council. Municipality practices source segregation, hence biodegradable and non-biodegradable waste is collected separately. Collection is more frequent in commercial and densely populated areas, with daily collection on main roads and twice a week on other roads. During the months of December, January and February, waste generation rises with the increasing migrating tourist to the Galle Fort area and the authorities arrange additional collection turns around Fort area during tourist season to overcome this situation.

THE CITY	
Province	Southern
District	Galle
Local Authority	Galle Municipal Council
Municipal Area	17.42 km^2
Number of Wards	15
Population	112,252 (2019)
No of Households	19,269
Rate of Population Growth	0.75%
Climatic Zone	Wet zone
Annual Rainfall	1525-1900mm (Rainy season: May to August and October to January)
Average Temperature	28-30 ºC
Elevation	1 m above MSL
Major Industries	Tourism, Fishing, Rubber
WATER	
Potable Water Sources	Gin River
Pipe Borne Water Coverage	90%
SOLID WASTE	
Waste Generation	84 MT/Day (estimated)
Waste Collection	32 MT/Day
Waste Collection in the Peak Season	40-42 MT/Day (December, January, February)
Collection Coverage	38%
SW Treatment/ Disposal Method	Composting+ Plastic Recycling+ Landfilling
Available Area for Disposal	0.86 (Heenpendala) and 10 Acres (Monroviawatta)
Duration in Operation	10 and 6 years respectively
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	18 m3/ Day
Treatment & Disposal	Hikkaduwa sewage treatment Plant

MC collects only non-surgical waste from Karapitiya teaching hospital, Mahamodara Hospital and two private hospitals; Hemas hospital and Co-operative hospital.

Treatment & Disposal

As in many other LAs SW disposal is a significant issue in Galle. There is a centralized composting facility situated 20 km away from the city center in Monroviawatta, Rathgama that has been in operation under Southern Provincial Council, where only a part of the waste (56%) from the city is processed as compost.

Balance waste is open dumped at a land situated in Heenpendala. Since 2006, the city has been disposing the collected waste at this dumping site close to Mahamodara Lake. Current practice is mere open dumping where significant environment and health risks are involved led by animal scavenging (dogs, monitors, and birds), mismanagement of leachate generated from excessive moisture content of waste and flies and vermin breeding etc. Recyclables such as metals and plastics are sorted out at the dumpsite and sent for recycling. The city faces a challenge in finding land for waste disposal and the situation may exacerbate in future due to high-rate of urban growth and inadequate capacity of the current landfill site.

Table 14: Facilities available for the SWM of the Area – Galle MC

Vehicle fleet	Compactors(6), tractors (12), Handcarts (6)
Staff Involved	MC Engineer (1), Public Health Inspector (1), Supervisor (15), Labourers (136)

Figure 20: Galle MC Dump Site Heenpendala (photo credit: IWMI)

Figure 19: Waste Collection in Galle MC (Source: Citynet Report – Galle)

Compost Plant

The plant, built under CEA 'Pilisaru project' in 2012 in Monroviawatta,Rathgama processes waste from 7 local authorities including Galle MC, Rathgama PS, Hikkaduwa PS, Bope-Poddala PS, Ambalangoda MC, Ambalangoda PS and Balapitiya PS. Land extent of the plant is about 10 acres. This cluster composting facility accepts separated biodegradable waste from Galle and other neighboring cities. Nearly, 46 MT/Day of organic waste including 18 MT/Day from Galle MC is processed at the compost plant. The plant uses windrow composting method. Turning of piles is done by skid-steer loaders and all other operations, including screening and packaging are done manually. At present there is only a small quantity of compost is sold and the majority of the compost produced is give away free to the government institutions.

Design Capacity	50 MT/day (Source: CEA database)
SW quantity processed at the plant	46 MT/day
Workforce and level of skills	Labours (38), Supervisor (01), Officer (01)
Operating cost	Electricity – 600LKR, Water – 15000 -16000 LKR
Compost production	100-150 MT/month
Average Sales of compost	Approx. 10MT/Month
Selling price of compost	LKR 10/kg
Monthly income	100000-150000 LKR

Figure 21: Rathgama Compost plant (Galle MC) **Photo credit: IWMI**

WASTEWATER AND SEPTAGE

There is no proper wastewater management system implemented in the city yet. Most of the greywaters from households, commercial and other institutions is directed to the drainage canal system which ultimately flows into the sea.

In the absence of a sewerage system, majority of households use water sealed latrines and around 10% use pit latrines, most of which are found among low-income settlements (UN-Habitat, 2006). These are constantly filled with septage and evacuations need to be done on regular basis. It has been reported that houses in low-lying lands experience failure of the sanitary system due to rise in the water table resulting in poor soakage of the effluent (UN-Habitat, 2006). Presently, septage collection is carried out by both MC and private collectors. MC charges 5000 LKR per load from public places and 3000 LKR from household for the desludging service.

Table 15: Resources available at Galle MC for septage collection

Vehicle fleet	3000 L Septic Truck (01), 2500 L septic trucks (02)
Workforce	Supervisor (1), Labourer (4), Driver (2)

Until recently, the normal septage disposal practice was to dump the collected septage into a pit at a private land in Dadalla under a disposal fee of 1550 LKR per truck. However, there were several objections against the disposal of septage in to this land by the residents in Dadalla area as the land is surrounded by a highly populous area. There were also concerns by the residents that it may cause problems to the nearby water bodies.

With the construction of Hikkaduwa sewage treatment plant (STP) in 2010, MC transport the collect septage to Hikkaduwa plant for the treatment. The plant operated and maintained by NWSDB comprises of series of ponds following natural treatment methods. About 225 LKR per m^3 is charged for discharging of septage at the treatment plant. However, MC is only allowed to dispose a limited quantity of septage into the plant on a day. On the other hand, the long distance between the city and treatment plant (30 km), also has been a reason for MC to limit the septage collection service provided by them. Currently MC is not able to cater the demand for desludging of the sanitation systems within the area due to the aforementioned reasons.

Figure 22: Hikkaduwa Sewage Treatment Plant

Treatment system	Facultative and Polishing Ponds
Starting year	2010
No. of staff	10
Coverage	Network - 20km; Households- 180; hotels- 60; accepts septage from Galle, Aluthgama and nearby areas
Treatment plant capacity	1000 m^3/Day
Overall BOD removal	85%
Sludge influent	40m3/day

Source: (IWMI FSM Assessment, WB, 2019)

LOOKING AHEAD

Current solid waste management system of the city is facing many challenges including lack of resources, lack of institutional capacity to handle increasing waste amounts, no proper disposal mechanisms etc. The city is looking for a suitable land for the waste disposal (JICA, 2012).

And also, MC only has limited resources for the wastewater management. There is no adequate sewage disposal facilities, which may result in indiscriminate dumping of septate at different locations creating many environmental and health problems to the city dwellers. Therefore, implementation of a proper wastewater disposal system is an essential requirement despite the cost. It is proposed to construct a sewerage system along with a wastewater treatment plant covering Galle MC area under the project of Sanitation and Hygiene Initiative for Towns (SHIFT) funded by EU, French Agency for Development (AFD) and the Government of Sri Lanka. NWSDB is the implementing agency for the project.

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Japan International Cooperation Agency (JICA)., Nihon Suido Consultants Co. Ltd., Yachiyo Engineering Co. Ltd. and Yokohama Water Co. Ltd., 2012. Data Collection Survey on Sewerage Sector in Democratic Socialist Republic of Sri Lanka

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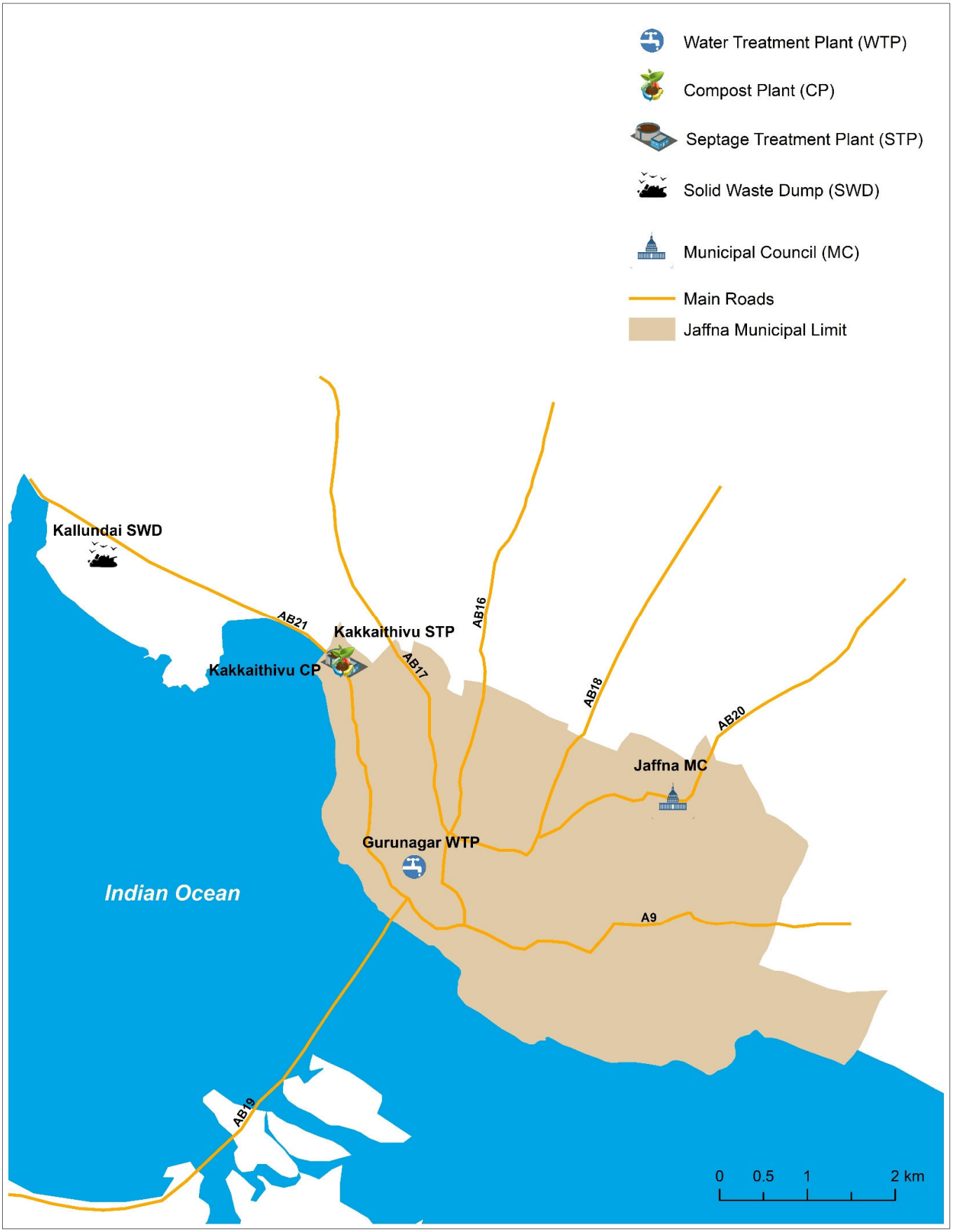
6. Jaffna


Water Treatment Plant (WTP)
Compost Plant (CP)
Septage Treatment Plant (STP)
Solid Waste Dump (SWD)
Municipal Council (MC)
Main Roads
Jaffna Municipal Limit
Kallundai SWD
AB21
Kakkaithivu STP
Kakkaithivu CP
AB17
AB16
AB18
AB20
Jaffna MC
Gurunagar WTP
Indian Ocean
A9
AB19
0
0.5
1
2 km

Jaffna City Profile

BACKGROUND

Jaffna is the capital city of Northern Province of Sri Lanka. Jaffna lagoon forms the Southern boundary of the town. The Municipal Council consists of Jaffna and part of Nallur Divisional Secretariat Division.
Topography of Jaffna area is almost flat and there is no any steep gradient within the limit. Jaffna peninsula is underlain by three formations: the pre-Paleozoic basement rocks, the Mannar Sandstone and the Jaffna Limestone. Main livelihoods of the area involve agriculture, fishing, teddy tapping and cattle raising.

WATER

The responsibility of water supply to the city area lies with Jaffna Municipal Council (JMC). The present water source for the city water supply is from the Kondavil well field. The water is pumped to the town overhead tank and distributed through the pipe network covering Jaffna division and serves approximately half of the population of JMC. The Gurunagar Water Supply Scheme, from the Thirunelvely well field provides water for Jaffna Teaching hospital and the market. The overhead tank of the hospital is directly connected to the Thirunelvely supply main.

The central government implemented Jaffna – Killinochchi Water Supply project under ADB and GoSL funds to enhance 24 hours supply for entire population. The work comprises of improvement of Iranaimadu Tank (Headwork including high lift irrigation).

SOLID WASTE MANAGEMENT

Generation and Collection

Jaffna MC is providing SW collection service in such a way that it is collected daily from house to house by collection vehicles from respective collecting zones. The waste in narrow road areas where collection vehicles cannot pass is collected by handcarts. The kerbside collection system with waste bins and the stationed collection system for mixed waste also available in MC area. From large shops and large restaurants waste is collected twice per week. MC has imposed a waste tax of 230 LKR per 200 L barrel on those private entities and garden waste is collected for 575 LKR per 1 load of tractor when the residents requested (JICA, 2016).

SW collected from hotel sector which is mostly the food waste, is amounted approximately as 3 tons per day. Hospitals located in the city including Jaffna teaching hospital, private hospitals such as Apolo hospital and Yaal hospital also receive the collection service from the MC.

THE CITY	
Province	Northern
District	Jaffna
Local Authority	Jaffna Municipal Council
Municipal Area	20.2 km^2
Population	91,100 (2015) [JICA, 2016]
No of Households	18,348 [UNHabitat, 2018]
Rate of Population Growth	~0.59 %
Climatic Zone	Dry zone
Annual Rainfall	1,300 mm (Rainy season: April to May and October to December)
Average Temperature	38.7 °C (high), 24.9 °C (low)
Elevation	5 m above MSL
Major Industries	Agriculture, Fishing, Cattle raising
WATER	
Potable Water Sources	Kondavil well, Thirunelvely well
Pipe Borne Water Coverage	50%
SOLID WASTE	
Waste Generation	104.87 tons / day [JICA, 2016]
Waste Collection	82.3 tons / day [JICA, 2016]
Collection Coverage	77.8 % [JICA, 2016]
SW Treatment/ Disposal Method	Open dumping + Composting
Total cost of waste collection	177,974,000 LKR [JICA, 2016]
Available Area for Disposal	20.8 hectares (Kallundai dumpsite)
Duration in Operation	Since 2002
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	11 m3 / day [JICA, 2016]
Treatment & Disposal	Buried in Kallundai SW dumpsite

Figure 23: Solid waste dump site Kallundai (2013)

Table 16: Facilities available for the SWM of the Area

Vehicle fleet	Tractors (18), Compactors (04), Rented Tractors (12) – LKR 1550 per load
Workforce	Permanent (431), Temporary (125)

Disposal

The most common practice of SW disposal in the city however is to dump SW into an open land in Kallundaii which is located approximately 6 km away from Jaffna city.

The land is situated close to the Jaffna lagoon in Maanippai area, Valikamam south west pradeshiya sabha which has an extent of 20.8 hectares. The General hospital is facilitated with an incinerator to manage hazardous waste. The infectious waste (syringes, etc.) is not taken to the disposal site since it is incinerated. However, the waste generation from hospitals mainly consist of municipal waste and the disposal amount at the Kallundai disposal site is approximately 4.5 tons/day (JICA, 2016). Due to these improper SW disposal practices, Jaffna lagoon and the adjacent coastal area is highly prone to pollution. Given these circumstances there has been proposals to upgrade the compost plant partnering with the private sector, to cater the total SW collected.

Treatment

JMC owns a compost plant through which a small portion of the collected SW is treated. Currently, a part of the plastic and polythene collected by MC is processed at a recycling plant operated by a private entrepreneur to produce pellets. This project was funded by the World Bank. There have been initiatives to formalize these SW recycling facilities through public private partnership (PPP) mechanism to establish a plastic recycling facility to the city.

Compost plant

The compost plant of JMC which is located at Kakkaithivu, was set up in 2006 and has been in operation since then. Plant is located in an area of 0.5 acres land. The initial capacity of the facility was limited to 2 tons / day which was later increased by another 3 tons / day in 2011 under “Pilisaru” project funding. The plant produces approximately 1 ton of compost per month. A tractor load (Approximately 700 kg) of compost is sold at 3500 LKR, while the well powdered and quality compost price is 5000 LKR per tractor load. The retail price of compost is 6 LKR per kg.

Design Capacity	5 tons / day
SW quantity processed at the plant at present	9 - 10 tons / week [JICA, 2016]
Vehicle/ Machinery	Tractor (1)
Workforce	Permanent Workers (4), Temporary Workers (6)
Compost production	200 kg / week
Average Sales of compost	~1 ton / month
Selling price of compost	6 LKR / Kg

Figure 25: Compost plant at Kakaitheevu

Figure 24: Plastic recycling facility - Jaffna MC (Photo Credit: IWMI)

WASTEWATER AND SEPTAGE

Jaffna Town currently does not have a sewerage system, hence is depending on onsite sanitation systems. Bucket latrines and water sealed latrines existed in Jaffna city until 1984. Later on, under the UNICEF program steps were taken to convert all bucket latrines into water seal latrines by providing financial incentives and constructing common septic tanks in 1984. As a result, all the latrines within the city are water sealed on with one, two or three compartment septic tanks. MC maintains ten number of public toilets facilities where some of those needs to be emptied once in every week whereas some need to be emptied frequently as once in a day.

Both MC and private sector are engaged in collecting wastewater and septage by means of septic trucks. MC owns three gully trucks having capacity of 2600 L and one gully truck having a capacity of 4000 L. Altogether approximately 30m^3 per day of septage is collected by the MC. Generally, the charge for emptying septic tank through 2600 L truck is around 3380 LKR per load whereas if it’s through 4000 Liter truck the charge is around 5200 LKR per load.

Table 17: Resources for Septage management in Jaffna MC [JICA, 2016]

Vehicle fleet	Gully bowsers (03 - 2600 L and 01 - 4000 L)
Workers	04

Current disposal method for the collected septage is to be buried in the Kallundai SW dumpsite (approximately 11m3/day). A sewerage scheme for the city is necessary, therefore National Water Supply and Drainage Board (NWSDB) is planning to implement a sewerage scheme under ADB and GoSL funding. The project includes the construction of sewerage network and the treatment plant at Kallundai.

MC is providing services on collection of wastewater within the city limits as well. It is noted that the same resources are being used for the collection and transporting of wastewater. MC has introduced a separate charging mechanism for the collection and transportation of wastewater which is 1716 LKR and 2640 LKR per load through 2600 litter truck and 4000 litter truck respectively.

Jaffna Teaching Hospital owns a separate sewage and wastewater treatment system to manage the sewage and wastewater generated within their own premises. As far as the wastewater disposal is concerned, generally most of the wastewater channels drain into the Jaffna lagoon and some drain out on the East and West of the Jaffna City.

LOOKING AHEAD

Developments are proposed to reinstate the existing drainage network within Jaffna Municipal Council and support a comprehensive study of the drainage of Jaffna city region, including not only the current municipal council area, but also the identified future expansion areas, prepare a Master Drainage Plan which would ensure prevention of inundation of city during monsoonal rains. (Source - Strategic Cities Development Programme)

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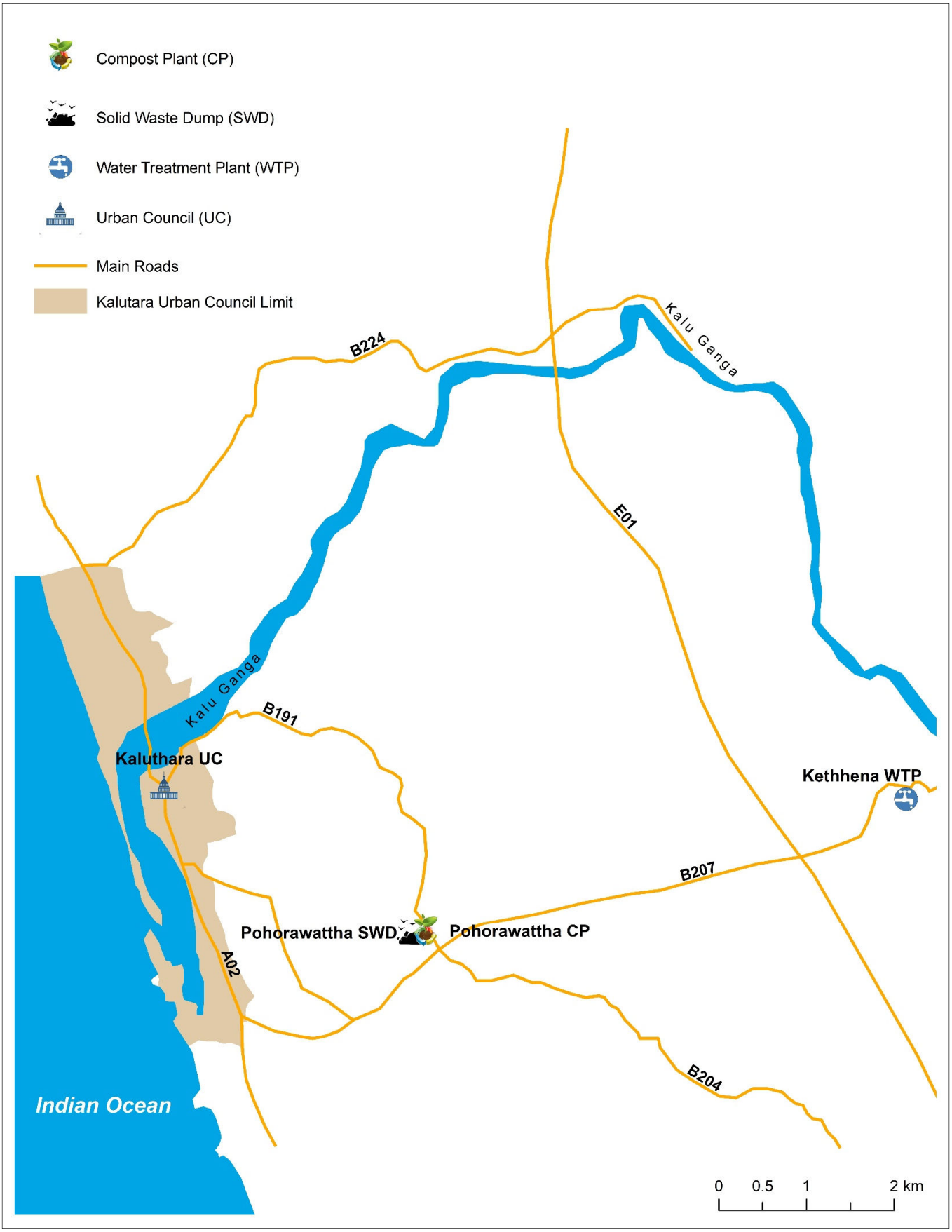
7. Kaluthara


Compost Plant (CP)
Solid Waste Dump (SWD)
Water Treatment Plant (WTP)
Urban Council (UC)
Main Roads
Kalutara Urban Council Limit
B224
Kalu Ganga
E01
Kalu Ganga
B191
Kaluthara UC
Kethhena WTP
B207
Pohorawattha SWD
Pohorawattha CP
A02
B204
Indian Ocean
0
0.5
1
2 km

Kaluthara City Profile

BACKGROUND

Kalutara is the third largest urban area in Western Province after Colombo and Negombo which is situated 40km away from Colombo. Kalutara is of special importance as a capital to Kalutara district, where not only the main service center of the district is located but also a town of religious importance due to the location of the sacred Kalutara Bo Tree and other religious buildings. There is evidence regarding the existence of a harbour at Kalutara around its sea outfall prior to the development of the Galle harbour.

The main source of income for the people is agriculture. Although paddy cultivation is practiced, the yield is extremely poor. Horticulture at the domestic level is practiced extensively. The most common fruit grown in the area is Mangostine. Toward the interior, rubber and cinnamon are grown to a large extent.

WATER

The existing water supply scheme for Kalutara is maintained and operated by NWSDB. Kalu Ganga (River) is the main water source for the city. Raw water is extracted from the Kalu River at the Intake at Kethhena. Water purification plant is located at Kethhena. It has a full treatment process and the capacity of the treatment plant is 56.25 m^3/day. Capacity of the existing water supply project is not sufficient and need the augmentation and improvement of the existing scheme. Salinity intrusion into the intake at Kethhena during the draught period also a key issue. (JICA, 2012).

THE CITY	
Province	Western
District	Kalutara
Local Authority	Kalutara Urban Council
Municipal Area	8.5 Km^2
Population	41,965 (2011)
No of Households	7,552
Rate of Population Growth	0.88%
Climatic Zone	Intermediate
Annual Rainfall	2 500 mm - 3 000 mm (Rainy season: April to August and October to January)
Average Temperature	Max: 31 ºC, Min: 28 ºC
Elevation	3 m above MSL
Major Industries	Agriculture
WATER	
Potable Water Sources	Kalu Ganga
Pipe Borne Water Coverage	> 50 % (NWSDB)
SOLID WASTE	
Waste Generation	30 tons / day
Waste Collection	26 tons / day (2014)
Collection Coverage	100 %
SW Treatment/ Disposal Method	Composting, Controlled landfill
Total Cost for Waste Management	45.55 million LKR
Available Area for Disposal	Pohorawatta Compost facility (4 acres)
Duration in Operation	Since 2011
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	120 m^3 / month
Treatment & Disposal	Pumping station at Mt. Lavinia

SOLID WASTE MANAGEMENT

Generation and Collection

SWM in the area is a responsibility vested upon the Kalutara UC. There are 12 SW collection centres and the collection is carried out once in two days, engaging hand carts. The amount of SW collected is about 30 tons per day in the urban area. However, theoretically, the total amount of SW generation is only 26 tons per day which is less than the SW collected. This discrepancy could be due to the fact that the SW generation contributed by the floating population is not accounted in the waste generation figure. At the moment there is no separate charge imposed for SW management included in the property tax. It was noted that the transport facilities for SW are not adequate and the present working conditions of the vehicles also are not satisfactory.

Table 18: Facilities available for the SWM of the Area – Kaluthara UC

Vehicle fleet	Tractors (6), Hand carts, Wheel loader (1)
Equipment	Conveyor belt (4), Sieves (2), Air blower (1), BOB CAT (2), Sealing machine (1)
Workforce and level of skills	SW collection: Labourers (88), Compost plant: Site manager (1), Management assistants (1), Supervisor(1), Loader operator(2), Labourers (17), Security(2)

Kalutara UC has a compost plant in order to treat the organic waste collected within the UC area. The Compost plant built in Pohorawaththa Nagoda nearly 7km away from city centre was a much needed solution for the UC to manage SW properly by turning the SW open dump in to a composting site. At present residual waste after composting is disposed at the same premises at Pohorawatta.

Composting and Recycling Facitlity

The compost plant was established in 2011 under the Pilisaru National Solid Waste Management Programme, which is now being managed under the Waste Management Authority (WMA), Western Province. It enables to convert 50% of SW collection in to compost. The plant also provides composting facility for two other local authorities namely Kalutara Pradeshiya Sabha (PS) and Panadura PS. It is designed in a capacity to compost 40 tons of SW per day. Currently mixed waste collected is sorted using three conveyor belts installed at the plant. Sorted organic waste is then directed to the compost plant while sorted out recyclables such as paper, cardboard, plastic, glass and metal are stored separately to be sold once a substantial amount is collected.

The compost produced is sold under the brand name of "Mihisaru" for a price of 8 LKR per Kilogram. The management team working in the plant is doing well in marketing of compost as they have prior experience in working in the composting industry. The buyers seek to purchase bulk quantities of compost to be sold in areas like Galle and Mathugama. Also, small quantities of compost are bought by the domestic garden farmers directly from the outlet at the plant. The revenue generated from compost selling is about 450,000 LKR/month (2013). The quality of compost is tested every three months.

Design Capacity	40 tons / day
SW quantity processed at the plant at present	30 tons / day
Vehicle/ Machinery	Tractors (06), Hand carts, Wheel loader (01) Conveyor belt (04), sieves (02), air blower (01), BOB CAT (02), sealing machine (01)
Workforce	Site manager (01), management assistants (01), supervisor (01), loader operator (02), labourers (17), security (02)
Operating cost	800,000 LKR/ month (2013)
Compost production	100MT/month
Selling price of compost	8 LKR/kg

Figure 26: Composting facility at Pohorawatta

Photo credit: IWMI

WASTEWATER AND SEPTAGE

The whole town depends on septic tanks and pit latrines for disposal of night soil. Some people who have settled near canals and marshland discharge the effluents directly into the waterways, thereby polluting the environment and posing health hazards. UC is carrying out the de-sludging of septic tanks/ pit latrines. Approximately 4,500 LKR of payment per load has to be made to UC by the requester in order to carry out the de-sludging of septic tanks or pit latrines through the septic trucks. Normally, Urban council receives two requests daily for septic tank/ pit latrine desludging.

Presently, there is no Sewerage Scheme operating in Kalutara UC. Moreover, there are no Sewage Treatment plants operating in the area. Even in the Nagoda Hospital, there is no separate treatment plant to treat wastewater before releasing it to the natural stream. Currently septage collected by septic trucks is dumped into the Pumping Station which is being operated by National Water Supply & Drainage Board (NWSDB) located at Mt. Lavinia (about 20 km away from Kalutara) which ultimately disposed to the sea outfall.

Table 19: Facilities for septage Collection Service - Kaluthara UC

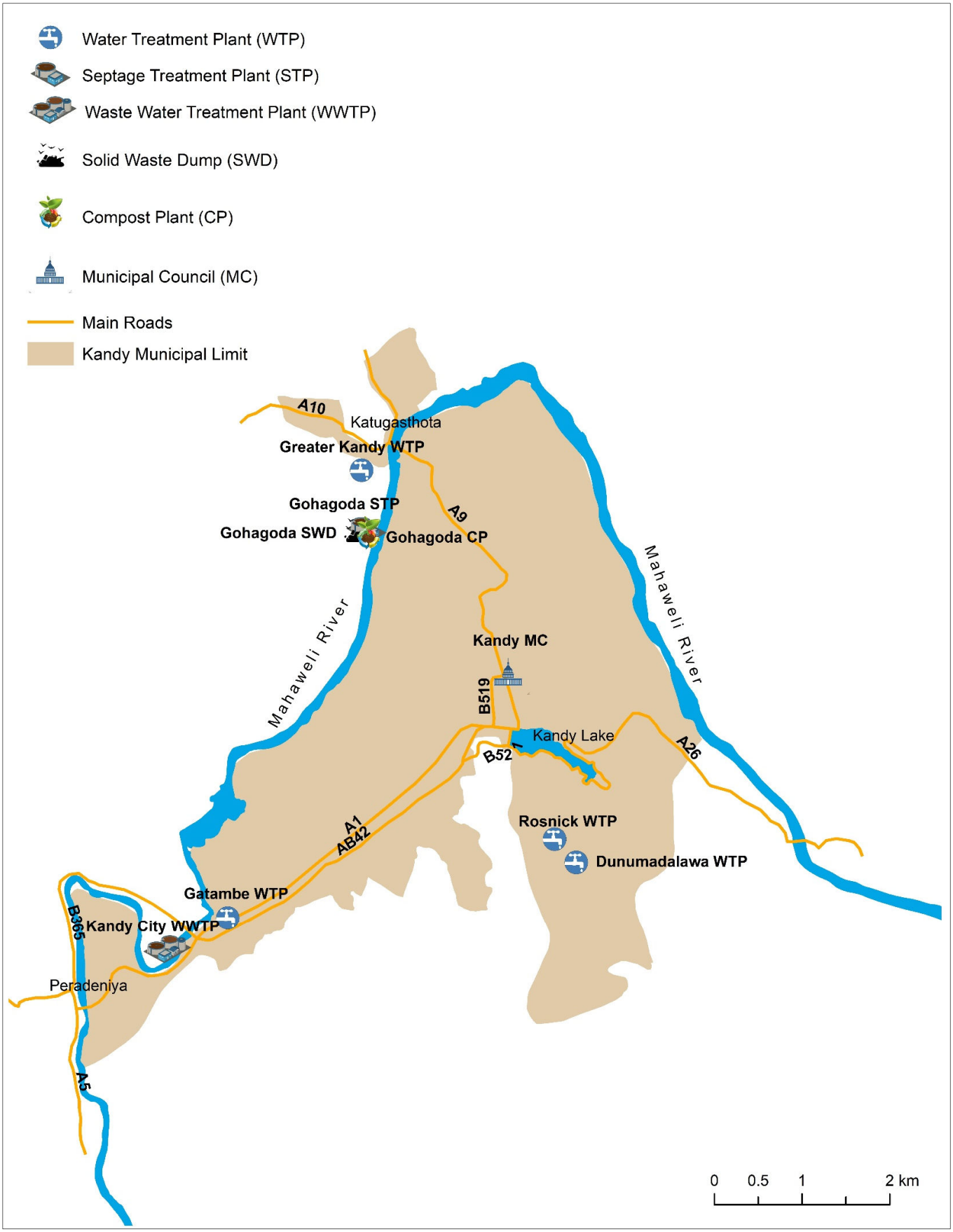
Vehicle fleet	01 Gully Bowser (3000 L)
Workers	Labours (02), Driver (01)

These is no decentralized wastewater treatment plant has been installed to treat effluent generated from different institutions in the urban area. Most of the time wastewater is directed to the storm drainage lines. Some areas of the UC have no drainage system, and the residents are thereby compelled to throw their wastewater by the wayside.

REFERENCE

Japan International Cooperation Agency (JICA)., Nihon Suido Consultants Co. Ltd., Yachiyo Engineering Co. Ltd. And Yokohama Water Co. Ltd., 2012. Data Collection Survey on Sewerage Sector in Democratic Socialist Republic of Sri Lanka

8. Kandy


Water Treatment Plant (WTP)
Septage Treatment Plant (STP)
Waste Water Treatment Plant (WWTP)
Solid Waste Dump (SWD)
Compost Plant (CP)
Municipal Council (MC)
Main Roads
Kandy Municipal Limit
A10
Katugasthota
Greater Kandy WTP
Gohagoda STP
Gohagoda SWD
Gohagoda CP
A9
Mahaweli River
Mahaweli River
Kandy MC
B519
Kandy Lake
B52
A26
Rosnick WTP
Dunumadalawa WTP
A1
AB42
Gatambe WTP
B365
Kandy City WWTP
Peradeniya
A5
0
0.5
1
2 km

Kandy City Profile

BACKGROUND

Kandy is considered as the second major city in Sri Lanka next to Colombo. It is the capital city of Central Province. Mahaweli River flows along boundary of Kandy municipal area covering around 2/3 of the boundary limits. The Temple of tooth relic is one of the main attractions of the city for many local and foreign tourists. Apart from the Palace of Tooth Relic, the Botanical Garden of Peradeniya is another tourist attracted location in the Kandy city. It also is a commercial center with a high number of a floating population. The city is surrounded by river Mahaweli and there is a lake in the middle of the city, which has added a scenic value to the city. Kandy was the last kingdom of Sri Lankan kings and therefore the city has a historic value. It was declared a world heritage site by UNESCO in 1988 due to the ancient pride and the Temple of Tooth Relic.

WATER

Potable water supply for the Municipal area is performed by the Kandy Municipal Council. Mahaweli River, Rosnik tank and Dunumadalawa Tank are the main sources of water supply for the municipal area. Daily intake from the above sources is around 36,000 cubic meters and they are purified through two (2) purification plants of Gatambe & Wales Parks. Since 36,000 cubic meters produced by municipality is not sufficient, Kandy Municipal Council receive around 10,000 - 12,000 cubic meters from the National Water Supply & Drainage Board daily through other sources (UDA, 2019).

THE CITY	
Province	Central
District	Kandy
Local Authority	Kandy Municipal Council
Municipal Area	26.45 km^2
Population	102 459 (2012)
No of Households	24 229 (UNHabitat, 2018)
Rate of Population Growth	0.65 %
Climatic Zone	Wet Zone
Annual Rainfall	2500 mm (Rainy season: May to August and October to January)
Average Temperature	28 ^oC (high),19 ^oC (low)
Elevation	500 m above MSL
Major Industries	Tourism
WATER	
Potable Water Sources	Mahaweli River, Rosnick Tanks, Dunumadalawa Tank
Pipe Borne Water Coverage	100%
SOLID WASTE	
Waste Generation	179 Tons / Day (UDA, 2019)
Waste Collection	150 Tons / Day (UDA, 2019)
Collection Coverage	83.8 %
SW Treatment/ Disposal Method	Open dumping, Controlled landfill
Total Cost for Waste Collection	LKR 18 million (Annually)
Available Area for Disposal	32 acres (Gohagoda)
Duration in Operation	Since 1970
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	50-60 m^3 / day (UDA, 2019)
Treatment & Disposal	Treatment Plant in Gohagoda

SOLID WASTE MANAGEMENT

Generation and Collection

The Kandy city is a commercial hub attracting many businessmen, making the day time floating population very high. Also it attracts so many local and foreign tourists especially during the “Kandy Perahera” season. Solid waste management in Kandy city is quite a challenge to the municipal council due to these reasons. There are many industries and agricultural practices increasing the amount of solid waste generated. Unlike most local authorities where SWM is a task of the health and sanitation department, there is a separate unit established within the Kandy Municipal Council (KMC) for solid waste management. The collection of solid waste is commendable. Source separation is carried out under thorough monitoring and inspection by the KMC.

Table 20: Facilities available for the SWM of the Area – Kandy MC

Vehicle/ Machinery	Compactors of 6 tons Capacity (03), Compactors of 2.5 tons capacity (04), Wheel tractors (16), Hand carts (97)
Workforce and level of skills (laborers, technicians, supervisors etc.)	Labours (262), Supervisors (12)

Kandy MC dumps waste at Gohagoda. The dumpsite currently receives about 150 tons of waste per day. Apart from Kandy MC, Harispattuwa PS, University of Peradeniya, Ceylon Tobacco Corporation, DCSL (Distilleries), Amaya Hotel, Randoli Hotel dispose their waste to the same site. There are 120 families living around these premises. The subsequent development of the dump site has improved the situation to a certain extent. The leachate collection drains are modified to the storm water drains. The leachate is collected through a separate pipe lines and gravitated to the dump. Then it is pumped to the wetland for further natural treatment.

> *"Sampath Piyasa"* a project run by the Kandy Municipal Council under the Solid Waste Recycling Initiative with Korean aid, collects waste material and transports them to *Sampath Piyasa* centers at Gohagoda, Ranawana and Central Market. However, it needs more organized network of local collection with "Divi Neguma" support in each ward.

WASTEWATER AND SEPTAGE

Most of the wastewater generated in the city is directed to the Meda Ela, which is a tributary of the Mahaweli river contributing to a high level of pollution and eutrophication. Polluted water ultimately drains into Mahaweli River which is the main source of drinking water for the city and suburbs. Although there is an underground drainage system in the KMC area built in British era it doesn't cover every road in the area.

The city does not have a sewer system as of now. Septage from onsite sanitation systems is collected on request by the Kandy Municipal Council. The collected septage is treated at the treatment plant built in Gohagoda in the same premises as the solid waste disposal facility.

Table 21: Resources for Septage management in Kandy MC

Vehicle fleet	03 Gully Bowsers (2 - 7000 L & 1 - 3200 L)
Workers	01 Supervisor, 03 Drivers, 05 Laborers

Kandy City Wastewater Management Project is a response by the Government of Sri Lanka to address the problem of wastewater management effectively in the municipality. Co-financed by the Government of Sri Lanka and the Japanese International Cooperation Agency (JICA), the project is jointly implemented by the National Water supply and Drainage Board (NWSDB) and Kandy Municipal Council (KMC). This project aims to tackle canals and river pollution issues all together. It aims to develop a new sewerage system that serves about 55,000 resident population and 150,000 migratory populations with 12,600 service connections linked to a sewage treatment plant with the capacity of 17,000 m^3/day.

Once construction is completed, NWSDB will assume responsibility for operation and main pump house. KMC on its part will handle the service connections and the operation and main pump house of the wastewater transmission network including the small pump house (Source - Kandy Municipal Council website). As sewerage system is installed, it is expected to improve water quality of Mahaweli river, one of the major water sources in the country. Improvement of its water quality in upper stream will have positive impact for downstream areas (Source - Kandy Town Development Plan (2019 - 2030): UDA). The project will also provide improved sanitation in densely populated and low-income areas in Kandy, through instalment of in-house sanitation facility, and refurbishing public sanitary facilities.

Figure 27: Solid Waste Dump Site - Kandy MC

Figure 28: Kandy Septage Treatment Plant

Photo credit: IWMI, 2013

LOOKING AHEAD

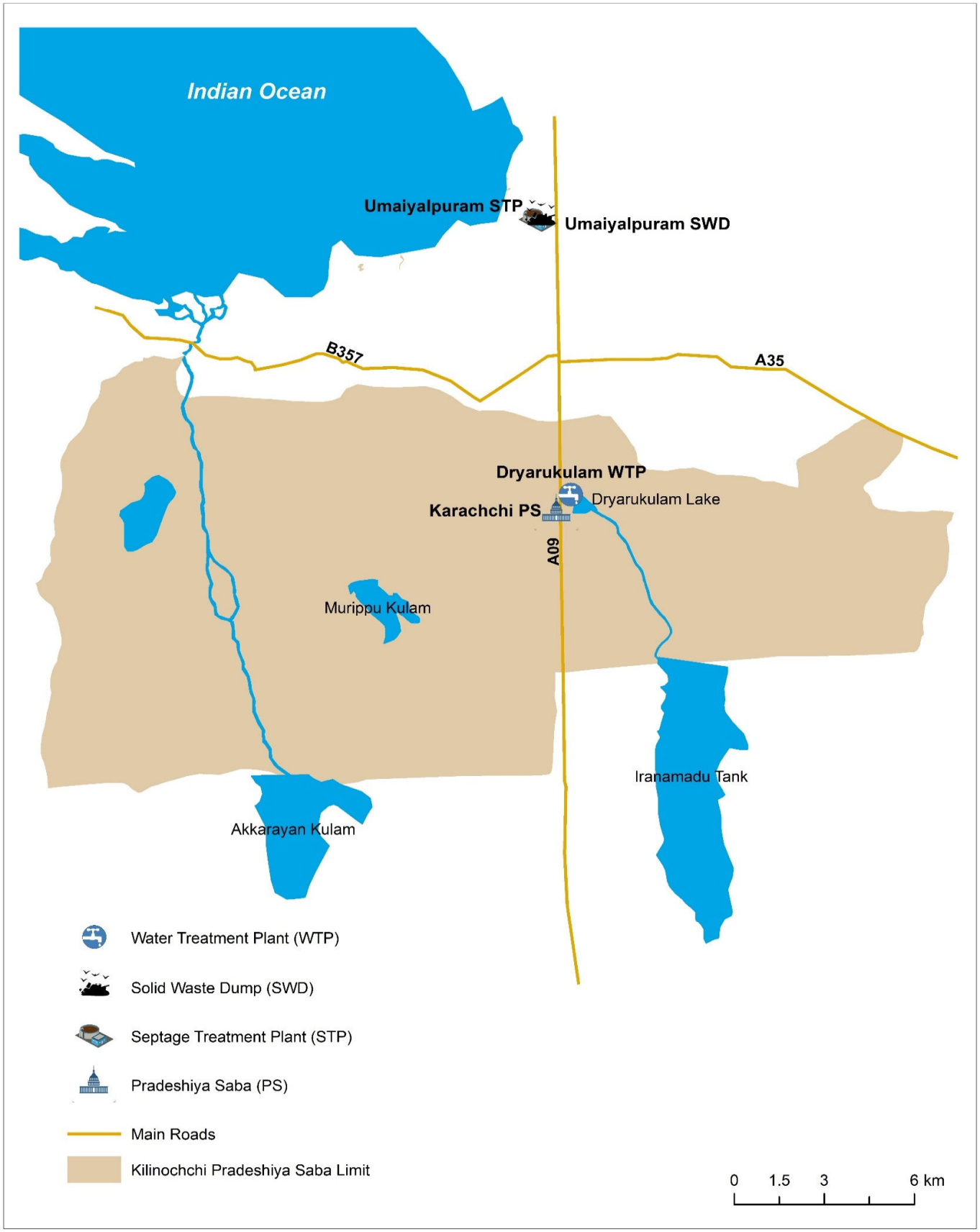
There is a plan to expand the existing wastewater treatment project by 2030 towards other suburbs of Kandy.

REFERENCES

Kandy Municipal Council http://www.kandy.mc.gov.lk/

Kandy Town Development Plan (2019 - 2030): UDA

9. Kilinochchi



Kilinochchi City Profile

BACKGROUND

Killinochchi town or Karachchi Pradeshiya Sabha which belongs to the Northern Province of Sri Lanka is situated along A9 highway between Mankulam and Paranthan Junctions which connects Mullaitivu town. The distance to Killinochchi from Jaffna and Kandy is 64 km and 257 km respectively. Kilinochchi is one of the major agrarian cultivation destinations in the island from the pre-historic times. Iranamadu (Ranamaduva) Tank, Kanakampikai Kulam (Pond), and Kilinochchi Kulam are the major irrigation sources for paddy and various other cultivations. Most of the people living in area are farmers and related to agricultural work.

WATER

Main water source of the Killinochchi city is the Iranamadu tank. Water from Iranamadu tank is channeled to Dryarukulam tank where the water is stored, treated and distributed to the city. At present, the water supply scheme covers only about 40% of the city population and the rest of the population depends on tube wells and dug wells for their water needs. Kilinochchi Water Supply Scheme is currently being rehabilitated. The government has allocated 740 million LKR for the rehabilitation project while the balance funds required amounting to 677 million LKR is provided by the Japanese government. Upon completion the project will have the capacity of pumping 3,800 m^3 of potable water to 100 km per day. Over 40,000 families in the Karachchi Divisional Secretariat Division and Kandavalai Divisional Secretariat Division would be supplied with drinking water benefiting under this scheme.

SOLID WASTE MANAGEMENT

Generation and Collection

The solid waste (SW) collection from domestic, commercial units and restaurants in the city is carried out on a daily basis by the Pradeshiya Sabha (PS). Daily SW collection from households and institutions is estimated as 3 tons.
Additionally, SW generated in the Military bases are being collected by themselves which amounts to 5 tons per day. Moreover, SW collected from the hospital is estimated as 5 tons per month.

Figure 29: Solid waste disposal site – Kilinochchi (photo credit: IWMI)

THE CITY	
Province	Northern
District	Kilinochchi
Local Authority	Karachchi Pradeshiya Sabha
Municipal Area	620.67 km^2
Population	76,325 (2015) [EML, 2017]
No of Households	33,319
Rate of Population Growth	1.5%
Climatic Zone	Dry zone
Annual Rainfall	1000 – 1250 mm (Rainy season October to January)
Average Temperature	34 ºC (high), 25 ºC (low)
Elevation	10 m above MSL
Major Industries	Agriculture
WATER	
Potable Water Sources	Iranamadu tank/ Tube wells
Pipe Borne Water Coverage	40 % (NWSDB)
SOLID WASTE	
Waste Generation	46 tons / Day (estimated)
Waste Collection	8 tons / Day (total collection by PS and military bases)
Collection Coverage	17 %
SW Treatment/ Disposal Method	Open dumping
Available Area for Disposal	12 acres (Umaiyal Puram)
Duration in Operation	Since 1975 (approx.)
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	120 m^3 / month
Treatment & Disposal	Dumped into an open pit near SW dump

Table 22: Facilities available for the SWM of the Area Killinochchi

Vehicle fleet	Tractors (2)
Workforce	Permanent labours (06), Permanent drivers (02), casual labours (02)

Treatment and Disposal

Currently, the disposal of SW is carried out in a land which belongs to the Killinochchi (Karachchi PS) in Umaiyalpuram. The dumping site is located 6 km away from the town. PS has made initiatives to implement a composting project with the support of Pilisaru National Solid Waste Management project.
Although hospital has an incineration facility to process medical waste, it is not functioning at present. Thus, disposal of hazardous waste generated from the hospital has become a critical issue Pradeshiya Sabha is facing at present. The dumpsite is located in close proximity to the environmental sensitive areas hence the adverse impacts from the improper disposal practices has become a critical issue which needs to be immediately.

WASTEWATER AND SEPTAGE

In the absence of a sewerage system, people in Killinochchi area depend on onsite sanitation systems for their sanitation needs. PS provides the service of desludging of septic tanks and pit latrines by means of septic trucks. Public toilets maintained by PS requires frequent emptying.

Table 23: Types of Latrines used in Kilinochchi (EML, 2017)

Public toilets	97
Water sealed	13,273
Temporary systems	6,895

The service charge for empting septage from domestic and government insitutions is limited to LKR 3,600 while for other private organizations, it amounts to LKR 4,500. However, manual cleaning of pit latrine is also practiced especially in the rural area. In the event of manual cleaning, the charge for emptying one pit ranges from LKR 1000 to 3000.

Table 24: Resources allocation for Septage management in Kilinochchi

Vehicle fleet	4,500 L Gully Bowser (1)
Workers	Driver (1), Labour (1)

There is a high demand for septage collection and disposal in the area particularly due to the large number of public sanitation facilities maintained in the city. Septage from these public toilets are collected in sealed holding tanks requiring them to empty regularly to prevent overflowing of the systems. Septage collected are emptied into an open pit located close to the solid waste dumpsite at Umayalpuram. This haphazard disposal practice has resulted in degradation of human habitat and unhygienic conditions (EML, 2017).

National Water Supply and Drainage Board has implemented constructions of a new septage treatment plant for Kilinochchi under Water Supply and Sanitation Improvement Project (WASSIP) funded by World Bank. The proposed STP is designed to treat 25 m^3 of septage and raw sewage per day and will cater mainly to the septage disposal requirements of Karachchi PS, Pachchilaipalli PS and Poonakari PS. The treatment process is a waste stabilization pond system.

There is no central Wastewater Treatment Plant exists in the PS area. Nevertheless, there are few decentralized Wastewater treatment plants operating at individual premises. For example, The People's Bank has a sewage treatment plant which has an anaerobic treatment process. On the other hand, it was noted that the hospital also has a wastewater treatment plant which however is not operational at present.

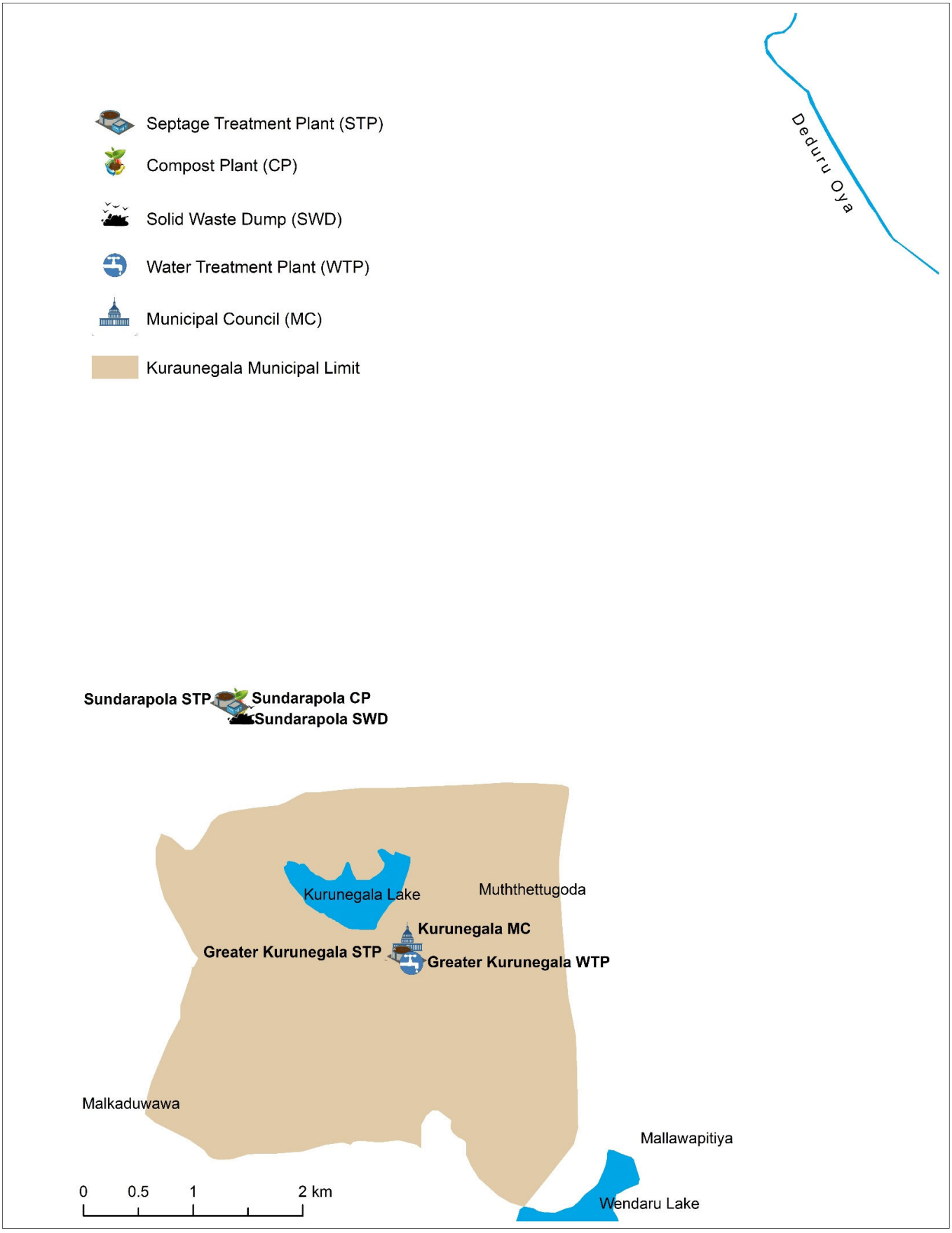
Figure 31: Construction of the new STP – Kilinochchi (photo credit: IWMI)

Figure 30: Present septage disposal practice - Kilinochchi (source: EML, 2017)

REFERENCE

EML Consultants (2017). Environmental Assessment for the Proposed Septage Treatment Facilities at Kilinochchi - World Bank Funded Water Supply and Sanitation Improvement Project (WASSIP). Ministry of City Planning and Water Supply.

10. Kurunegala



Kurunegala City Profile

BACKGROUND

Kurunegala is the capital city of the North-Western (Wayamba) Province of Sri Lanka. It is situated about 94km from Colombo towards the northern side of the Island. Since the Kurunegala MC is the main service centre of the province, the large number of service-oriented institutions as well as higher education centers located within the boundaries of Kurunegala MC serve a floating population of about 250,000 (JICA, 2016). Majority of the residents in the municipal area belong to Sinhalese.

WATER

City of Kurunegala receives most of its drinking water from Deduru Oya although at times of shortage during the drought periods this is supplemented by Kurunegala Tank, which is situated within the city. National Water Supply and Drainage Board (NWSDB), recently implemented Greater Kurunegala Water Supply and Sewerage Project aiming to improve the living condition of people in and around the city of Kurunegala, by providing safe drinking water and adequate sanitary facilities. The project improved access to safe drinking water with an expanded water supply system that included a 100-meter weir across Deduru Oya river, a 90,000-cubic-meter storage tank, a new intake structure and 8.5 kilometer raw-water transmission main, expansion of the water treatment plant from 9,000 to 14,000 cubic meters per day (Source: NWSDB).

THE CITY	
Province	North Western
District	Kurunegala
Local Authority	Kurunegala Municipal Council
Municipal Area	11.34 km^2
Number of Wards	12
Population	26,903 (2015) (JICA, 2016)
No of Households	5296
Rate of Population Growth	0.98%
Climatic Zone	Intermediate zone
Annual Rainfall	1800 mm (Rainy season: May to August and October to January)
Average Temperature	35°C (high) - 27°C (low)
Elevation	116 m above MSL
Relative Humidity	Max: 91%, Min: 69%
WATER	
Potable Water Sources	Deduru Oya, Kurunegala Tank
Total water supply (NWSDB)	6,863 m^3/day
SOLID WASTE	
Waste Generation	48 MT/Day
Waste Collection	44 MT/Day
Collection Coverage	100%
SW Treatment/ Disposal Method	Composting, controlled landfill
Total Cost for Waste Management	69,046,000.00 LKR (2016)
Available Area for Disposal	12.5 acres
Duration in Operation	Started the dump site in 1960
WASTEWATER & SEPTAGE	
Sewerage cover	20% - 1100 households
Sewage Treatment Plant	4500m^3/day (Design capacity) 1700m^3/day (operational capacity)
Septage Collection	24m3/ Day
Treatment & Disposal	Septage Treatment Plant (design capacity 16m3/day, operational capacity 24m3/day)/ excavated pit at Sundarapola

SOLID WASTE MANAGEMENT

Generation and Collection

Municipal Council provides the waste collection service every day to collect biodegradable component and once a week to collect non-biodegradable component. Source segregation was initiated in December 2012 by the Kurunegala MC and the separation rate reached 75% in commercial areas and 50% in residential areas (JICA, 2016). The city waste collection system is designed to collect waste along ten routes comprising residencies and Lake Park, commercial units and public places, public fair and market, and underserved settlements. Organic component of the waste is reported to be more than 60% of the collected.

Although the theoretical value of SW generation amounts to be about 20 tonnes per day, it has been estimated that realistically about 40-45 tonnes of SW is generated per day within the municipality. This huge gap could be due to the fact that a significant amount of waste is generated from the floating population which is of about 250,000, as well.

Table 25: Resource allocation for waste collection - Kurunegala MC (JICA, 2016)

Vehicle fleet	Hand Carts- 38, Tractors – 12, Compactor truck – 6, lorry- 2
Workforce	Drivers (15), Labourers(186), casual labourers (28)

Treatment and Disposal

SW management has been one of the serious environmental issues in Kurunegala urban area for many years. Although the situation has been improved particularly on the collection side, SW disposal remains a big challenge to the authority. Current practice is that the total SW collected is transported to the Sundarapola final disposal site. The disposal site is located 2km away from the city in the Kurunegala Pradeshiya Sabha (PS) area and the SW collected from PS is also disposed at the same site. Consequently, daily disposed amounts of SW are approximately 40 tons from the Kurunegala

MC and 10 tons from the Kurunegala PS estimating about 50 tons in total. The land was obtained by MC under a lease agreement for 99 years. In 2013, a large-scale cluster compost plant was established at Sundarapola dumpsite that has a capacity to treat about 40 tons of waste daily under the Pilisaru programme. However, at present only 2 tons of biodegradable waste collected from the MC town market and regular fair is processed at the plant to produce compost. Majority of the waste collected by MC (about 94% of the collected) is sent to the landfill adjacent to the compost plant for open dumping.

In addition, a small facility is also installed in the same premises to transfer collected recyclables by some handcarts to a tractor and the collection workers of the handcarts can receive a monthly average income of between 300 and 400LKR by selling the collected recyclable waste (JICA, 2016). Recyclables include metal, cardboard, PET bottles, plastic, glass, coconut shell etc and amounts about 0.6 tons per day. The recycling center was initiated in 2012 with the funds of 5.6 million LKR from CEA and the Municipal Council with modern machineries to prepare plastic pellets and shredding. The selling price of 1 kg of plastic pellet is around 40- 45 LKR and 1kg of PET bottle is 20 LKR.

Figure 32: Compost Plant Sundarapola

Figure 33: Disposal site at Sundarapola (photo credit: IWMI)

Compost Plant

Pilisaru Project (CEA) invested 83 million LKR on Sundarapola compost compound and completed the construction in January 2013. Although the plant has a capacity to accept 40 tons of mixed waste and process the organic component of it which is about 24 tons (60% of the mixed waste) daily to produce compost, only 2 tons is processed as composting at present. The reason for this underperformance of the compost plant was given as the inadequate numbers of workers to handle the collected waste. Even though a sufficient workforce has been assigned to perform the duties at the composting facility, the operation of the compost plant is often disrupted due to the absence of the workers.

Design Capacity	40 MT/day
SW quantity processed at the plant at present	2 MT/day
Vehicle/ Machinery	Bob cat (01), excavator (01), tractor (1), sieving machine (2)
Workforce	Supervisors (02), permanent workers (20), temporary workers (06)
Operating cost	LKR 1,638,000.00 (2016)
Compost production	12 MT/ month
Average Sales of compost	5 MT/month
Selling price of compost	10 LKR/kg

WASTEWATER AND SEPTAGE

Residents contributes to the majority of the wastewater generated compared to the industries in the city. In September 2018, a new wastewater treatment plant was installed under the Greater Kurunegala Water Supply & Sanitation Project in order to collect and treat the wastewater generated in the city. The plant along with the sewer network was built with the funds from Government of China and GoSL and is operated by NWSDB. Total cost for the treatment plant and the sewer network has been LKR 8 billion. The treated effluent is discharged into the Boo Ela and it is proposed that wetlands will be constructed along the canal (Ela) as a polishing treatment before the final effluent reaches Wilgoda Anicut, after which will be used to irrigate agricultural land.

Although there is a WWTP operating in the city entire population is not served by the plant. HHs who are not connected to the sewer network continue to depend on the onsite sanitation systems. Desludging of these onsite sanitation systems is performed by the MC based on the requests made by various entities including domestic, governmental and commercial institutions etc. MC has two gully (FS) trucks to carry out desludging of septage. Septage is mainly collected from the central MC area and in addition, collected from outside the MC boundary as well. Desludging fees are about 3500LKR within the town limit and about 4000 LKR for entities that are located outside of the town. On an average day, MC collects about 24,000 Liter (24m^3) of septage from various entities.

Table 26: Resources for Septage management in Kurunegala MC

Vehicle fleet	Two Gully bowsers (2200L and 3000L)
Workers	Plant operator (01), Supervisor (01), Drivers (02), labours (04)

MC has its own septage treatment facility constructed in 2013 by CEA. The treatment plant comprises of a receiving tank, settling tank followed by coir fibre tanks for the effluent treatment while sludge from the settling tank is directed to the drying beds for dewatering. The design capacity of the treatment plant is 16 m^3 per day. However, the present delivery amounts exceed the design capacity inhibiting the effective treatment of septage. When the plant is overloaded due to the inadequate capacity and particularly during the rainy season, the collected septage is alternatively disposed into an excavated pit in the landfill. Private operators are also engaged in the desludging service and are allowed to discharge the septage into the pit at a disposal a fee of 1500LKR.

The leachate generated by open dumping of SW and septage overflow from the pit is collected into a tank and pumped to the treatment plant. However, the plant often is overloaded and does not have adequate capacity to handle the pollution load generated by these additional waste streams. Proper treatment and disposal practices are therefore must be in place to control the pollution occurred from these improper disposal practices.

Figure 34: Wastewater treatment plant at Kurunegala

Treatment system	Activated sludge process
Starting year	2018
No. of staff	35
Coverage	Network - 138km; Households - 1100; (Planning to provide 2500 more free of charge. After that HHs have to pay about Rs. 100000-150000/connection (Only actual cost)
Treatment plant capacity	4500 m^3/day
Operating capacity	1700 m^3/day
Operation cost	3 million LKR/ month
Sludge production	2 ton/day (filter pressed and sent to the compost plant)

Source: (IWMI FSM Assessment, WB, 2019)

Figure 35: Septage treatment plant at Sundarapola

Figure 36: Co-composting and pelletization research at Kurunegala composting facility

Photo credits: IWMI

LOOKING AHEAD

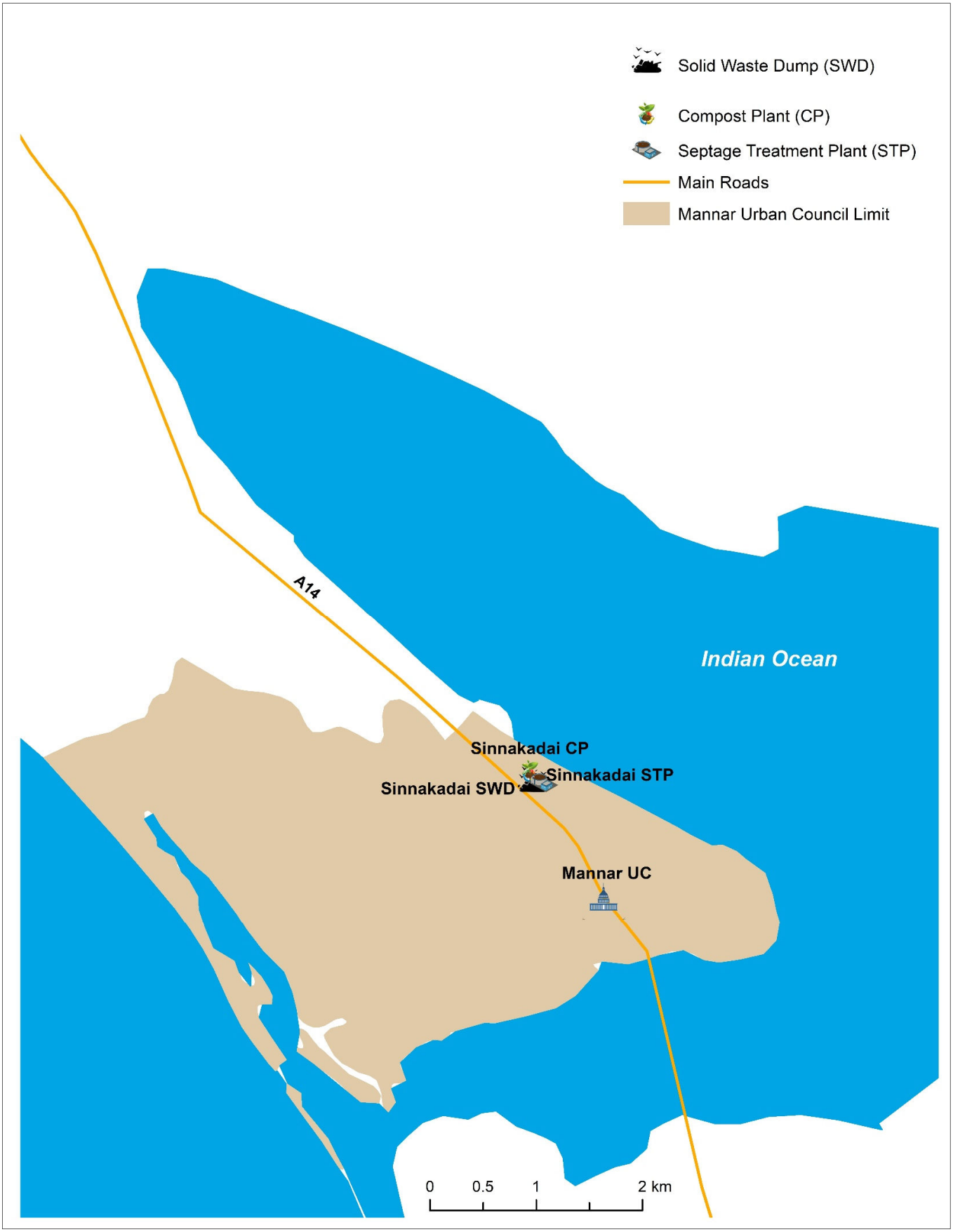
Various government (CEA, NWSDB, Kurunegala MC, University of Colombo), Non-Government, (Practical Action, COSI), INGOs (IRC) and International organizations (IWMI, DANIDA, SEI) have initiated numerous programmes to address the environmental issues the city is facing that are attributed to solid and liquid waste management. One of these initiatives was envisioned at sustainable composting. IWMI along with the collaboration of CEA and MC conducted a research project in 2013, which aimed at enhancing the value of the compost produced at the plant.

The pilot project intended to promote co-composting of MSW with the dried fecal sludge and pelletizing the co-compost product. The research work and demonstrations were well taken and MC continued to produce co-compost. However, with the current operational issues these practices are seldom followed at present.

REFERENCE

Japan International Cooperation Agency (JICA). and Kokusai Kogyo Co. Ltd., 2016. Data Collection Survey on Solid Waste Management in Democratic Socialist Republic of Sri Lanka

11. Mannar


Solid Waste Dump (SWD)
Compost Plant (CP)
Septage Treatment Plant (STP)
Main Roads
Mannar Urban Council Limit
A14
Indian Ocean
Sinnakadai CP
Sinnakadai STP
Sinnakadai SWD
Mannar UC
0
0.5
1
2 km

Mannar City Profile

BACKGROUND

Mannar, formerly spelled Manar, is the main town of Mannar District, Northern Province, Sri Lanka, governed by an Urban Council. It is located in Mannar Island overlooking the Gulf of Mannar. Apart from the thin strip of land that joins the peninsula to the mainland, Mannar island is also connected by a causeway over the shallow waters forming a 3 km stretch of A14 Madawachchiya –Talaimannar main road. The small fishing port of Mannar is located on the southeastern shore. The landscape in Mannar district varies from wooded jungles to paddy fields and palm trees.

Mannar Island, though called an island, is in fact a peninsula formed in a shape of a tongue. At Talaimanar, the westernmost tip of the island, it is almost connected to the Dhanuskodi, the easternmost tip of peninsula of Southern India by a reef of corals submerged in the Palk Straits. Majority of the city residents are engaged in fishing or fishing industry and related employment such as drying fish.

WATER

In earlier days, the residents in the city had to depend on groundwater for their day-to-day needs. Nevertheless, groundwater often was not suitable for drinking purpose due to the saltiness. Consequently, the city had been facing difficulties with the access to drinking water.

To overcome this challenge, a pipe born water supply scheme was established in the city and is being operated by National Water Supply and Drainage Board. Three water supply sources are available at present in Mannar Island namely, Murunkan water supply scheme (15,000 m^3/day), Keeri well water (2250 m^3/day) and ground water within Pesalai PS area (UDA, 2019).

THE CITY	
Province	Northern
District	Mannar
Local Authority	Mannar Urban Council
Municipal Area	27.6 km^2 (ADB, 2012)
Population	25,472 (ADB, 2012)
No of Households	4900
Rate of Population Growth	-0.3 % (2016) [UDA, 2019]
Climatic Zone	Dry & Semi-Arid
Annual Rainfall	975 mm -1,075 mm (Rainy season: April to August and October to January)
Average Temperature	23.3 ºC (low), 33.3 ºC (high)
Elevation	1.0 m above MSL
Major Industries	Fishing
WATER	
Potable Water Sources	Murunkan water supply scheme, Keeri well water, ground water within Pesalai PS area (UDA, 2019)
Pipe Borne Water Coverage	
SOLID WASTE	
Waste Generation	28 MT / day
Waste Collection	25 MT / Day
Collection Coverage	
SW Treatment/ Disposal Method	Disposed at a land close to the cemetery
Available Area for Disposal	5 Acres (Close to Mannar Cemetery)
Duration in Operation	Since 1941
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	90 m^3 / month
Treatment & Disposal	Septage treatment plant, Mannar - Pond system (28 m^3 / day)

SOLID WASTE MANAGEMENT

Generation and Collection

Mannar Urban Council is responsible for collecting MSW and performs these responsibilities with limited resources. The UC has a fleet of vehicles that collect SW from households, commercial places and market on a regular basis. Given the limited amount of resources available in terms of vehicles and labor, and limited access to some localities (difficulties to drive through the by-roads); waste collection in certain areas is only conducted twice a week. Out of the total waste; nearly 68% produced by the residential activity and 4% produced by industrial sector and 28% produced by commercial sector. (UDA, 2019). Composition of the collected waste consists of 33% of biodegradable waste (short term 25% and long term 9%) which is much lower compared to the national average (often more than 50%).

Treatment and Disposal

Currently, waste segregation is not practiced in Mannar and as a result, large quantities of waste collected by UC are mixed waste. With the financial support provided through the Pilisaru project of CEA and National Solid Waste Management Support Center (NSWMSC) of Ministry of Local Government and Provincial Councils (MOLGPC) a small-scale compost plant has been established in the UC area. The LA also owns a plastic recycling facility, which is located within the same premises. The laborers separate the plastics, iron and glass from the waste manually and sell them to vendors. The remaining waste ends up being openly dumped in multiple locations around Mannar town. At present there are three places used for dumping purpose, which are located at UC and PS area covering 8 acres land.

Table 27: Facilities available for the SWM of the Area - Mannar UC

Vehicle fleet	13 tractors, 01 compactor truck, 01 dump truck, 4-ton truck
Workforce and level of skills (laborers, technicians, supervisors etc.)	64 (60 Labour Force + 4 Supervisors)

Figure 37: Compost plant and plastic recycling center in Mannar (photo credit: IWMI)

WASTEWATER AND SEPTAGE

Urban Council has recently constructed a drainage system with the financial and technical assistance of UNOPS. The project included constructing fully-fledged concrete canal structures running through four directions covering the areas of Mannar Bridge, the fish market, salt basin channels and Pallimunai, Talaimannar road from the middle of the town to the seashores.

In absence of a sewerage system the town depends on onsite sanitation systems as means to contain septage.

Table 28: Types of Latrines used in Mannar UC area

Pit latrines	60 %
Septic tanks	40 %

Emptying these sanitation systems is a service provided by the MC. With financial aids from ADB, a new septage treatment plant has been built for the Urban Council under Sri Lanka: Dry Zone Urban Water and Sanitation Project. The has the capacity of treating 28m^3 of septage per day (ADB, 2012). Septage collected by the UC is transported to this plant for treatment.

Table 29: Resources for Septage management in Mannar UC

Vehicle fleet	2 Gully Bowsers (5000 L & 2000 L)
Workers	2 labors, 2 drivers

Figure 38: Septage treatment plant in Mannar

Treatment system	Waste stabilization pond system (consisting of anaerobic, facultative and maturation pond series)
Design capacity	28 m^3/day
Starting year	2014
No. of staff	2 labors
Operating capacity	15-25 m^3/day (3-5 gully bowser loads are disposed daily)

Source: (IWMI FSM Assessment, WB, 2019)

LOOKING AHEAD

Considering solid waste management, introducing source segregation at the household level, encouraging source waste management such as home composting and provision of adequate resources for solid waste management units are major concerns of the Urban Council. Further 10 acres of land has been identified for future waste disposals at Pesalai area inside of the mixed development Zone. It is planned to divide this land into several parts for different purpose such as for open dumps (7 acre) and use for composting practices (2 acre) also separation of waste for 3R mechanisms (2 acre) (UDA, 2019).

Currently, infrastructure improvement is underway but it has to keep pace with the rapid development envisaged. Special attention is needed on waste management, as this will be a growing problem. Tourism and recreational activities need attention, which will also provide job opportunities to people.

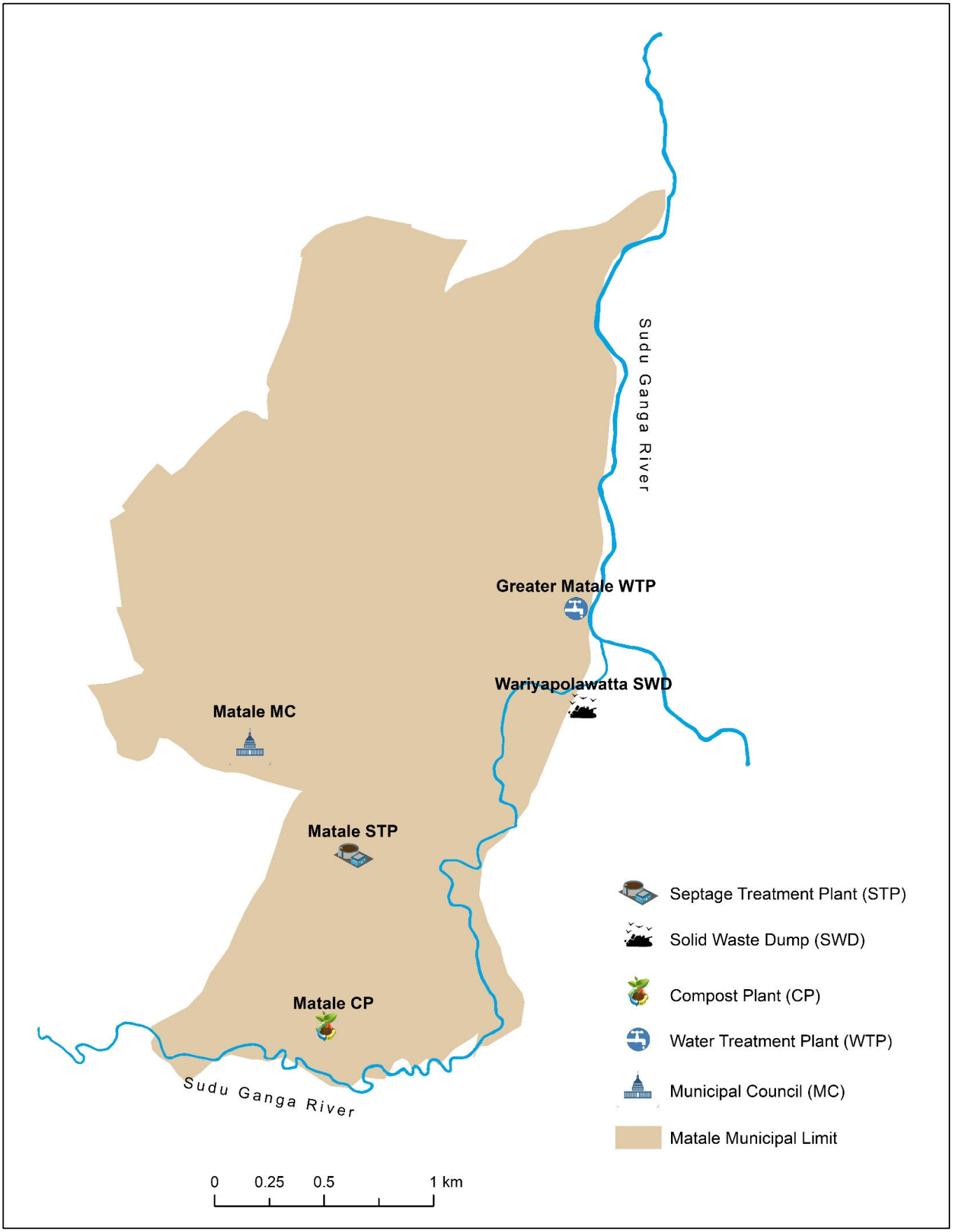
REFERENCES

ADB Initial Environmental Examination Report on Sri Lanka: Dry Zone Urban Water and Sanitation ProjecT - for Mannar Septage Treatment Plant (2012)

IWMI report for UNOPS on SWM in Mannar district

Mannar Island Development plan (2019-2030)-UDA (2019)

12. Matale


Sudu Ganga River
Greater Matale WTP
Wariyapolawatta SWD
Matale MC
Matale STP
Matale CP
Sudu Ganga River
Septage Treatment Plant (STP)
Solid Waste Dump (SWD)
Compost Plant (CP)
Water Treatment Plant (WTP)
Municipal Council (MC)
Matale Municipal Limit
0
0.25
0.5
1 km

Matale City Profile

BACKGROUND

Matale is a hilly town located 142 km away from Colombo and 26 km from Kandy. Kandy – Jaffna (A9) highway is crossing the city and "Sudu Ganga", a tributary of Mahaweli River flows in the northern direction from eastern boundary of the city. Matale is mainly an agricultural area where tea, rubber, vegetable and spices cultivation dominate. It is a historical city with a growing potential of tourism industry. Apart from the permanent residential, there are additional 60 000 of floating population in the city. Matale municipal council is the commercial and administration center of the district. The city has over 8 000 trade establishments and over 200 small and medium scale industries. The municipality consists of 61 % residential, 19 % agricultural and 20 % other institutions. Matale has lots of scenic and ancient places such as Knuckles mountain range and 'Alu Vihara Rajamaha Viharaya' temple.

WATER

The Water Supply Scheme in Matale city is operated and maintained by National Water Supply and Drainage Board (NWSDB). Intake of the water supply is from Sudu Ganga river at Kiula (JICA, 2012). Water is treated at the treatment plant in Kiula prior to distribution, covering about 17 000 connections in municipal area.

Shallow groundwater stratum of the hilly area is very thin and there is less potential for groundwater extraction. Groundwater level in hilly slopes are not deep and during long dry spells, dug wells get almost dry. There are 27 artisan wells in and around the city. Matale MC has developed three artesian wells in "Dola" at Dole road, "Bubula" at Diyabubula road and one well at Godapola road area for public bathing. Those artisan wells have attraction of local visitors, and shallow groundwater is used for drinking purpose (JICA, 2012).

THE CITY	
Province	Central
District	Matale
Local Authority	Matale Municipal Council
Municipal Area	8.61 km^2
Number of Wards	13
Population	50 300 (2015)
No of Households	8698
Rate of Population Growth	1.5 %
Climatic Zone	Wet Zone
Annual Rainfall	1950mm (Rainy season: May to August and October to January)
Average Temperature	25.2 °C
Elevation	364 m above MSL
Major Industries	Tea, Rubber, Spices, Tourism, Porcelain
WATER	
Potable Water Sources	Sudu Ganga River
Water Treatment Plants	01 (Matale)
Pipe Borne Water Coverage	90%
SOLID WASTE	
Waste Generation	38 MT / Day (estimated)
Waste Collection	28 MT / Day
Collection Coverage	74 %
SW Treatment/ Disposal Method	Composting + Landfilling + Recycling
Total Cost for Waste Management	47 915 463 LKR (2018)
Available Area for Disposal	2 acres (Wariyapolawatta)
Duration in Operation	13 years
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	434 m^3 / Month
Disposal	Matale Wastewater Treatment Plant
Septage Treatment	434 m^3 / Month

SOLID WASTE MANAGEMENT

Generation and Collection

Matale MC is responsibile for the management of SW produced in the area. Waste in the municipal area is collected via 9 waste collection routes and the waste collection system has been designed in a manner to extend the collection service in all 13 wards. The council practices "Just in time" waste collection system in 10 wards before the daily city activities begin in order to avoid traffic and other inconveniences. Waste is collected separately as biodegradable and non-biodegradable. All households and commercial institutions are encouraged to segregate their waste. MC has scheduled to collect both biodegradable and non-biodegradable waste in city center on daily basis. Over 8,000 trade establishments and over 200 small and medium scale industries within the municipality limits contribute to the total waste generated in Matale (JICA, 2012).

Hazardous waste from Matale hospital is not collected along with municipal solid waste and the hospital has adopted several waste management practices such as incineration, burying or flushing to an underground tank.

Table 30: Community waste management practices in Matale MC

Door to door collection	70 %
Giving waste to collectors	17 %
Household dispose	13 %
Waste is collected by roads	01 %

Treatment and Disposal

The municipality dispose waste into a 2 Acres land in Wariyapolawatta area which has been leased from a private party. About 23 MT of waste is disposed into this site daily. Another 5 tons of waste is recycled through composting process. There is no clear understanding of how the remaining 10 tons of waste that is not collected is managed. However, in the case of households that do not receive the MMC service or do not use it, their waste is buried, burnt or composted etc.

The municipal dumpsite is close to a common water stream of the area called "*Diyabubula*" and has a gentle slope towards the stream. The disposal site does not follow sanitary landfill techniques, hence there is a possibility that it may cause negative environmental impacts on the water body and the surrounding nature.

Table 31: Facilities available for the SWM of the Area - Matale MC

Vehicle / Machinery	Compactors (02), Wheel Tractors (04), Hand Carts (10), Dumper (01)
Workforce and level of skills (laborers, technicians, supervisors etc.)	Laborers - in total (120), Supervisors (02)

Figure 39: Municipal dump site in Wariyapolawatta

COMPOSTING FACILITY IN MATALE MC

As a response to the rising waste problem in Matale city area, the MC is in association with National Cleaner Production Center and United Nations Environment Program (UNEP) to develop an Integrated Solid Waste Management (ISWM) Plan towards a Zero-Waste City to guide the city to adhere to a more sustainable waste management approach. The inception of composting industry in Matale was in 2007, when UNESCAP funded to establish a compost plant with a capacity to accept 2 tons of waste per day in a land provided by Matale MC (Higgolla Area). Sevanatha Urban Resource Centre managed the project at the initial stage. To improve the facility's business performance by operating the facility and undertaking business planning and associated functions, Sevanatha established a social enterprise (Micro Enriched Compost). In 2009 same compost plant extended under the financing of Central Environmental Authority (CEA) through "Pilisaru" National Solid Waste Management project in order to treat another 2 tons of waste. In 2011, a third extension of the compost plant was done with the funding from the UNESCAP with the whole capacity of 5 tons per day. Currently, the Compost plant is being operated under Matale Municipal Council.

Besides, shortage of the laborers, high number of laborers absentees and frequent drop outs, laborers attending to their work untimely and leave quickly, lack of safety equipment available for laborers, and lack of care on safety and health among laborers are some of the problems that have been reported as faced by the MC in managing waste and composting (Ihalagedara and Pinnawala, 2015).

Design Capacity	5 MT / Day
SW quantity processed at the plant at present	5 MT / Day
Vehicle/ Machinery	Tractor (07), Compactors (03), Sieving Machine (02)
Workforce	Supervisor (05), Workers (07), Waste Collectors (27), Drivers (05)
Compost production	1.2 tons / month
Average Sales of compost	100 kg / day
Selling price of compost	12 LKR / kg, Bulk selling (>1000kg) = 10 LKR / kg

Compost Packet


Compost Pile


Garbage separation equipment

Figure 40: Compost facilities in Matale MC (photo credit: IWMI)

WASTEWATER AND SEPTAGE

Domestic wastewater generated in the city is disposed in to the street drains and drainage channels directed into a natural stream of Sudu Ganga namely Brahmana Ela. The stream is heavily polluted with greywater and plastic waste. The main drain at Gongawala road is one of the examples of polluted drains (JICA, 2012).

In Matale MC, there is no existing sewer network and MC provides the service for desludging of onsite sanitation systems operates in the city by means of gully trucks. A request along with a payment has to be made by the owner of the sanitation system to the MC in order to obtain the desludging service.

Table 32: Types of sanitary facilities used in Matale MC (JICA, 2012)

Pit latrines	10 %
Septic tanks	70 %
Cesspits	20 %

Charges comprise of an inspection fee prior to deliver the desludging service and are varied based on several factors such as location (within the MC boundary or beyond), poverty status of the household and category of the entities (commercial, religious places, estates etc). Currently, within the MC area charge for households 4 320 LKR for one de-sludging while 10 800 LKR for large scale commercial properties. On average two de-sludging requests are attended by the MC daily within the MC area. The income from septage de-sludging service is one of the major incomes of the MC (JICA, 2012).

Table 33: Resources for Septage management in Matale MC

Vehicle fleet	Gully bowser (02) - 800 L & 1000 L
Workers	Driver (02), Laborers (02)

LOOKING AHEAD

When the wastewater treatment plant of the area is considered, lack of technical knowledge & financial resources and unavailability of coir media are among the major issues MC has encountered while operating the treatment plant. Apart from that, unavailability of roofing facility for the drying bed that leads to an extended drying period during rainy season has also been identified as an issue to be rectified.

Although, 70 % of the households in the Matale MC are having proper septic tanks, 30 % of the households direct their greywater and pit latrine and cesspit overflows to public drains (JICA, 2012). Currently, there is no sewerage system even within the city center and it was revealed that combine sewer and greywater collection system with a treatment facility is required to prevent further deterioration of Sudu Ganga water quality and improvement in environment and advancement in quality of the life (JICA, 2012).

Septage disposal and treatment is carried out at a treatment system built in the corner of Matale cemetery, under the financial assistance of German Government in 2006. Prior to implementing this plant, septage was disposed in trenches excavated near the waste dumping site. The plant has a capacity of treating 15 m3 of septage daily. At present, the plant receives a total amount of about 14 m3 per day. The treatment system comprises of a sedimentation tank, an aerobic digester with coir media and drying beds. MC has adopted reuse practices into septage management by utilizing treated effluent for gardening purposes and dried sludge for landscaping and horticulture.

There are several industries found in Matale city limit including wood-based industries (Saw mills), apparel manufacturing Industries (Juraniza Fashion Garment and Winter Knitting Garment) and a Food Industry (Diana Chocolate Company). Most of the industries use their own wastewater treatment plants. Some small and medium scale commercial units such as vehicle service stations discharge wastewater in to drains.

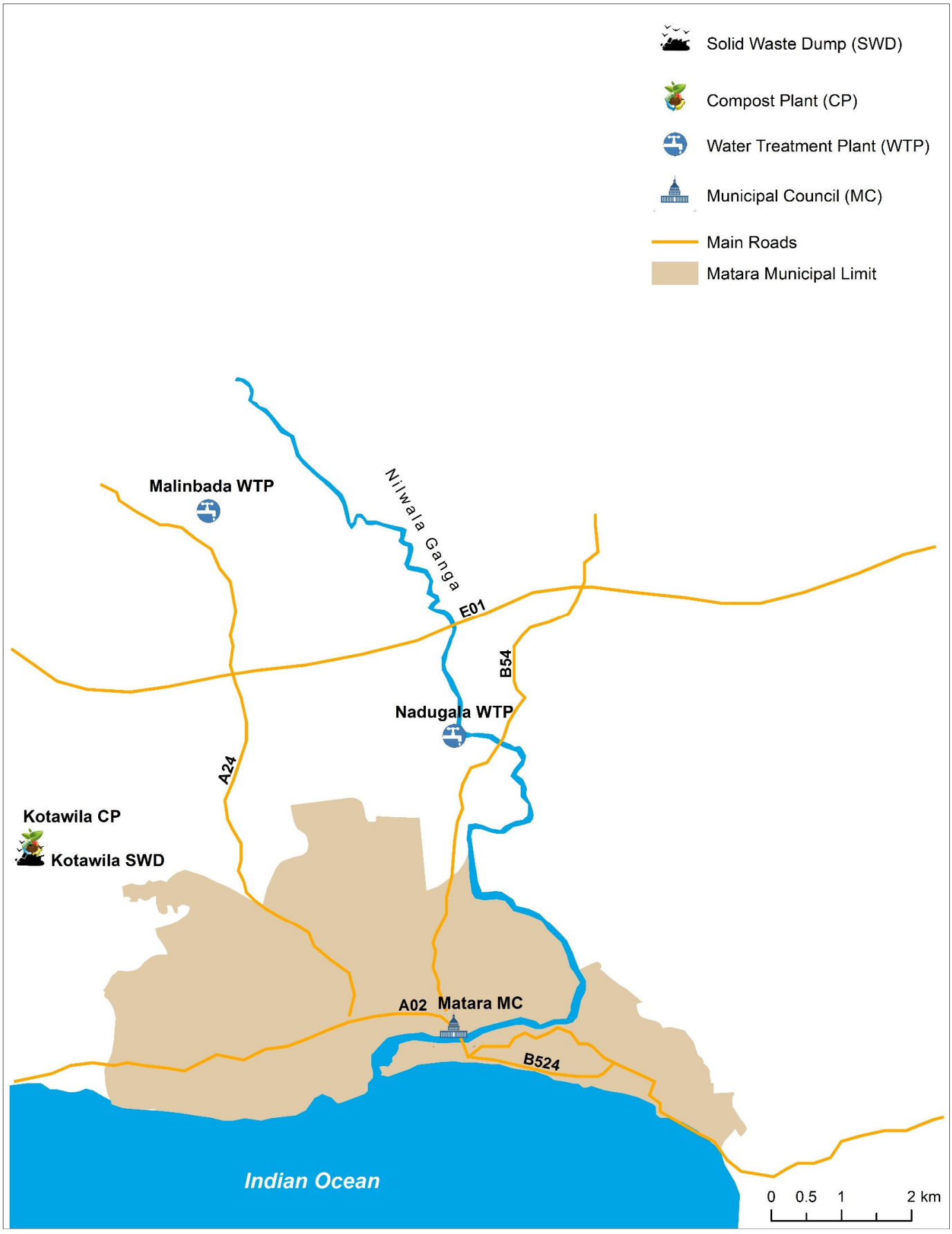
Figure 41: Wastewater Treatment in Matale MC (photo credit: IWMI)

REFERENCES

Ihalagedara, M. and Pinnawala, M., 2015. Problems related to sanitary labours in solid waste management: A case study in Matale municipal council. In *Proceedings of the 3rd International Symposium on Advances in Civil and Environmental Engineering Practices for Sustainable Development ACEPS* (pp. 155-161).

Japan International Cooperation Agency (JICA)., Nihon Suido Consultants Co. Ltd., Yachiyo Engineering Co. Ltd. and Yokohama Water Co. Ltd., 2012. Data Collection Survey on Sewerage Sector in Democratic Socialist Republic of Sri Lanka

13. Matara


Solid Waste Dump (SWD)
Compost Plant (CP)
Water Treatment Plant (WTP)
Municipal Council (MC)
Main Roads
Matara Municipal Limit
Malinbada WTP
Nilwala Ganga
E01
B54
Nadugala WTP
A24
Kotawila CP
Kotawila SWD
A02
Matara MC
B524
Indian Ocean
0 0.5 1 2 km

Matara City Profile

BACKGROUND

Matara City is a major city in Southern Province and located on almost flat land parallel to the sea. Matara, 160km from Colombo, is a busy, sprawling commercial town. Main attractions of the city are its ramparts and well-preserved Dutch fort. The city is famous for beautiful beaches including Polhena which has a good coral reef and famous as a surfing point.

Some part of the city is below the sea level. The Nilwala Ganga (river) flows through Matara city and meets the Indian Ocean at Matara sea shore. Today's Matara consists of high number of buildings with a lot of business activities going on as many companies from Colombo have established branches in the Matara city.

WATER

The Drinking water supply for Matara UC area is provided by the National Water Supply and Drainage board (NWSDB). Average monthly production is about 109,971 m^3. Total number of connections as end of 30th April 2015 is 6,343 and the source of water is the Nilwala River.

Raw water is taken from Nilwala River at the Intakes at Kadduwa and Nadugala. The treatment plants are located at Malimboda and Nadugala. Those are conventional full treatment process and the capacity of the treatment plants are 36,000m^3/day and 7,000m^3/day respectively.

SOLID WASTE MANAGEMENT

Generation and Collection

Matara MC provides waste collection from houses and other entities and transport to compost project site at Kotawila village, nearly 10km away from Matara City.

Table 34: Facilities available for the SWM of the Area (Matara MC)

Vehicle/ Machinery	Tractors 16, Tippers 6, Hand tractors 3, Bob cat 1, JCB 1, Compactor 1, Hand carts 15, Tricycle (Plastic Collection) 3
Workforce and level of skills	Labors (Permanent) 196, Labors (Contract basis) 76

Treatment and Disposal

MC owns a compost plant through which whole amount of the collected biodegradable waste (18-20 tons/day) is treated. Non-biodegradable waste (plastic and polythene; ~11 tons/day) collected by MC is processed at a recycling plant operated by a Polygon Pvt. Ltd.

MC has initiated a waste to energy project with the support of CEA and Bio Recycle Pvt. Ltd. Currently, the produced energy is used for the operations at the compost plant and the recycle center. SW residuals are disposed at the dumpsite situated adjoined to the composting facility.

THE CITY	
Province	**Southern**
District	Matara
Local Authority	Matara Municipal Council
Municipal Area	13 km^2
Number of Wards	37
Population	77,592 (2012)
No of Households	12,081
Climatic Zone	Wet Zone
Annual Rainfall	2000 - 2500mm (Rainy season: October to December)
Average Temperature	35^{o}C (high), 26^{o}C (low)
Elevation	2 m above MSL
Major Industries	Tourism, Business
WATER	
Potable Water Sources	Nilwala River
Pipe Borne Water Coverage	> 50 % (NWSDB)
SOLID WASTE	
Waste Generation	58 MT (estimated)
Waste Collection	30-35 MT/Day (2019)
Collection Coverage	60%
SW Treatment/ Disposal Method	Open dump, Controlled landfilling, Composting
Annual Budget for waste collection	12 435 250 LKR (2010)
Available Area for Disposal	13 Acres (Kotawila village)
Duration in Operation	Since 2000
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	20.3 m^3/day
Treatment & Disposal	Dump into a Coconut Plantation

Figure 42: Water Treatment Plant (Matara MC)

Figure 43: Landfill site adjoining the compost site (Matara MC) (photo credit: IWMI)

Composting and Recycling Facility

Matara compost plant is located in Kotawila, 10 km away from the city. The compost plant was set up in 2000 and has been in operation since then. Plant is located in an area of 13 Acres land. Currently, the plant receives about 30-35MT/day of mixed waste and processes 18-20 MT/day of biodegradable waste.

Design Capacity	Unknown
SW quantity processed at the plant at present	18-20MT/day
Vehicle/ Machinery	Tippers 6, Bob cat 1, JCB 1, Compactor 1
Workforce	Labors 27
Compost production	10 tons/month
Average Sales of compost	~ 91,000 LKR/month
Selling price of compost	10 LKR/kg

Figure 44: Septage disposal at coconut plantation (Matara MC)

Figure 45: Compost Plant – Matara MC (photo credit IWMI)

WASTEWATER AND SEPTAGE

96% of the population has access to a sanitary latrine. Although the access to sanitation facility is very high, the MC encounter problems regarding septage management. Natural presence of shallow water table in coastal areas, and high percolation rate of sandy soil in most coastal places hinders the soil treatment of fecal sludge (through soakage pits) from the sanitation systems, hence being contained in pits or septic tanks. The frequent filling of these systems demands regular emptying. Residents within the MC boundary have to pay a charge of 2,800 LKR and 2,050 LKR per one load from the 4000 L and 1800 L gully bowsers respectively upon obtaining the desludging service from the MC. Sometimes the truck capacity is not enough to empty the pits. If the pits are located in inaccessible places for the truck, manual removal of septage is done by the skilled sanitary workers.

Table 35: Available resources for septage management (Matara MC)

Vehicle/ Machinery	Gully bowser (02) 4000 L ,1800 L
Workforce and level of skills (laborers, technicians, supervisors etc.)	Labors (2)

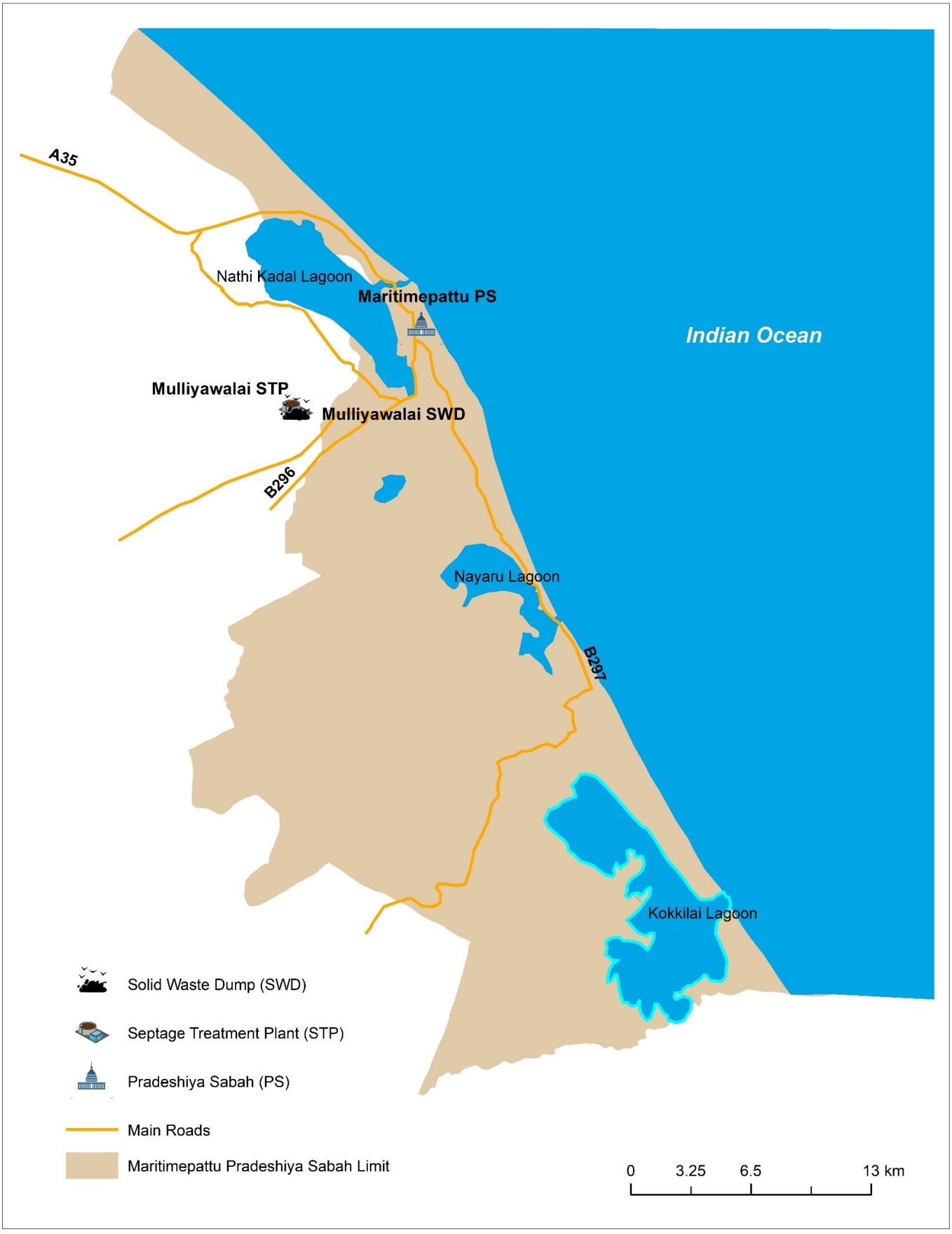
Matara MC uses 70 acres of coconut land in Thalpitiya to unload the trucks, as a short-term solution. Landowner has allowed unloading the trucks into the trenches between coconut trees. The whole city depends on septic tanks and pit latrines for disposal of septage. Some people who have settled near canals and marshland discharge the effluents directly into the waterways, thereby polluting the environment and posing health hazards.

Most of the Factories located at Matara discharge raw untreated effluent into open drains leading to natural waterways or low-lying land and thereby polluting the ground water table which is very high in this area.

REFERENCE

Japan International Cooperation Agency (JICA)., Nihon Suido Consultants Co. Ltd., Yachiyo Engineering Co. Ltd. and Yokohama Water Co. Ltd., 2012. Data Collection Survey on Sewerage Sector in Democratic Socialist Republic of Sri Lanka

14. Mullaithivu



Mullaithivu City Profile

BACKGROUND

Maritimepattu pradeshiya sabha is a local authority in Mullaitivu District, of Northern Province. A large fishing settlement, the town in the early 20th century grew as an anchoring harbor of the small sailing vessels transporting goods between Colombo and Jaffna.

WATER

The water sources for drinking is depend on 148 public wells and 18 tube wells and private wells. There are 12 ponds, 5 rivers, one spring available for the purposes. However, during dry period the public face water shortages. One tube well (Bowser Supply) and one dug well was constructed by International Committee of Red Cross (ICRC) in 1980. This was renovated and still in use. The government provided one bowser with 10,000 L capacity and three bowsers with 4,000 L capacity. for water distribution. For the water supply services public has to pay 0.50 LKR / Liter. In Kokkillai area the price is 1.00 LKR / Liter.

SOLID WASTE MANAGEMENT

Generation and Collection

The solid waste collection in the Maritimepattu pradeshiya sabha is limited to the main road and town centers. There are eight markets in the area and thirteen slaughter houses located in the PS area. Daily solid waste collection in pradeshiya sabha is approximately 2 tons. However, they are facing problems with inadequate human resources in rendering the solid waste collection service.

Table 36: Facilities available for the SWM of the Area (Mullaithivu)

Vehicle fleet	Tractors (3)
Workforce	13

Figure 46: Solid waste Dumpsite (Mullaithivu) (photo credit: IWMI)

THE CITY	
Province	Northern
District	Mullaithivu
Local Authority	Maritimepattu Pradeshiya Sabha
Municipal Area	728.6 km^2
Population	41,558 (Ministry of City Planning and Water Supply, 2017, 2017)
No of Households	13,028 (Ministry of City Planning and Water Supply, 2017, 2017)
Climatic Zone	Dry zone
Annual Rainfall	1300-1400mm (Rainy season October to February)
Average Temperature	33 °C (high), 26 °C (low)
Elevation	30 m above MSL
Major Industries	Fishing
WATER	
Potable Water Sources	Public wells (148), tube wells (18)
Pipe Borne Water Coverage	
SOLID WASTE	
Waste Generation	16.6 MT / Day (estimated)
Waste Collection	2 MT / Day (2013)
Collection Coverage	12 %
SW Treatment/ Disposal Method	Open dump into forest area
Available Area for Disposal	3 acres (Kayattai)
Duration in Operation	Since 2010
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	18 m3 / day
Treatment & Disposal	Excavated pits in solid waste dump site

Treatment and Disposal

Present solid waste disposal method practiced by the pradeshiya sabha is open dumping where the solid waste is disposed to forest area in Kayattai, Mulliyawalai. The medical waste generated by the hospital is disposed at their own dumping site. It was noted that there is no facility at the General Hospital to handle medical waste.

WASTEWATER AND SEPTAGE

Within the PS area, only 80 % of population is having their own toilets. The balance population depend on sharing the toilets with others or common toilets. Apart from that, public toilets are available in the sea side area and religious places such as churches and Hindu kovils.

Septage desludging service is provided by the PS on request basis, which is approximately three requests per day. Pradeshiya sabha owns two septic trucks having capacity of 4000 L and 8000 L. Mostly 4000 L septic truck is used for household septage desludging whereas 8000L one is only used at the Hindu Kovil. Generally desludging charge per load is 5 000 LKR at presen

Table 37: Resources allocated for Septage management (Mullaithivu)

Vehicle fleet	4,000 L Gully Bowser (1), 8,000 L Gully Bowser (1)
Workers	Driver (01), Labor (01)

Septage collected in the area using gully bowsers are emptied into an open pit located close to the solid waste dump site at Mamuli, Nagacholai.

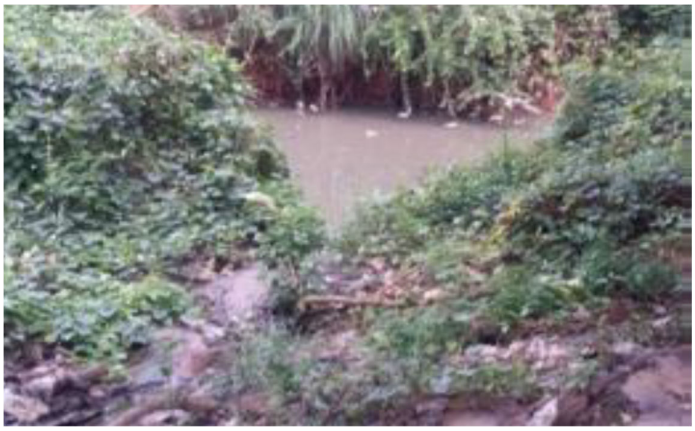


Figure 47: Septage dumping pit – Mullaithivu (Ministry of City Planning and Water Supply, 2017)

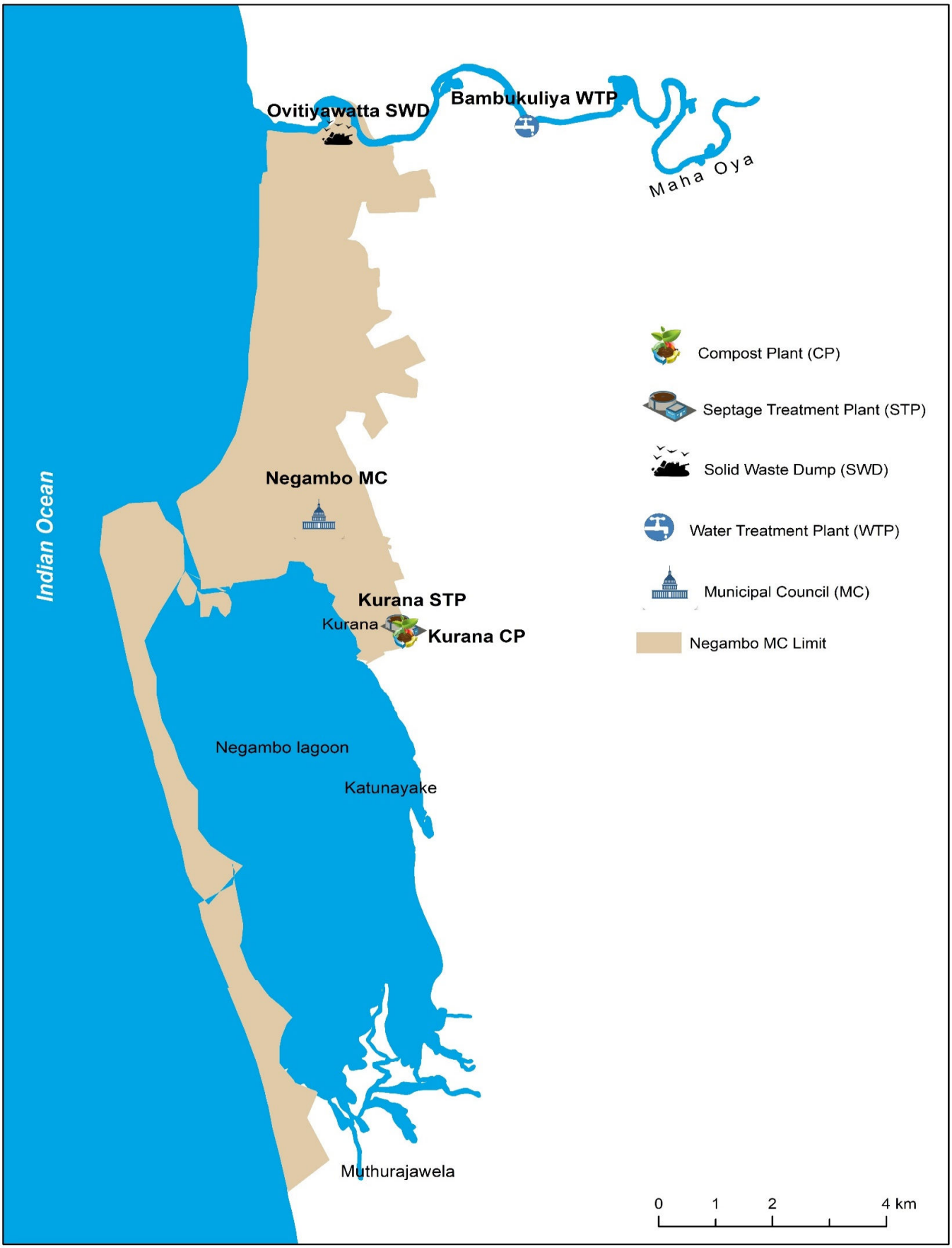
LOOKING AHEAD

A Septage Treatment Plant (STP) for Mullaithivu Pradesiya Saba has been proposed under the Water Supply and Sanitation Improvement Project (WASSIP) executed by the Ministry of City Planning and Water Supply with the financial assistance of the World Bank. The proposal is in line with the project objectives, with the aim of improving environmental sanitation in the project areas and improve quality of life of the people. The proposed STP will serve the entire Mullaitivu district and will be able to treat the septage collected in the area with a design capacity of 25m3/day. The treatment process is a waste stabilization pond system. (Ministry of City Planning and Water Supply, 2017).

REFERENCE:

MINISTRY OF CITY PLANNING AND WATER SUPPLY - Environmental Assessment for the Proposed Septage Treatment Plant at Mullaitivu (2017)

15.Negombo


Ovitiyawatta SWD
Bambukuliya WTP
Maha Oya
Indian Ocean
Negambo MC
Kurana STP
Kurana
Kurana CP
Negambo lagoon
Katunayake
Muthurajawela
Compost Plant (CP)
Septage Treatment Plant (STP)
Solid Waste Dump (SWD)
Water Treatment Plant (WTP)
Municipal Council (MC)
Negambo MC Limit
0
1
2
4 km

Negombo City Profile

BACKGROUND

Negombo is located in the administrative district of Gampaha, Western Province in the west coast of Sri Lanka. It is a coastal town developed around the Lagoon of Negombo located about 37 km away from Colombo on the Northern direction. The city is located within the close proximity to Bandaranayke International Airport, Katunayake Free Trade Zones and Katunayake expressway interchange. Negombo's geography is a mix of land and water. The coastal city owns the Dutch canal flows in the middle of the city, a lagoon and a perennial water body to the northern border of the city formed by the Ma Oya river.

Negombo is renowned for fishing industry. Approximately 36% of the population depend on the sea or lagoon for their living. Traditional fishing industry is still in practice in the area. Negombo fish market is one of the best markets in the country for fresh fish. Apart from fishery, tourism significantly contributes to the economy sector of the city. The main tourist resorts are situated north of the town.

WATER

Maha Oya River is the main water source of Negombo Township. Water for the city is supplied through Bambukuliya water supply scheme. Currently Negombo has 40373.125m^3 of total water demand.

SOLID WASTE MANAGEMENT

Generation and Collection

Municipal council trucks collect waste separately in categories of organic and inorganic waste. Waste is collected daily in two shifts around the city center and nearby tourist areas whereas in other areas, organic waste is collected in three days per week and inorganic waste only once a week. Home composting is promoted in the municipal council area and subsequently, 500 compost bins have been distributed among households (UDA development plan, 2018).

During seasons of April and December, the population in Negombo rises due to migration of tourists. MC increases the waste collection shifts during peak seasons. To overcome rising garbage problem, MC conducts special awareness programs among the hotel/ restaurant owners and public general about waste reduction methods and safe disposal practices.

Treatment and Disposal

Municipal Council disposes majority of the collected waste (more than 80%) into a private land located in Ovitiyawatta, which has cha racteristics of a wetland. The area often inundates during the rainy season and continuation of waste dumping in this land might cause disastrous consequences to the surrounding area. Unfortunately, the local authority has no alternative with regard to the disposal of solid waste. Municipal waste has been disposed to this land for over 18 years.

THE CITY	
Province	Western
District	Gampaha
Local Authority	Negombo Municipal Council
Municipal Area	30.84 km^2
Number of Wards	39
Population	145,600 (2016)
No of Households	33 406
Rate of Population Growth	2.0%
Climatic Zone	Wet zone
Annual Rainfall	2400 mm (rainfall season: May to August and October to January)
Average Temperature	27 – 28 °C
Elevation	3.5 m above MSL
Major Industries	Fishing, Tourism
WATER	
Potable Water Sources/ schemes	Bambukuliya Water Supply scheme
Pipe Borne Water Coverage	59%
SOLID WASTE	
Waste Generation	110 MT/Day (estimated)
Waste Collection	110 MT/Day
Collection Coverage	100%
SW Treatment/ Disposal Method	Open dumping, Landfilling, Composting
Available Area for Disposal	5 Acres (Ovitiyawatta)
Duration in Operation	38 years
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	60 m3/Day
Treatment & Disposal	Septage Treatment Plant (Kurana)

MC also operates a small compost plant that accepts 10 tons of organic waste daily and three recycling centers that collects recyclables such as plastics, glass and polythene.

Figure 48: Negombo MC Compost plant (photo credit: IWMI)

Composting and Waste Recycling Facilities in Negombo

The compost plant in Negombo was constructed in 2007 with the funding of the Municipal council. The facility is located in Kurana area and processes a portion of organic waste collects by the local authority. Compost is sold at 7.00 LKR per kilogram and there are 5 Kg, 20 Kg and 50 Kg packs available depending on the demand. Municipal Council earns approximately Rs. 100,000 120,000 per month by selling compost. Air-force, Agrarian Service Department, Coconut estate owners are the main buyers of the produced compost.

Design Capacity	10 MT/day
SW quantity processed at the plant at present	8 MT/day
Vehicle/ Machinery	Tractor (01), skid steer loader (02), screening machine (02), sewing machine (01), weight scale (01), convey belts (03)
Workforce	Supervisor (1), Laborer (10)
Average Sales of compost	10-12 MT/Month (2013)

Figure 49: Compost Product - Negombo MC (photo credit: IWMI)

Apart from that, the Municipal Council maintains three recycling collection centers in Kadolkale, Muhandiramwatta and Negombo. Each center carries a capacity of 1 ton per day. The centers collect recyclables such as glass, polythene, plastic, paper and cardboard. The collected polythene and plastic are sorted and compacted into bales before selling. The MC has given permission for the laborers engaged in the waste collection to handle the selling of collected recyclable items by themselves as a motivation for their services.

WASTEWATER AND SEPTAGE

Most of the greywater from households in the municipal area is directed to canals or storm water drainage system. Main storm water drainage system covers the area of Dehimalwatta, Greens road, Main Street, and the Rajapakse Broadway, and provision has been made for the flow of water to the lagoon. Water running in the canal network is polluted and shows indication of eutrophication taking place.

Negombo municipality completely depends on on-site sanitation systems without any sewerage coverage.

Table 38: Types of Latrines used within Negombo MC (UN-Habitat, 2002)

Water sealed toilets & septic tanks	98.4%
Pit Latrines	1.6%

Emptying of onsite sanitation systems is a service provided by the MC at a charge. The charges are about 3000 LKR from the residences, 5000 LKR from business places, 2500 LKR from religious places and 3000 LKR from government places within MC area per turn. Average monthly revenue of Negombo MC from desludging service is about 292,000 LKR.

Table 39: Current resources for the Septage Management in Negombo MC

Vehicle fleet	Gully Trucks (04)
Workforce	Supervisor (01), Plant Operator (01), Driver (04), Laborers (10)

Collected septage is disposed at a treatment plant operated by the MC. The plant was constructed at Kurana in 2005, with the assistance from National Engineering Research and Development Centre (NERDC) in planning and building the plant. The plant treats water with the technology of anaerobic Treatment (Up-Flow Anaerobic Floating Filter). However, the plant was operated only six months intermittently after the commissioning. In 2017, steps were taken to rehabilitate the existing plant with additional treatment units to ensure effective functionality of the treatment plant.

Although improper septage disposal is considerably addressed through the current system, indiscriminate disposal of septage is still being practiced in some areas especially during the rainy seasons.

Figure 50: Kurana septage treatment plant

LOOKING AHEAD

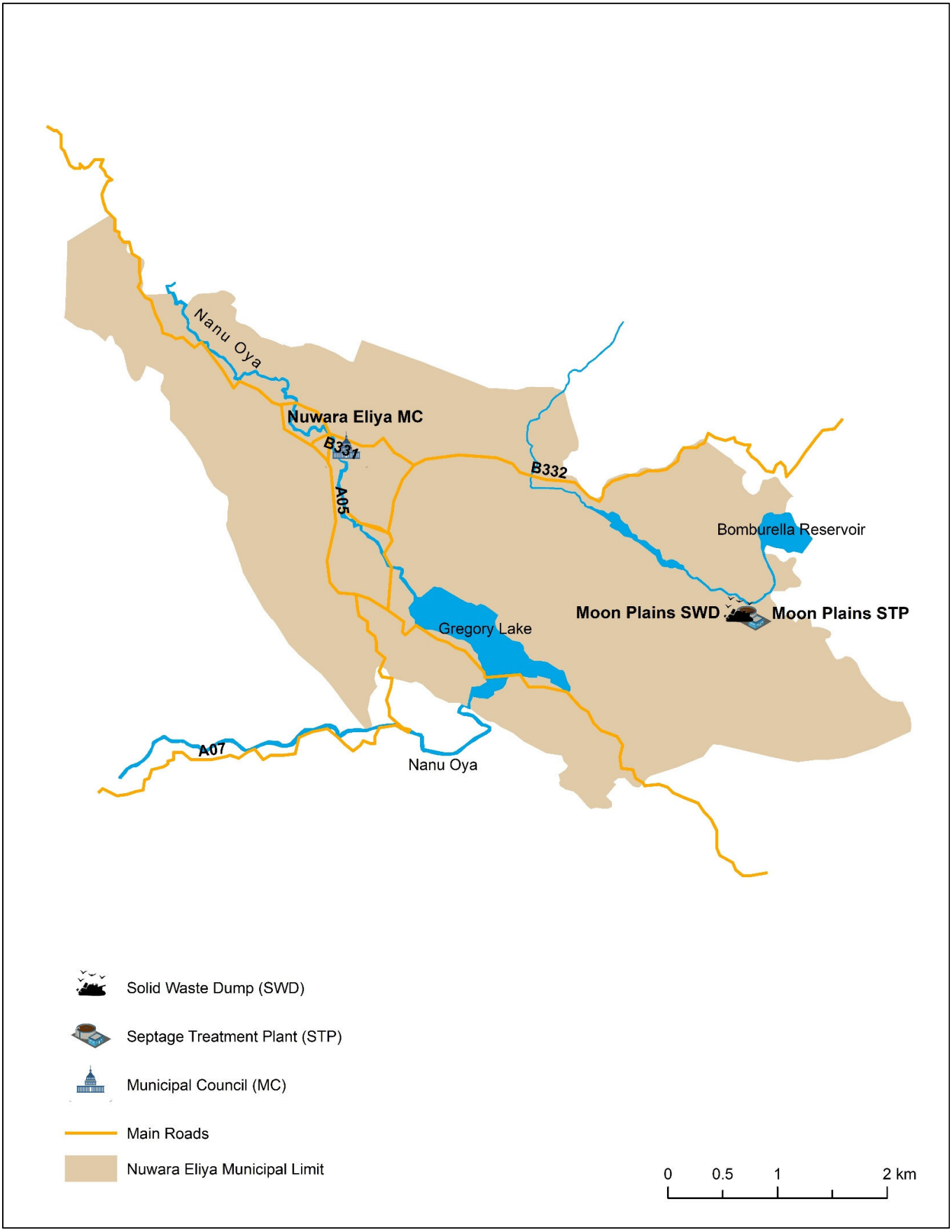
Negombo MC has proposed several strategies to overcome the identified solid and liquid waste management problems in the city. Strict development controls in environmental issues, citizen awareness programs, establishing community organizations to prevent and monitor environmental unfriendly practices within the area are among the several short-term measures proposed by the MC. In the long term, the MC is looking at formulating a development plan by giving the highest priority to the environment. Currently Negombo MC is seeking for a suitable land for the solid waste disposal to shift the existing dumping site.

With the objective of improving sanitation facilities in the area, the European Union and the French Agency for Development, have funded for a new project to implement a centralized wastewater management system to Negombo MC. The project, Sanitation and Hygiene Initiative for Towns (SHIFT) targets for 75,000 beneficiaries in the year of 2022.

REFERENCE

UDA. 2018. Urban Development Plan for Negombo City 2018-2030. Urban development Authority

16. Nuwara Eliya



Nuwara Eliya City Profile

BACKGROUND

Nuwara Eliya City is in the central mountain region and almost encircled by mountains. It is considered as the commercial, agricultural & administrative center of the District. Tea, vegetables, potato and flowers cultivation are main sources of income for citizens (JICA, 2012). It is often referred to as 'Little England' with its colonial-era bungalows, Tudor-style hotels, well-tended hedgerows and pretty gardens. Nuwara Eliya has favoured with cool-climate escape for the English and Scottish pioneers of Sri Lanka's tea industry.

Currently, 97-98% of population represents the household dwellers in Nuwara Eliya. Urban slums and estate dwellers represent in between 2-3% of the total population of the city. There are around 752 of commercial institutions in Nuwara Eliya including 2 industrial institutions.

WATER

Water supply to Nuwara Eliya city is catered through both surface and groundwater sources by Municipal Council. Surface water supply scheme comprises of nine water intakes from spring streams at Piduruthalagama mountain range (in Haddon Hill, Piyathissapura etc) and 15 storage tanks. Water quality of these sources are extremely good due to regular flushing from high rainfall and topographical release. Therefore, only treatment performed for drinking water is chlorination. Total water production for Nuwara Eliya MC is reported as 3,770m^3 per day (JICA, 2012). During dry season, supply from surface water decreases and groundwater is supplied through 12 tube wells to meet the deficit in water requirements of the city.

THE CITY	
Province	Central
District	Nuwara Eliya
Local Authority	Nuwara Eliya Municipal Council
Municipal Area	13 km^2
Population	31,585 (2019)
No of Households	10 784
Rate of Population Growth	-0.035 %
Climatic Zone	Wet Zone
Annual Rainfall	2021.2 mm (Rainy season: September to January and relatively dry until August)
Average Temperature	20.5 ºC (JICA, 2016)
Elevation	1,868 m above MSL
Major Industries	Tourism, Tea, Vegetables
WATER	
Potable Water Sources	Nine natural water spring streams (from Piduruthalagala mountain range)
Pipe Borne Water Coverage	90 % (2003)
SOLID WASTE	
Waste Generation	32 MT / Day (source: Nuwaraeliya MC)
Waste Collection	21 MT / Day (JICA, 2016)
Collection Coverage	66 %
SW Treatment/ Disposal Method	Semi-Aerobic Engineered Landfill + Plastic Recycling
Total Cost for Waste Management	28,308,000 LKR
Available Area for Disposal	5 acres (Moonplains)
Duration in Operation	20 years
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	44 m3 / Day
Treatment & Disposal	Treatment Plant (Moonplains)

SOLID WASTE MANAGEMENT

Generation and Collection

Generally MC's waste collection plan is carried out in two shifts (daytime/nighttime). During peak season however, an additional collection shift is arranged to handle the surplus. Uncollected waste is mostly self-managed (home composting, burning, and self dumping) by the residents. Nuwara Eliya MC has implemented several initiatives like public awareness programs on waste management and distribution of composting barrels among residents to minimize waste generation. As a result, the daily collection is maintained as ~21 tons / day and 90 % of people segregate their waste.

Waste is collected separately as degradable and non-degradable. About 76% of the waste (16T/day) collected is biodegradable whereas 24% (5T/day) is non biodegradable. Biodegradable waste is dumped into the landfill and non-biodegradable recycle materials such as glass, paper (approx 4T) are sold to the private buyers. There is a recycle center for polythene, plastic and PET-bottles at the landfill site which was commenced in July, 2017. Residual waste which is non biodegrabale and non recyclable are disposed at the landfill.

Table 40: Facilities available for the SWM of the Area (Nuwara Eliya MC)

Vehicle fleet	Compactors (3), Tractors (10), Hand cart (35)
Workforce and level of skills	Superivsors (6), Waste Collectors (115), Drivers (11), Leboures (9)

Treatment and Disposal

Since composting of degradable waste is not feasible under cold and extremely wet conditions, an alternative solution was implemented in 2004, supported by JICA with the cost of 17 million LKR. Solid waste collected from this city is disposed in a Semi-Aerobic Engineered Landfill in the nearby Galway forest area at Moonplains. 5 Acres from the 14 Acre catchment is used as the dumpsite. It is close to a water stream which provides water to the Bomburuella reservoir from which water is used for domestic and irrigation purposes.

Moonplains Sanitary Landfill Site

Moonplains landfill started in 1996 by Nuwara Eliya municipal council as a normal dumping site, and converted in to a sanitary landfill in 2003 with the help of JICA foundation. This land fill is located in a valley surrounded by a cultivated Eucalyptus forest, which is owned by Forestry Department, outside the Nuwara Eliya MC. Moonplains landfill has been designed under a level 3 sanitary land fill which uses semi aerobic landfill method. It includes leachate control facility, leachate treatment facility, drainage facility, gas venting facility, sanitary waste disposal facility and other required facilities for education, for security and for Maintenance.

Leachate Collecting and Treatment Facility

Leachate treatment facility consists of 11 ditches interconnected in a Zig Zag manner with coconut coir as the biofilter media.

Gas Venting Facility

This includes a pipe system that underlies the landfill which is ending up with a perforated oil barrel filled with rubble stones. Apart from these facilities, the landfill includes a separate disposal pit for infectious waste which comes from the hospitals. There is a storm water drainage system to drain excess rain and groundwater from the dumping site.

Figure 51: Nuwara Eliya Municipal Dump Site

Figure 52:Moonplains Sanitary Landfill

Figure 53: Gas Venting Facility - Moonplains

WASTEWATER AND SEPTAGE

Street drains and drainage channels are discharged into Upper Nanu Oya river or Upper Bomburu Ella reservoir. The pollution loads of the drains are higher at Lady McCulurmn Drive, Bambarakele, Race Course, Kelegala and Bonavista areas due to high population density. Some of the combined greywater and septic tank overflows contaminate the public drains (JICA, 2012).

Types of sanitation status exists in the city are indicated below.

Table 41: Types of Latrines used within Nuwara Eliya MC

Septic Tanks	30%
Cesspits	50%
Pit Latrines	20%

Municipal Council maintains seven public toilets in the city. Septage desludging service is provided by the MC on request. During the peak season, MC carries out additional septage collection shifts in the nighttime based on the demand.

It has been proposed to develop a sewerage network covering 1750 households in city center and tourist area, which has the highest population density within the municipality (JICA, 2012). Leading hotels in the area are having separate wastewater treatment plants, which need to be conformed to CEA standards in their wastewater discharge

Charges for de-slugging is reported as 2900 LKR for households and 4600 LKR for commercial units. Revenue from septage collection is reported as 2,104,100 LKR in year 2016.

Table 42: Facilities for septage Collection Service (Nuwara Eliya MC)

Vehicle fleet	02 Gully bowsers (4000 L & 6000 L)
Workers	10 Workers, 3 Gully bowsers operators

Collected septage is disposed at the septage treatment plant at Moonplains dumpsite land which was built in 2004 with funding from JICA. The plant comprises of sedimentation tanks followed by aerobic digestion system with coconut coir medium. Treated effluent is directed to the same leachate treatment plant in sanitary landfill. Deposited sludge is removed manually and disposed to the dumping site.

LOOKING AHEAD

Although proper SW disposal practices are established through Moonplains sanitary landfill, several environmental problems have been encountered with the existing system. One key issue is the potential for contamination of the underground spring due to discontinuity of the bedrock. Also, there is a lack of infrastructure facilities such as electricity, water and telephone connection, which makes administrating processes are more difficult.

Septic tanks and soil absorption systems in Nuwara Eliya need to be developed and the community awareness regarding the sanitation should be improved.

Figure 55: Bomburuella reservoir – Dumpsite situated at the catchment of this reservoir

Figure 54: Septage treatment plant in Moonplains

Treatment system	Open, Inter-connected tank with floating coir-fiber filters
Design capacity	15-20m3/day
Starting year	2004
No. of staff	10 Workers, 3 Gully bowsers operators
Coverage	Septage collected from public toilets, septage from the city and nearby areas
Operating capacity	44m^3/day

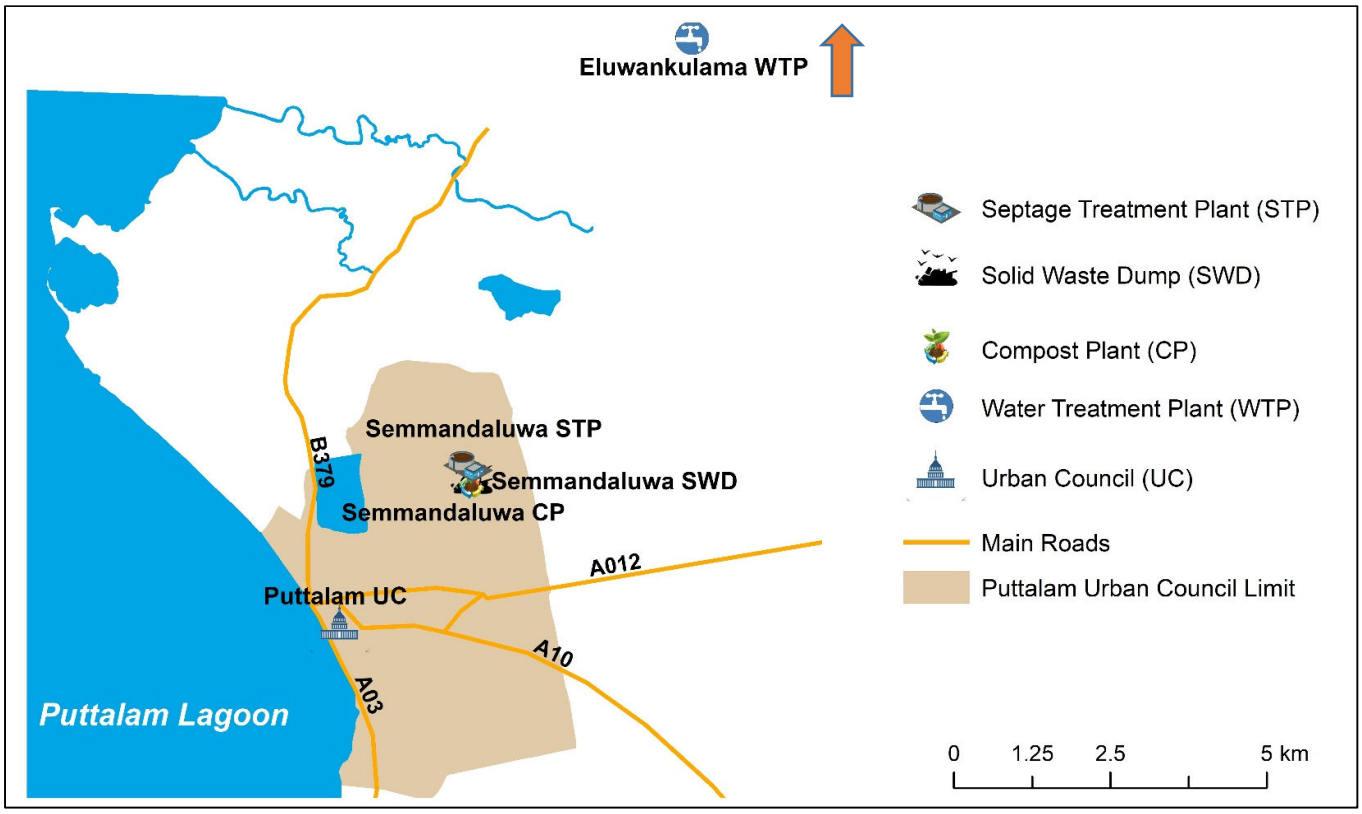
Source: (IWMI FSM Assessment, WB, 2019)

REFERENCE

Japan International Cooperation Agency (JICA). and Kokusai Kogyo Co. Ltd., 2016. Data Collection Survey on Solid Waste Management in Democratic Socialist Republic of Sri Lanka

Japan International Cooperation Agency (JICA)., Nihon Suido Consultants Co. Ltd., Yachiyo Engineering Co. Ltd. and Yokohama Water Co. Ltd., 2012. Data Collection Survey on Sewerage Sector in Democratic Socialist Republic of Sri Lanka

17. Puttalam


Eluwankulama WTP
Semmandaluwa STP
Semmandaluwa SWD
Semmandaluwa CP
B379
A012
Puttalam UC
A10
A03
Puttalam Lagoon
Septage Treatment Plant (STP)
Solid Waste Dump (SWD)
Compost Plant (CP)
Water Treatment Plant (WTP)
Urban Council (UC)
Main Roads
Puttalam Urban Council Limit
0
1.25
2.5
5 km

Puttalam City Profile

BACKGROUND

Puttalam governed by an Urban Council, is the administrative capital of the Puttalam District which borders Kala-Oya river and Modaragam-Aru river in the north, Anuradhapura District and Kurunegala District in the east, Ma-Oya river in the south, and the Indian Ocean in the west. It is situated 130 km north from Colombo. It has one of the largest and picturesque lagoons in the country. It is also popular for shallow sea fishing and prawn farming activities. Kalpitiya town located in the peninsula is a famous tourist attraction and developing as a marine sanctuary.

WATER

Main water source for the town is Kala-Oya river, one of the largest river flows at about 35 km north of the town. The water extracted from Kala-Oya river is treated at the Eluwankulama WTP having a capacity of 12,000m3/day. The water supply scheme which is operational since May 2018, has about 14,000 connections and covers more than 90% of the city center. During dry season water supply decreases creating a conflict between water demands for drinking and agriculture.

SOLID WASTE MANAGEMENT

Generation and Collection

Puttlam Urban Council is responsible for the collection and disposal of solid waste from the town. At present, the total waste collection per day amounts to 8-10 tonnes. The collection is carried out from early morning to late night. Solid waste is less of a problem in the rural areas as there is generally enough space in home gardens to allow on-site disposal.

Treatment and disposal

SW collected is transported to the outskirts where it is simply dumped in an open ground on a 7 Acre land in Semmandulawa area since 1997. The dumping site is situated at remote area in north eastern direction from the town center. Puttalam lagoon is an environmental sensitive area closer to the dumping site. Cattle feeding on garbage and air pollution due to burning of SW are key environmental issues associated with the current disposal practices.

Table 43: Facilities available for the SWM of the Area - Puttalam UC

Vehicle/ Machinery	Tractors (9), hand carts (05)
Workforce and level of skills	Public Health Inspectors (02), Permanent cadre (48), contract basis (68)

THE CITY	
Province	North western
District	Puttalam
Local Authority	Puttalam Urban Council
Municipal Area	25.24 km^2
Population	45,000 (2019)
Rate of Population Growth	0.68 %
Climatic Zone	Dry Zone
Annual Rainfall	1190mm (Rainy season: October to December)
Average Temperature	29 ºC (high), 25 ºC (low)
Elevation	2 m above MSL
Major Industries	Salt production, Coconut Plantations, Fishing, Energy production
WATER	
Potable Water Sources	Drinking water well, Tube well, Pipe-borne
Pipe Borne Water Coverage	90 %
SOLID WASTE	
Waste Generation	27 MT/day (estimated)
Waste Collection	10MTday
Collection Coverage	37 %
SW Treatment/ Disposal Method	Open dump, Controlled landfill, Composting
Total Cost for Waste collection	31,616,171 LKR (2013)
Available Area for Disposal	7 acres (Semmandulawa)
Duration in Operation	Since 1997
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	300 m^3/month
Treatment & Disposal	Septage treatment plant-Puttalam

Figure 56: Solid waste dumpsite - Puttalam UC (photo credit: IWMI)

Composting and Recycling Facility

The compost plant is located at solid waste dump site in Semtathunuwa, Mangundu. Currently, the plant receives about 15-16 tractor loads/day (8-10 T/day) of mixed waste and processes ~12 tractor loads/day (80 % out of total collected waste) which is biodegradable waste.

Design Capacity	Unknown
SW quantity processed at the plant at present	6MT/day
Workforce	Workers (10), supervisor (01), security (01)
Compost production	2,500kg/month
Average Sales of compost	37,500 LKR/month
Selling price of compost	15 LKR/kg
Customers	Coconut plantation

Figure 57: Compost plant in Puttalam (photo credit: IWMI)

WASTEWATER AND SEPTAGE

Currently there is no treatment process practiced for the wastewater generated in Puttlam and the wastewater drains in to Puttlam lagoon, which is the second largest lagoon of Sri Lanka.

People in the area rely on on-site sanitation systems for their sanitation needs. The urban council received a gully bowser by the Asian Development Bank and have engaged in emptying septic tanks since 2009. As the ground water table is shallow the emptying frequency is rather high in certain areas within the urban council. An average of 10 septic tanks are emptied in a day by the urban council. This includes the septic tanks of the public latrines in the city.

Table 44:Resource Allocation on Septage Management - Puttalam UC

Vehicle fleet	1 Gully bowser (7000 L)
Workforce and level of skills (laborers, technicians, supervisors etc.)	2 Workers

The charges for providing the service of the gully bowser within the Urban Council area is 2 500 LKR plus taxes while the outside area is 5 000 LKR plus taxes and additional charges depend on the extra distances. The monthly revenue from the gully bowser is around 105,000 LKR/month (Puttalam Urban Council).
A new septage treatment facility was established in 2014 under ADB funded Dry Zone Water and Sanitation Project for Puttalam city.

Figure 58: Septage treatment plant in Puttlam

Treatment system	**Waste stabilization pond system**
Design capacity	25m3/day
Starting year	2014
No. of staff	5 Workers
Operating capacity	10 m^3/day (approx.)

Source: (IWMI FSM Assessment, WB, 2019)

The plant located in Semmanthulawa area comprises series of effluent treatment ponds and sludge drying beds. The plant is designed to produce an effluent that meets the current discharge standards stipulated by CEA.

REFERENCE

ADB Initial Environmental Examination Report on Sri Lanka: Dry Zone Urban Water and Sanitation Project - for Puttalam Water and Sanitation System (2012)

18. Ratnapura

Ratnapura City Profile

BACKGROUND

Ratnapura is the capital city of Sabaragamuwa Province, Sri Lanka. The city is located 101 km southeast of Colombo. It is the centre of a long-established industry of precious stone mining including rubies, sapphires, and other gems. Apart from gem mining, the city is known for rice and fruit cultivations. Large plantations of tea and rubber surround the city. Tea grown in this region is called low-country tea. There is a well-established tourism industry in Ratnapura. Sinharaja Forest Reserve, Udawalawe National Park, Kitulgala, and Sri Padaya (also known as Adam's peak) especially popular among tourists. Ratnapura is situated in the flooding plain of river Kalu making it vulnerable to regular floods and landslides usually in the month of May.

WATER

Supply of pipe water within the town is operated by the National Water Supply Drainage Board. Five water collecting tanks within the town are available and their total capacity is 4500m3. Certain areas where the water supply is not available, unprotected wells and river water is used for their water needs. There are 150 public water posts within the city for low income residents and for those who arrive the town established by the Municipal Council.

SOLID WASTE MANAGEMENT

Generation and Collection

MC collects about 30MT of waste everyday and only 50% of the collected waste is sorted into organic and inorganic waste at the source of generation. Essentially, residential sources contribute to 45% of the waste collection. Waste collection schedule is such that the waste in the urban center, common areas and the areas located along main roads are collected daily as door-to-door collection whereas the byroads are visited 03 days per week to collect the waste generated in the entities located along the byroads.

Table 45: Facilities available for the SWM of the Area (Ratnapura MC)

Vehicle/ Machinery	12 tractors, 14 trailers, 2 compactors, 2 hand carts and 1 hullers
Workforce and level of skills (laborers, technicians, supervisors etc.)	4 health supervisors, 12 work supervisors and 15 drivers and 50 laborers

Treatment and Disposal

At present, the MC practices to open dump the majority of the collected waste in a land belonging to the municipal Council in Kanadola area.

THE CITY	
Province	**Sabaragamuwa**
District	Ratnapura
Local Authority	Ratnapura Municipal Council
Municipal Area	22.2 km^2
Number of Wards	18
Population	49 083 (2016)
Floating population	100 000
No of Households	8698
Rate of Population Growth	1.0%
Climatic Zone	Wet Zone
Annual Rainfall	4000-5000mm (Rainy season: May to August and October to January)
Average Temperature	35°C (high), 24°C (low)
Elevation	305m above MSL
Major Industries	Mining, Tea, Rubber, Spices
WATER	
Potable Water Sources	Angammana Reservoir and Kalu Ganga (Pompakale WTP)
Pipe Borne Water Coverage	79.5%
SOLID WASTE	
Waste Generation	37 MT/Day (estimated)
Waste Collection	30 MT/Day (2013)
Collection Coverage	81%
SW Treatment/ Disposal Method	Composting+ Landfilling+ Recycling
Annual budget for Waste collection + management	23,235,800 LKR (2012)
Available Area for Disposal	8 Acres (Kanadola)
Duration in Operation	Since 1993
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	36 m3/ day
Treatment & Disposal	Kanadola septage Treatment Plant

The dumpsite is located about 3.5 km away from the council office. There is also a Compost plant and a recycling centre located in the same land in Kanadola. In general, collected solid waste is brought to the disposal site and about 3 tons of waste is used to produce compost. About 1% of the waste is being recycled and the rest (approx.26 tons) is disposed following the method of open dumping. This site is located at a high elevated area with a steep slope to the ground below where the agricultural and residential areas are located. Consequently, impacts on humans and the agriculture caused by the current waste disposal practices appears to be extreme. According to the households in the downside, paddy fields situated immediately down to the dump is not being cultivated due to the possible contaminations from solid waste.

Figure 59: Plastic and polythene recycling centre at Kanadola

Figure 60: Solid waste dump - Kanadola

Photo credit: IWMI

Compost Plant & Recycling Center

The compost plant of Rathapura MC was established in 2014 by UNESCAP (The United Nations Economic and Social Commission for Asia and the Pacific) funds at the same land in Kanadola where the dumpsite is located. Generally, the plant produces about 3,000kg of compost per month and sells 1kg for LKR 15. The MC earns around LKR 30,000-40,000 of monthly revenue by selling compost.

The recycling center contructed the same land in 2018 was funded by Piliasaru project under Central Environmental Authority(CEA). Every month the Council earns approximately Rs. 100,000 by selling recyclables.

Design Capacity	Unknown
SW quantity processed at the plant at present	3 MT/day
Vehicle/ Machinery	Tractor (01), skid steer loader (02), screening machine (02), sewing machine (01), weight scale (01), convey belts (03)
Workforce	Supervisors (04), workers (25)
Operating cost	6.64 million LKR/Month
Compost production	3-4MT/Month
Average Sales of compost	1-3MT/Month
Selling price of compost	15 LKR/Kg

(Source- Rathnapura MC, UDA development report)

Figure 62: Septage treatment plant at Kanadola

Figure 61: Compost facility - Kanadola

Photo credit: IWMI

WASTEWATER AND SEPTAGE

The drainage system of the town area extends up to 31km. A part of it is remodified by the funds recieved from Asian Development Bank (ADB). However, the local drainage network is frequently changed due to gem mining, causing an impact on the flow direction and flow pattern of drainage network. The river “Kalu” is the final destination of the wastewater generated in the city. (Source – Rathnapura Development plan -UDA)

Ratnapura MC is engaged in providing fecal sludge collection service ever since they received gully bowsers in 1993. The service is delivered to domestic households, garment factories, hospitals and any other institutes who make request to the Municipal Council. Two private hospitals also hire the, services of gully bowsers averagely twice a month. Apart from these, gully bowsers are also used to empty the septic tanks of the public latrines in Ratnapura main bus stand once a month. Revenue generated by the septage collection has been Rs. 5,746,920 in year of 2018. (Source – Rathnapura Municipal Council)

Table 46: Resources for Septage management in Rathnapura MC

Vehicle fleet	Gully bowser (2) (3600Lit)
Workers	Driver (2), Laborers (2)

Until the new septage treatment plant was installed, the council had no choice but to dispose the septage into an earth pit dug at Kanadola dumping site. The new septage treatment plant having a daily capacity of 40 m^3 has been operational since March 2019. Investment cost of Rs. 31million was funded by National Solid Waste Management Support Center (NSWMSC) of Ministry of Local Government and Provincial Councils for the implementation of the treatment plant. Currently the plant receives about 36m3 of septage to treat on daily basis depending on the demand of desludging.

Treatment system	Open sedimentation and Aeration tanks with sludge drying beds
Design capacity	40 m^3/day
Investment cost	LKR 31 Million
No. of staff	01
Operating capacity	36 m^3/day

Source: (IWMI FSM Assessment, WB, 2019)

LOOKING AHEAD

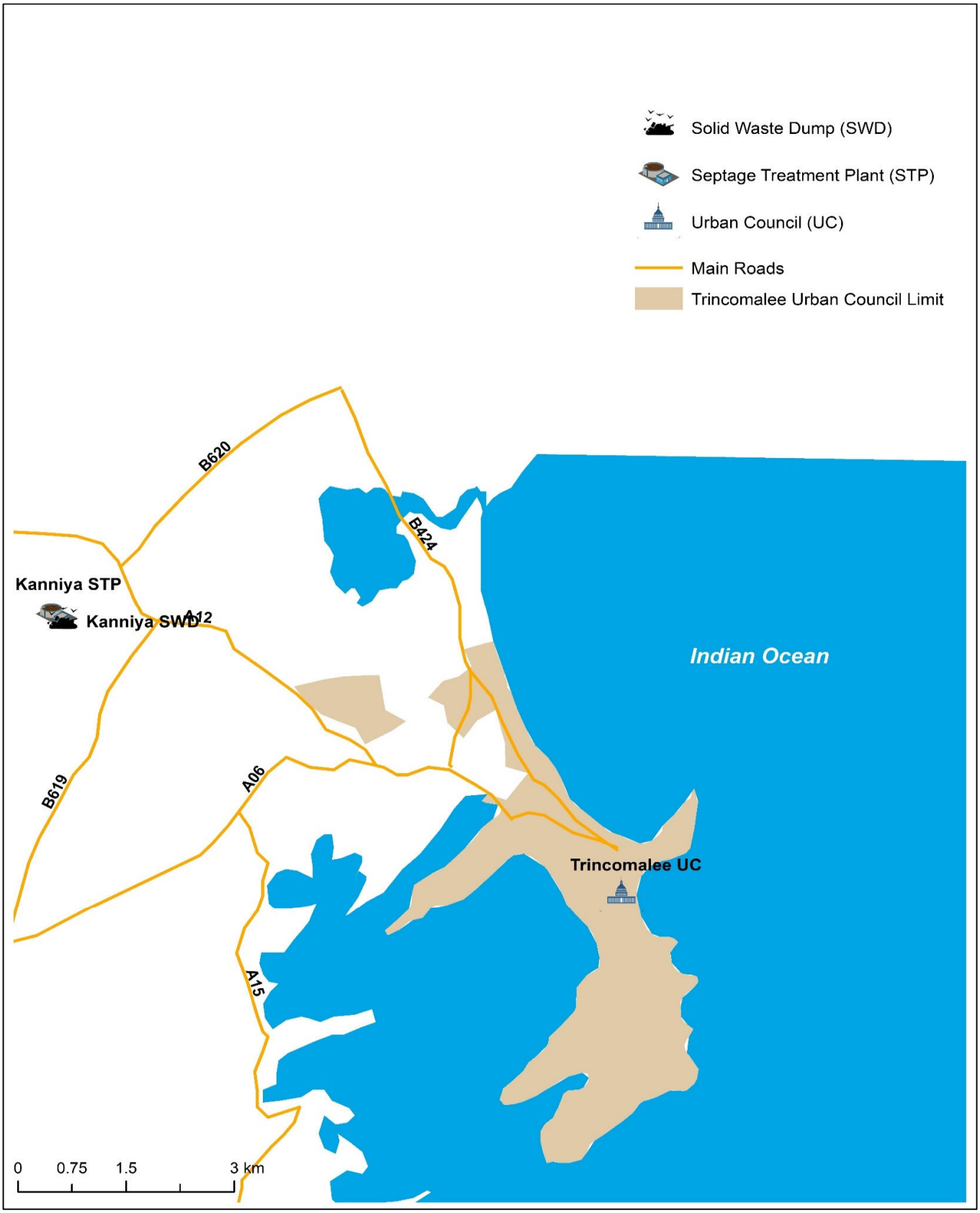
There is a proposal to develop sanitary facilities in the town by establishing public toilets at several places for the ease of daily commuting population.

Promoting home composting and source segregation, increasing the amount of composting and level of recycling are among the strategies MC is planning to implement in the view of reducing and/or proper managing the waste generated within the area. In addition, there are plans to conduct awareness programs focusing on reducing waste generation and maximizing resource recovery. (Source – Rathnapura Development plant -UDA)

REFERENCE

UDA. 2018. Urban Development Plan for Rathnapura City 2018-2030. Urban development Authority

19. Trincomalee



Trincomalee City Profile

BACKGROUND

Trincomalee is the administrative headquarters of the district and major resort port city of Eastern Province, Sri Lanka. The city is located on the east coast of the island overlooking the Trincomalee Harbour, 264 km North-East from Colombo.

Trincomalee Bay Harbour, is the fifth largest natural harbour in the world which has attracted seafarers, traders and pilgrims from all around the world since ancient times. Plans are under way to develop Trincomalee as a commercial seaport. Trincomalee is port city with commercial, naval and fisheries harbours. The services of harbour facilitate the industries such as Ilmanite mining & exporting, "Prima" flour processing industry, "Mitsui & Tokyo" cement producing industry, "Indian Oil" storage & refinery.

WATER

The existing Water Supply Scheme for Trincomalee is maintained and operated by NWSDB. Approximately 600 connections are maintained by Trincomalee UC. The main water supply is from Kanthale Reservoir, which is 35 km away from Trincomalee town. The water source for the proposed augmentation is from an intake of "Maheweli" river at Allai. When the Greater Trincomalee Integrated Water Supply Project (GTIWSP) is completed, more people will be benefited. The coverage area is Trincomalee and Gravets, Kinniya, Thambalagamuwa and Kanthale.

Majority of the town still depend on groundwater for their water supply needs especially bathing & washing purpose.

SOLID WASTE MANAGEMENT

Generation and Collection

Waste collection schedule in the UC is practiced in such a way that mixed waste from residents, which is stored in the waste collection bins, is discharged on the curb and collected by collection vehicles on weekly basis. Large amounts of waste generated by hotels and hospitals, etc., are stored in 100 L or 200 L barrels and are collected daily through door to door collection vehicle(s). Some large hotels discharged five barrels (Total 500-700 L) and are charged 4,000LKR per month (JICA, 2016). However, due to lack of resources and malfunction of vehicles, the collection system sometimes does not function well in the city.

Table 47: Facilities available for the SWM of the Area - Trincomalee UC (JICA, 2016)

Vehicle fleet	Compactors (4), Tractors (12), Handcarts (15)
Staff Involved	Supervisor (5), Collection wokers (118) Drivers (12), Disposal site worker (1)

THE CITY	
Province	Eastern
District	Trincomalee
Local Authority	Trincomalee Urban Council
Municipal Area	13.79 km^2
Population	55,564 (2014) [JICA, 2016]
No of Households	12,928 [UNHabiatat, 2018]
Rate of Population Growth	
Climatic Zone	Dry zone
Annual Rainfall	765-2580mm (Rainy season: April to August and October to January)
Average Temperature	39 °C (high), 28.2 °C (low)
Elevation	8 m above MSL
Major Industries	Tourism, Fishing, Agriculture, Animal husbandry, Business
WATER	
Potable Water Sources	Navy Reservoir, Kantale reservoir, Mahaweli River
Pipe Borne Water Coverage	
SOLID WASTE	
Waste Generation	62.09 MT / Day (JICA, 2016)
Waste Collection	39 MT / Day (JICA, 2016)
Collection Coverage	62.8 %
SW Treatment/ Disposal Method	Open dump at Kinniya (14 km away)
Total Cost for Waste Management	177,320,000 LKR (2014).[JICA, 2016)
Available Area for Disposal	0.4 hectares (JICA, 2016)
Duration in Operation	Since 2005 (JICA, 2016)
WASTEWATER & SEPTAGE	
Sewerage cover	0 %
Septage Collection	12m^3 / day (JICA, 2016)
Treatment & Disposal	Open dumping at the SW dump

Treatment & Disposal

Municipal waste collected by Trincomalee UC is disposed at Kanniya in a hilly forest area. The Kanniya disposal site has been in operation since 2005 and is shared by the Trincomalee UC and Trincomalee Town & Gravets PS as a regional disposal site (JICA, 2016). There are several environmental issues related to the existing disposal site such as roaming wild animals including elephants scavenging, flies & birds nuisance, fire, offensive odor and smoke generated at the dumping site.

Recyclables collected are amounts to be about 2 tons per day, which is sold to private dealers by the waste collectors themselves.

Figure 63: Kinniya SW Dump site

WASTEWATER AND SEPTAGE

There is no existing Sewerage Scheme operating in the City. The entire town depends on septic tanks, cesspits and pit latrines for disposal of fecal sludge. Some people who have settled near drainage canals and marshland, discharge the overflow from the sanitation systems directly into the waterways.

Table 48: Types of Latrines - Trincomalee UC (JICA, 2012)

Pit latrines	5%
Septic tanks	40%
Cesspits	55%

The UC receives around 3-4 requests per day to desludge the onsite sanitation systems within and outside the city. The collection fees of septage are 660 LKR/m3 for liquid only, whereas for sludge is 1300 LKR/m3 (JICA, 2016).

Table 49: Resources for Septage management - Trincomalee UC

Vehicle fleet	(3) Gully Bowsers (3000 L)
Workers	(3) Drivers

The UC owns a 15 m^3 / day capacity septage treatment plant located at the solid waste disposal site. The treatment plant comprises of open interconnected tanks series incorporated with sludge drying beds. However, the plant is not operational at present and appeared to be abandoned. Consequently, the collected septage is openly disposed at the SW disposal site. This indiscriminate disposal of septage has exacerbated the situation of SW dump.

The hospital has a wastewater treatment plant funded under NECORD (North east community restoration and development) Project. The treatment process follows anaerobic digestion. Clarified wastewater is pumped through pressure filters with chlorination through a small sea outfall (JICA, 2012).

Figure 64: Septage treatment plant in Trincomalee

LOOKING AHEAD

Major infrastructure developments are proposed for water supply in Trincomalee city. Augmentation of existing water supply facilities and supply to new areas and desalination projects are among the proposed developments. Sewage and wastewater collection, treatment and disposal system and solid waste collection and disposal systems are also proposed under the city development plan.

REFERENCES

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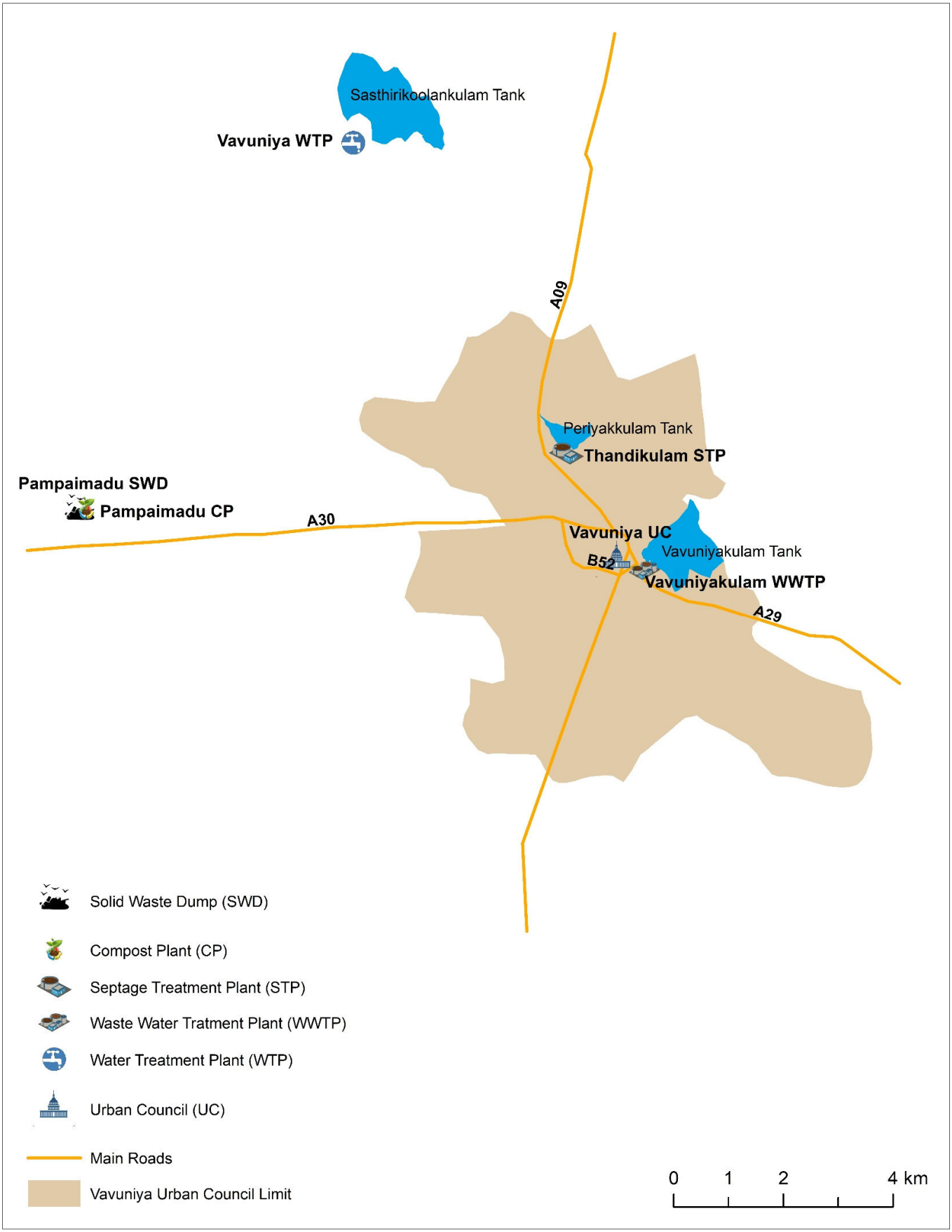
The State of Sri Lankan Cities (2018): UN-Habitat; https://unhabitat.lk/publications/the-state-of-sri-lankan-cities-2018

20. Vauniya


Sasthirikoolankulam Tank
Vavuniya WTP
A09
Periyakkulam Tank
Thandikulam STP
Pampaimadu SWD
Pampaimadu CP
A30
Vavuniya UC
B52
Vavuniyakulam Tank
Vavuniyakulam WWTP
A29
Solid Waste Dump (SWD)
Compost Plant (CP)
Septage Treatment Plant (STP)
Waste Water Tratment Plant (WWTP)
Water Treatment Plant (WTP)
Urban Council (UC)
Main Roads
Vavuniya Urban Council Limit
0 1 2 4 km

Vauniya City Profile

BACKGROUND

Vavuniya Township is located in the Northern Province of Sri Lanka, approximately 250 km northeast of Colombo. The area is governed by an Urban Council (UC), and the city acts as an economic hub and plays a regionally important role, linking cities of the north, east, west, and south. Vavuniya Urban Council (VUC) belongs to the dry zone of Sri Lanka and generally has a flat terrain.

WATER

The only stagnant water body of the Vavuniya city is the "Vavuniya Tank" which is located in the city center and it is highly polluted due to solid & liquid wastes received from its catchment. Therefore, the main source of water for drinking purposes in Vavuniya city is the groundwater (dug wells and tube wells) due to lack of adequate pipe borne water and suitable surface water resources. Because of water scarcity, people even use the agro wells for their domestic purposes (Piyasiri, S., & Senanayake, I., 2016).

SOLID WASTE MANAGEMENT

Generation and Collection

Solid waste in the town is the responsibility of Vavuniya Urban Council, and disposal is a problem that has become more acute as the population has expanded (ADB, 2012). However, majority of the SW generated in the area appeared to be self managed. Given the inadequate resources for collection of SW, the collection frequency varies among different areas.
Currently, source seperation is not practiced in the area.

Table 50: Facilities available for the SWM of the Area - Vavuniya UC

Vehicle/ Machinery	Four-wheel tractors (6), compactors (2), tippers (1), hand carts (4)
Workforce and level of skills	Labours (91)

Treatment and Disposal

SW collected is currently disposed at a land in Pampaimadu; about 14 km from Vavuniya Town. Although there is a small scale compost plant established in the UC, the composting practices appeared to be abondoned at present.

THE CITY	
Province	Northern
District	Vavuniya
Local Authority	Vavuniya Urban Council
Municipal Area	614 km^2
Population	125,720 (2015)
No of Households	34,814 (2015)
Rate of Population Growth	
Climatic Zone	Dry Zone
Annual Rainfall	1434 mm
Average Temperature	27.4 °C
Elevation	89m above sea level
Major Industries	Agriculture, Tourism
WATER	
Potable Water Sources	Dug wells, Tube wells
Pipe Borne Water Coverage	< 50 % (NWSDB)
SOLID WASTE	
Waste Generation	75MT/day (estimated)
Waste Collection	20MT/day
Collection Coverage	27%
SW Treatment/ Disposal Method	Open dumping, composting
Available Area for Disposal	
Duration in Operation	
WASTEWATER & SEPTAGE	
Sewerage cover	0%
Septage Collection	
Treatment & Disposal	Septage treatment plant

Figure 65: SW dump in Pampaimadu (source: IWMI)

WASTEWATER AND SEPTAGE

Storm water and grey water generated within the Vavuniya city is transported via drainage canals in six catchments areas across the city. The combined wastewater is directed to the WWTP situated adjacent to the Vavuniyakulam tank, which is the largest tank in the VUC (IWMI, unpublished). The plant originally had a oxidation ponds system and rehabilitated later into mechanically aerated ponds combined with the a constructed wetland under a UNOPS funded project. The treatment plant has a capacity of treating 2500 m3 of wastewater daily (IWMI, unpublished).

The city depend on onsite sanitation systems for their sanitation needs. MC provides the desluding service of the septic tanks via vacuum trucks. The collected septage is disposed at the septage treatment plant which is located about 12km away from the city center for treatment. The plant was established under the Water and Sanitation project funded by ADB.

Table 51: Resource Allocation on Septage Management - Vavuniya UC

Vehicle fleet
Workforce and level of skills (laborers, technicians, supervisors etc.)

The District General Hospital of Vavuniya initially operated an onsite sanitation system that comprised of septic tanks and soakage pits. These septic tanks required frequent emptying up to six times per day and due to the inadequate capacity of these systems, untreated effluent from the system was discharged into the surface drains causing contamination of irrigation canals and eventually surface and groundwater sources in the area. In order to address the aforementioned issues, upon UNOPs' intervention, a sewer collection network and a proper wastewater treatment system was introduced for the Vavuniya General hospital. The system has been in operation since January 2017. The WWTP of Vavuniya General Hospital is situated adjacent to the Thandikulam tank, which is about 3km away from the hospital. The wastewater from the hospital to the WWTP is conveyed through a sewer network that is laid along the A9 road. The treatment plant comprises of a facultative pond followed by a series of maturation ponds and has a capacity of treating about 400m^3 per day of wastewater (IWMI, unpublished).

Figure 66: Wastewater treatment plant in Vavuniyakulam (photo credit: IWMI)

Figure 67: Sewage treatment plant in Thandikulam

Figure 68: Septage treatment plant in Vavuniya

Treatment system	Waste stabilization pond system
Design capacity	28 m3/day
Starting year	2014
No. of staff	
Coverage	
Operating capacity	

Source: (IWMI FSM Assessment, WB, 2019)

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