SFD Report

Lalitpur Metropolitan City
Nepal

Final Report

This SFD Intermediate Report - SFD level 2 - was prepared by Environment and Public Health Organization (ENPHO)

Date of production: 06/08/2024

Last update: 27/10/2025

SFD Intermediate Report Lalitpur Metropolitan City, Nepal, 2025

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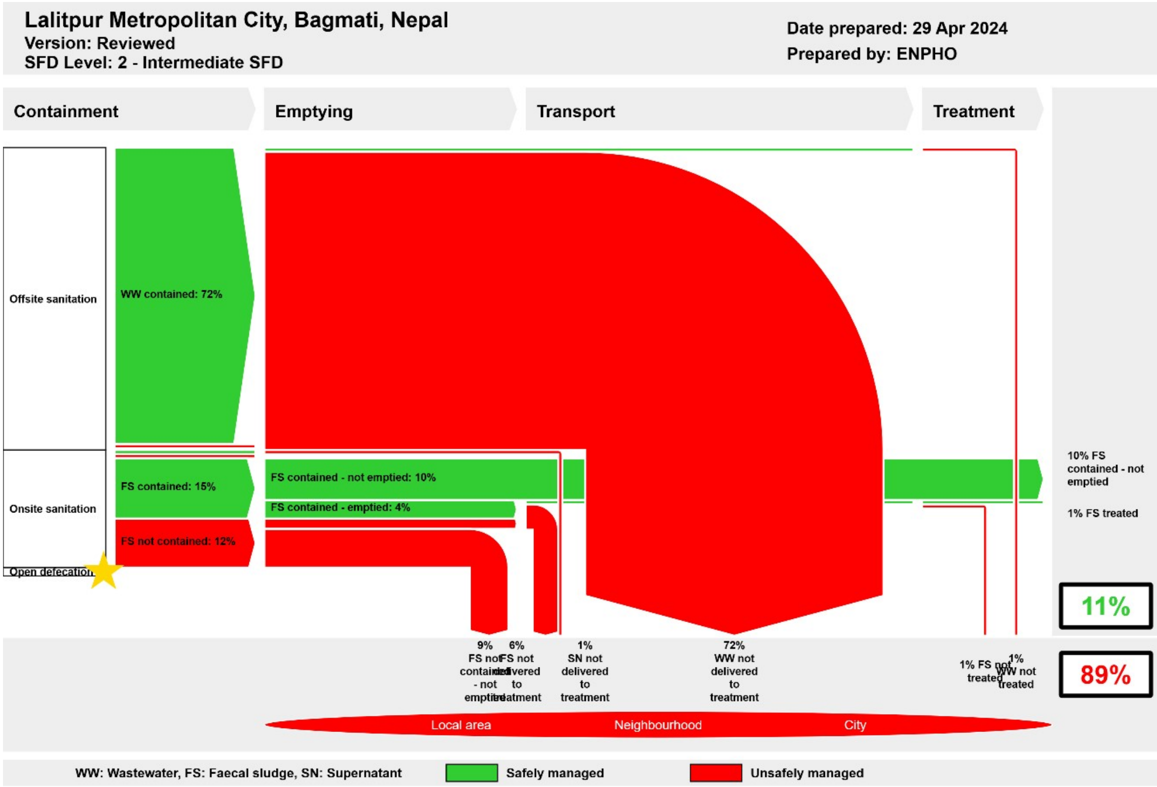
1. The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at sfd.susana.org

2. Diagram information

SFD Level:

This SFD is a level 2- Intermediate report.

Produced by:

Environment and Public Health Organization (ENPHO)

Collaborating partners:

Lalitpur Metropolitan City, Municipal Association of Nepal (MuAN), United Cities and Local Government- Asia Pacific (UCLG- ASPAC).

Status:

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3. General city information

Lalitpur Metropolitan City is in Lalitpur District, Bagmati Province of Nepal. It has a total of 29 wards and covers an area of 36.12 km^2. It is surrounded by Kathmandu Metropolitan City in the north, Godawari Municipality in the south, Mahalaxmi Municipality in the east and Kirtipur Municipality and Kathmandu Metropolitan City in the west.

According to the national population and housing census 2021, the metropolitan city has a total population of 294,098 and 77,159 households. The population density is 8,142 people/km^2. A ward number 14 has the highest number of households with 6,149 and the highest population of 22,841 and ward number 5 has the least households with 983 and least population with 3,971 (NSO, 2023).

Lalitpur Metropolitan City has an average monthly temperature above 10°C in their warmest months and above −3°C in their colder months (Trewartha and Horn, 1980).

It is extended from 27° 37' 12" N to 27° 41' 24" N latitude and 85° 17' 24" E to 85° 21' 36" E longitude. The elevation of the city is approximately 1,280 m above mean sea level.

4. Service outcomes

The overview of different sanitation technologies across the sanitation value chain in the metropolitan city is briefly explained in this section. All data in this section is from the household and institutional surveys conducted for this study (ENPHO, 2024) . All the households in the metropolitan city have access to basic sanitation facilities.

Sewer Networks:

The majority of households in the city i.e. 72% have connected toilets to offsite sanitation systems, such as sewer networks, while 1% are connected to water resources directly. The sewer systems are connected to the water resources without any treatment

Containment:

The study reveals that 27% the households in the city rely on onsite sanitation technologies. About 2% the households have installed septic tank which are considered as safe containment and 5% of the households have constructed fully lined tank. Notably, 15%, 4% and 1% are using lined tanks with impermeable walls and open bottom, lined pits with semi-permeable walls and open bottom and unlined pit respectively, which poses the high risks of groundwater contamination.

Emptying and Transportation:

According to the assessment of the sanitation situation, only 8% of the households have emptied their containments at least once after use. Among these households, 92% have opted for mechanical emptying, while 7% have done so manually. Additionally, 1% of households have emptied their systems openly during rainfall. The containments are typically emptied at an interval of 3 to 5 years, with few systems emptied more frequently.

Treatment and Disposal:

The construction and rehabilitation of Wastewater Treatment Plants (WWTP) at Balkumari (Kodkhu) and Dhobighat are currently underway. Additionally, Fecal Sludge Treatment Plants (FSTPs) are being built at these sites.

Harisiddhi includes four wastewater treatment plants. Three of these plants have been completed, while one remains under construction Among the completed plants, only one was operational, but it is currently not functioning properly.

Currently, the mechanically emptied faecal sludge by a service provider is treated at the FSTP in Mahalaxmi Municipality. However, other service providers are illegally disposing of faecal sludge despite strict actions taken by the metropolitan city.

Water Supply:

The household survey reveals that 50% of households in the metropolitan city rely on private taps for drinking purpose. Notably, 36% have used the Jar water for drinking. while 4% of households depends on public or community tap. 4% of the households depend groundwater such as dug well, hand pumps or deep boring and 6% depends on tanker water.

Shit Flow Diagram

The SFD graphic shows that 11% of the excreta generated are safely managed while 89% are unsafely managed. The safely managed excreta generated by 10% of the population is temporary. So, once the containments get filled and FS from the containments is emptied, the percentage of unsafely managed excreta would increase.

5. Service delivery context

Access to drinking water and sanitation has been defined as fundamental rights to every citizen by the constitution of Nepal. To respect, protect and implement the rights of citizen embedded in the constitution, the Government of Nepal (GoN) has passed the Drinking Water and Sanitation Act, 2022 which has emphasised on a right to quality sanitation services and prohibited direct discharge of wastewater and sewage into water bodies or public places.

Several policies have been in place to accomplish the sanitation needs of people. Particularly, the National Sanitation and Hygiene Master Plan (NSHMP) 2011 has proved as an important strategic document for all stakeholders to develop uniform programs and implementation mechanism at all levels. It strengthens institutional set up with the formation of water and sanitation coordination committee at every tier of government to actively engage in sanitation campaigns. The document adopted sanitation facilities as improved, basic, and limited in line with WHO/UNICEF guidelines. The draft Sector Development Plan (SDP) has envisioned the delineation of roles and responsibility of federal, provincial, and local government in an aim to initiate sustainability of Open Defecation Free (ODF) outcomes.

The Lalitpur Metropolitan City enacted the Waste Management Act in 2019 to ensure a clean and healthy environment by reducing potential risks to public health and the environment. It aims to minimise waste generation, promote reuse, and ensure the safe treatment and disposal of waste (LMC, 2019).

6. Overview of stakeholders

Based on the regulatory framework for Faecal Sludge Management (FSM), the major stakeholders for effective and sustaining service delivery in the metropolitan city are as presented in appendix 1.

Table 1: Overview of Stakeholders.

Key Stakeholders	Institutions / Organisations
Public Institutions at Federal Government	Ministry of Water Supply Department of Water Supply and Sewerage Management (DWSSM)
Public Institutions at Provincial Government	Ministry of Water Resource and Energy Development Water Supply and Sanitation Division Office (WSSDO)
Public Institutions at Local Government	Lalitpur Metropolitan City Office Harisiddhi Water Supply Users and Sanitation Committee
Non-governmental Organisations	Environment and Public Health Organization (ENPHO)
Private Sector	Kathmandu Upatyaka Khanepani Limited (KUKL) Public toilet operators
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC, WASH Alliance International

7. Credibility of data

The major data was collected from random household sampling. Altogether, 1,053 households and 105 institutions were surveyed from 29 wards of the metropolitan city on 3-4 Jan, 2024 (ENPHO, 2024) . Primary data on current sanitation practices in the metropolitan city was triangulated from Key Informant Interviews (KIIs) with municipal officials, public toilet operators, desludging service providers and water users and sanitation committee.

8. Process of SFD development

Data on sanitation situation was collected through household and institutional survey. The local enumerators from each ward of the metropolitan city were trained on all aspects of sanitation service chain starting from user interface, containment, emptying, transport, treatment, end use or safe disposal of excreta and the use of mobile application; *KoboCollect* was used for collection of data from households and institutions. Moreover, KIIs were conducted with officers and the engineer of the metropolitan city, public toilet operators, desludging service providers and water supply service provider to understand the situation practices across the service chain. Types of sanitation technologies used in different locations were mapped using ARCGIS. To produce the SFD graphic, initially a relationship between sanitation technology used in questionnaire survey and SFD PI methodology was made. Then, data was fed in SFD graphic generator to produce the SFD graphic.

8. List of data sources

The list of data sources to produce this executive summary is as follows:

- ENPHO. (2024). Assessment of Sanitation Status of Lalitpur Metropolitan City.
- LMC. (2019). Waste Management Act, Lalitpur Metropolitan City https://lalitpurmun.gov.np/sites/lalitpurmun.gov.np/files/documents/Sthaniya%20Rajpatra-watawaran.PDF.
- MoWS. (2022a). Water Supply and Sanitation Act. Ministry of Water Supply; Government of Nepal.
- NSO. (2023). National Population and Housing Census 2021. National Statistics Office.

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Abbreviations

DUDBC	Department of Urban Development and Building Construction
DWSSM	Department of Water Supply and Sewerage Management
ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
HH	Household
IRF	Institutional and Regulatory Framework
KII	Key Informant Interview
KUKL	Kathmandu Upatyaka Khanepani Limited
KVWMP	Kathmandu Valley Wastewater Management Project
LMC	Lalitpur Metropolitan City
MoUD	Ministry of Urban Development
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NGO	Non-Governmental Organisation
NPC	National Planning Commission
NSO	National Statistic Office
NUWSSSP	National Urban Water Supply and Sanitation Sector Policy
NWSC	Nepal Water Supply Corporation
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
PID	Project Implementation Directorate
RWSSNP	Rural Water Supply and Sanitation National Policy
SDG	Sustainable Development Goal
SDP	Sector Development Plan
SFD PI	Shit Flow Diagram Promotion Initiative
SFD	Shit Flow Diagram
SN	Supernatant
UCLG ASPAC	United Cities and Local Governments Asia Pacific
UNICEF	United Nations Children's Education Fund
WASH	Water, Sanitation and Hygiene
WWTP	Wastewater Treatment Plant

1. City context

Lalitpur Metropolitan City is in Lalitpur District, Bagmati Province of Nepal. It has a total of 29 wards and covers an area of 36.12 square kilometres. Lalitpur's administrative setup has evolved over time. Initially known as "Chemdol Adda" in 1918, it focused on sanitation and other municipal tasks within Lalitpur. Then, Lalitpur Municipality was formed in 1952 followed by Lalitpur Sub-metropolitan City in 1995, and Lalitpur Metropolitan City on 23 March,2017. It is surrounded by Kathmandu Metropolitan City in the north, Godawari Municipality in the south, Mahalaxmi Municipality in the east and Kirtipur Municipality and Kathmandu Metropolitan City in the west.

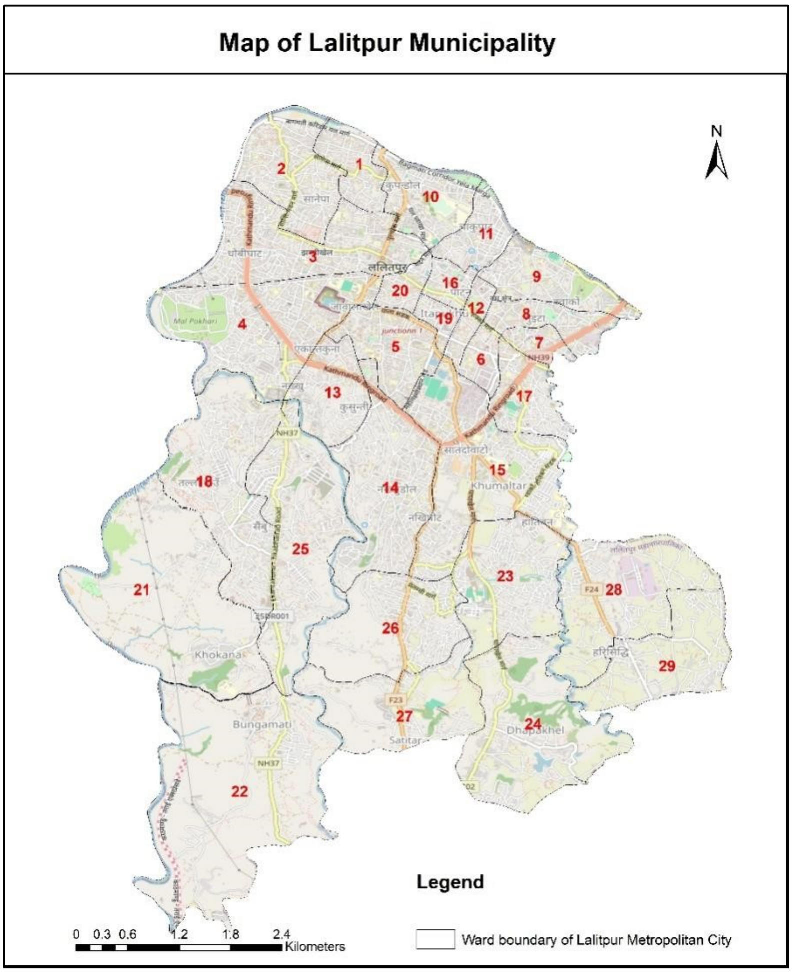

Figure 1: Map of Lalitpur Metropolitan City with ward boundaries.

1.1. Population

According to the national population and housing census 2021, the metropolitan city has a total population of 294,098 and 77,159 households. The total male and female populations are 146,730 and 147,368 respectively. The population density is 8,142 people per square kilometer. A ward number 14 has the highest number of households with 6,149 and the highest population of 22,841 (11,209 male ad 11,632 female) and ward number 5 has the least households with 983 and least population with 3,971 (1,901 male and 2,070 female) (NSO, 2023).

1.2. Climate

Lalitpur Metropolitan City has a temperate climate. Temperate climates are characterised by relatively moderate mean annual temperatures, with average monthly temperatures above 10°C in their warmest months and above −3°C in their colder months (Trewartha and Horn, 1980).

The figure 2 shows the average maximum and minimum temperature (°C), total rainfall (mm) and average relative humidity (%) recorded during December 2016 to April 2017 at Khumaltar, Lalitpur, Nepal.

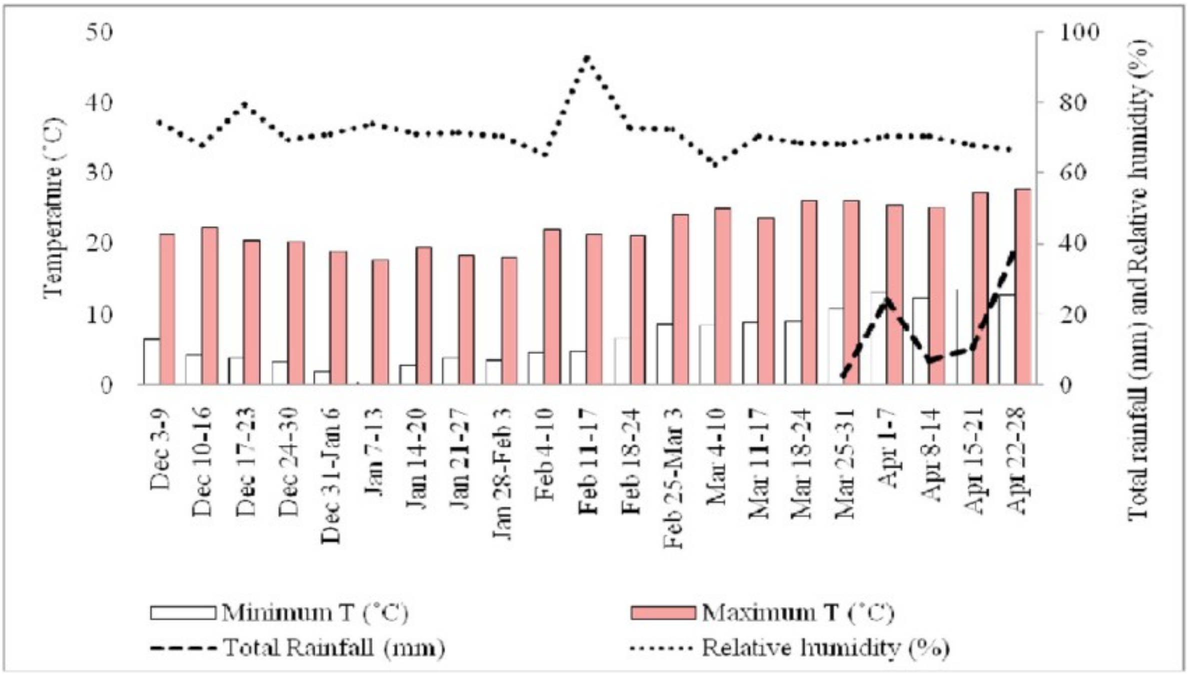

Figure 2: Average temperature, rainfall and relative humidity at Khumaltar Lalitpur (Source: National Agronomy Research Centre, Khumaltar).

1.3. Topography

Lalitpur Metropolitan City is located at latitude: 27° 37' 12" N to 27° 41' 24" N and longitude: 85° 17' 24" E to 85° 21' 36" E. The elevation of the city is approximately 1280 m above mean sea level. It was developed upon shallow deposits of clay and gravel located in the central area of an ancient dried-up lake. The Bagmati River acts as a natural boundary, dividing Lalitpur from Kathmandu to the north and west. There are two major north flowing rivers in the southern part of Lalitpur Metropolitan City (LMC) such as Kodkhu Khola and Nakkhu Khola.

Kodkhu Khola runs northward and is a tributary of the Manahara River, which eventually flows into the Bagmati River. It begins in mountainous terrain at an elevation of 1970 meters above mean sea level and descends to a valley plain at 1360 meters. The Kodku Khola spans 23.2 kilometers in total length (Maharjan, 2007). The Nakhu Khola originates from the outlet of the Tika-Bhairab Watershed, flowing northwest until it joins the Bagmati River near Chovar. The Tika Bhairab Watershed covers an area of 42.55 km^2 and is situated 13 km south of central Kathmandu (Hydrology Report of Nepal , 1995).

2. Service Outcomes

2.1. Overview

Data on sanitation situation was collected by Environment and Public Health Organization (ENPHO) through household and institutional surveys (ENPHO, 2024) . A total of 1,053 households were sampled from 77,159 households distributed in twenty-nine wards (further details are presented in section 4). The results were obtained after the triangulation and validation of the data with all the data sources including literature reviews and Key Informant Interviews (KIIs).

Particularly over the past 20 years, sanitation has been promoted in Nepal, which led to the nation as Open Defecation Free (ODF) nation on September 30, 2019, with the combined effort of the 3 tiers of the government (MoWS, 2020) . The study reveals that all the households in the Lalitpur Metropolitan City have access to toilets (ENPHO, 2024).

2.1.1 Sanitation System in Households Building

Offsite Sanitation System

An off-site sanitation system involves the collection and transportation of excreta and wastewater from their point of origin to a location outside the immediate area where they are produced. This system typically utilises sewer technologies such as simplified sewer systems, solids-free sewers, or conventional sewers for conveyance (Elizabeth Tilley, 2014) . The households survey reveals that 72% of the households have been connected to sewer networks (Figure 3) while 1% are connected to water resources directly.

Figure 3: Manhole of the sewer networks connected to households.

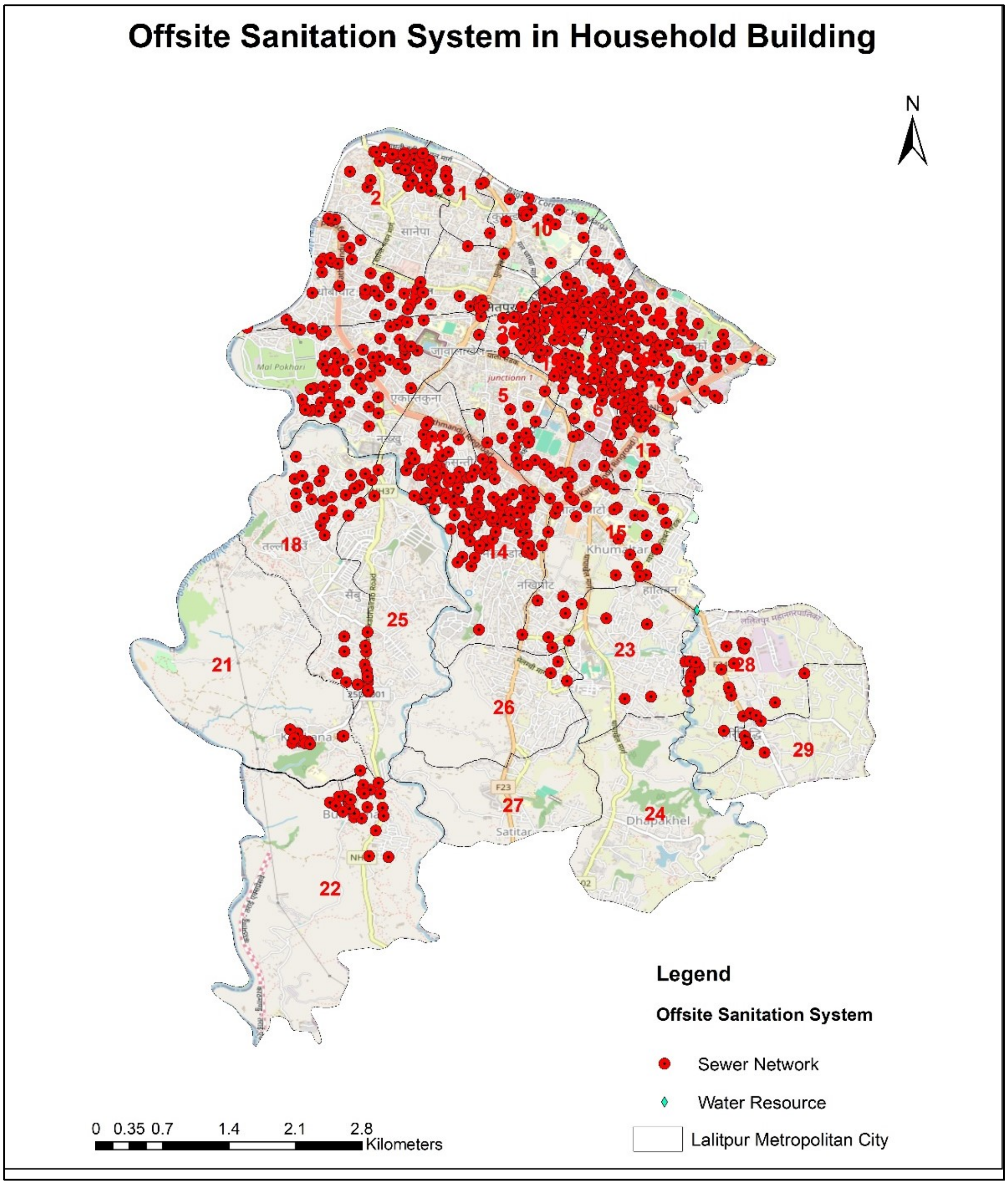

Figure 4: Map locating households connected to sewer networks in Lalitpur Metropolitan City.

Onsite Sanitation System

The onsite sanitation refers to a sanitation technology or sanitation system in which excreta is collected and stored and emptied from or treated on the plot where they are generated (SuSanA, 2018). About 27% of households in the metropolitan city rely on onsite sanitation systems. Table 1 shows the percentage of households with different types of containment in the metropolitan city.

Table 1: Types of containment in households in Lalitpur Metropolitan City (ENPHO, 2024).

Containment	Wall construction Materials	Bottom of containment	Chamber	Number	Connected to	%	Recategorised as SFD	%
Septic Tank	Cemented walls or cemented brick/ stone wall	PCC or plastered	Two or more than two	NA	Sewer Network Soak pit	2%	Septic Tank	2%
Fully lined tank	Cemented walls or cemented brick / stone wall	PCC or plastered	One or Two	NA	No outlet/ overflow	5%	Fully lined tank	5%
Lined tank with impermeable wall and open bottom	Cemented walls or cemented brick / stone wall	Soiling / nothing	One ,Two or More than Two	NA	Open ground No outlet/ overflow	15%	Lined tank with impermeable walls and open bottom	15%
Single pit	Concrete rings piled one	Soiling/ nothing	NA	One	NA	4%	Lined pit with semi-permeable walls and open bottom	4%
Unlined pit	Mud mortar stone/ brick wall/ dry stone wall/ no lining	Soiling / nothing	One	NA	No outlet/ overflow	1%	Unlined pit	1%

Lined tanks with impermeable walls and open bottom are the most popular containment technologies in the LMC and have been constructed by 15% of the households. A lined tank with impermeable walls and open bottom is an onsite sanitation technology where the walls of the tank are lined, and the bottom of tank is not lined and allows infiltration of leachate.

Fully lined tank, constructed by 5% of the households, is an onsite sanitation technology which is used to safely store faecal sludge. The walls and bottom of the tank are totally lined and sealed.

Around 4% of the households have single pits. The single pits are onsite technologies made from pre-cast concrete rings. There is no lining between rings and allows infiltration from both walls and bottom. These pits are categorised as lined pits with semi-permeable walls and open bottom for the preparation of SFD graphic.

A septic tank is installed in 2% of households. The septic tank is a properly designed technology with sealed wall and bottom having at least two chambers and the effluent discharged into a soak pit or sewer network. As there is no technically designed sewer system, the containments have been connected to an open drain or stormwater drain.

Figure 5 shows a map of the households with the types of containment observed in the survey.

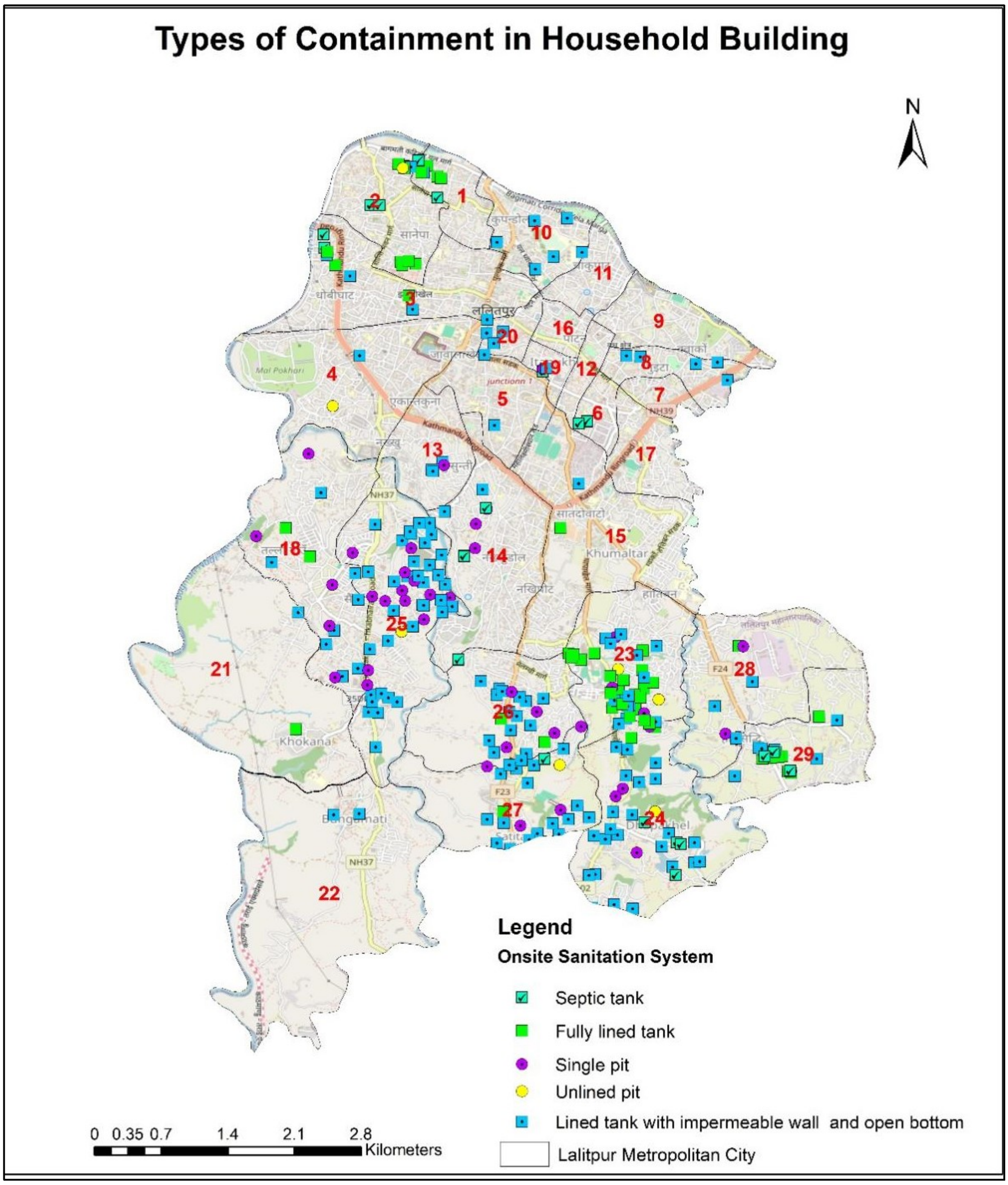

Figure 5: Map locating households with the types of containments in Lalitpur Metropolitan City.

2.1.2. Sanitation System in Institutional buildings

The institutional buildings (105 institutions) such as educational institutions, health institutions commercial buildings and government organisations were surveyed. The survey found that 70% of the institution has been connected to the sewer network while the remaining have been connected to onsite sanitation technologies. The lined tank with impermeable wall and open bottom is a popular onsite sanitation technology in the institutions. Figure 6 shows the different sanitation technologies available in the institutions of Lalitpur Metropolitan City.

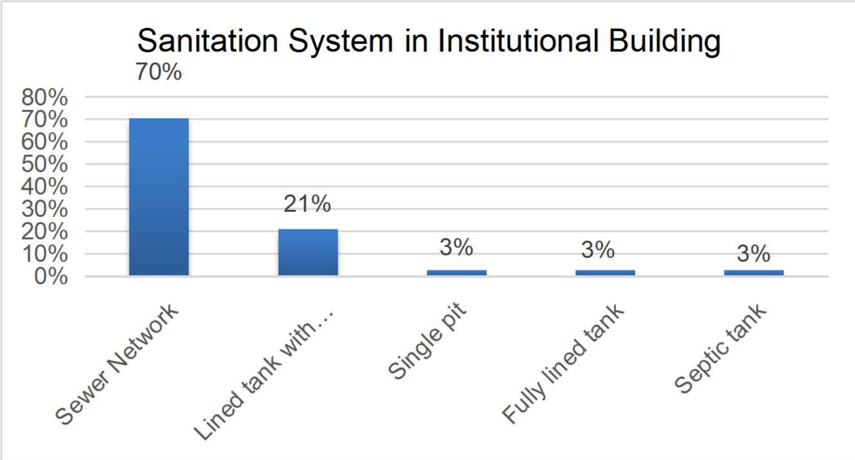

Figure 6: Sanitation system in the institutional buildings of Lalitpur Metropolitan City.

Figure 7 shows a map locating surveyed institutional buildings and types of sanitation technologies.

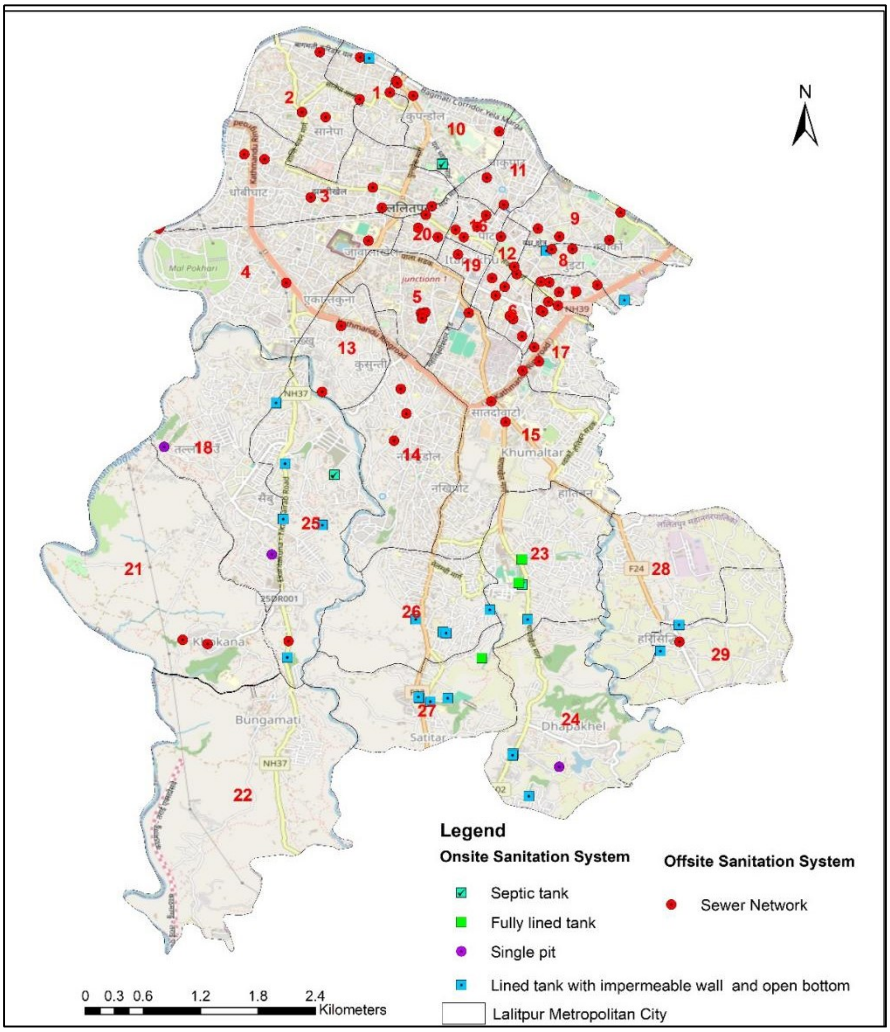

Figure 7: Map locating institutional buildings with types of sanitation technologies.

2.1.3. Public Toilets

LMC, in collaboration with AEROSAN Sustainable Sanitation, has constructed modern public toilets in Mangal Bazar (ward 11), Patandhoka (ward 16), and Jawalakhel (ward 4). Plans are underway to build additional modern toilets in Lagankhel and other areas. Under the 'one ward, one public toilet' policy, LMC is building public toilets in other seven wards. The construction in wards 2, 8, 9, 24, and 10 is nearly finished, while work in wards 25 and 27 is still ongoing (KII_1, 2024).

Public toilet at Mangalbazar

Public toilet at Patan Dhoka

Public toilet at Lagankhel

Public toilet at Patan Dhoka

Figure 8: Public toilets in Lalitpur Metropolitan City.

Some of the public toilets in Lalitpur have redefined the traditional concept of public toilets in Nepal. They are uniquely designed to be accessible and inclusive, serving to people with disabilities, women, children, and senior citizens. The facilities offer sanitary pads and a designated breastfeeding area, diaper changing area with handwashing station. The public toilets with such facilities as shown in Figure 9 have been constructed and operated in Mangalbazar, Jawalakhel and Patandhoka (KII_3, 2024).

Figure 9: Components of the modern public toilet.

2.1.4. Emptying and Transport

Emptying and transporting faecal sludge are crucial services for the proper operation of onsite sanitation technologies (Linda Strande, 2014) . A mere 8% of households have undertaken the emptying of their containment systems at least once since installation. Among these households, 92% have opted for mechanical emptying, while 7% have done so manually. The remaining 1% have practiced open emptying, particularly during rainy season.

Abhinas Dhuwani Sewa is providing the desludging services for 13 years in Kathmandu valley. It owns two vehicles of 3,000L capacity. This service provider has emptied faecal sludge approximately 35-40 trips per month per vehicle. The service providers emptied approximately 15 trips per month in LMC with the remaining trips from other municipalities of the Kathmandu valley. The desludging service provider charges NRS 3,500-5,000 (USD 26-38) per trip (KII_4, 2024).

Figure 10: Desludging service provider delivered the faecal sludge to treatment plant.

2.1.5. Treatment and Disposal

With the objective of restoring the rivers' aesthetic appeal by ensuring the discharge of only treated water, the Kathmandu Valley Wastewater Management Project (KVWMP) was launched in 2013. Under the KVWMP, the Project Implementation Directorate (PID)'s scope encompasses the construction and rehabilitation of Wastewater Treatment Plants (WWTP) at Balkumari (Kodkhu) and Dhobighat. The fecal sludge treatment plants (FSTPs) are also being constructed at Dobhighat and Kodku wastewater treatment plant sites.

Figure 11: Wastewater treatment plants at Balkumari under construction.

Harisiddhi (ward 28 and 29 of metropolitan city) includes four wastewater treatment plants strategically located to allow wastewater collection through gravity flow. Three of these plants have been completed, while one remains under construction. Among the completed plants, only one was operational, but it is currently not functioning properly (KII_2, 2024).


Figure 12: Current status of wastewater treatment plants at ward 28 and 29 of LMC.

The private service provider (Abhinas Dhuwani Sewa) has transported mechanically emptied faecal sludge to FSTP in Mahalaxmi Municipality (Figure 13). It has operated since 2016. It has a design capacity of 6 m^3 of faecal sludge per week. The caretaker of FSTP operator charges a tipping fee NPR 500 (USD 4) per trip (KII_4, 2024). Nevertheless, other service providers are still engaging in the illegal disposal of faecal sludge, even with the metropolitan city enforcing strict measures against such practices (KII_1, 2024).


Figure 13: Faecal Sludge Treatment Plant in Mahalaxmi Municipality.

Among the 7% of households that manually emptied faecal sludge, 57% have been applied directly in farmland, 29% have practiced composting, and remaining have practiced dig and dump (ENPHO, 2024).

2.1.6. Risk Assessment of Groundwater Pollution

The risk of groundwater pollution is assessed based on the source of drinking water, secondary data on water quality and the vulnerability of the aquifer with regards to lateral spacing between sanitation systems and groundwater sources.

a. Sources of Drinking Water

The household survey conducted by ENPHO shows that 50% of households in the metropolitan city rely on private taps for drinking purposes. Notably, 36% have used Jar water for drinking, while 4% of households depend on public or community tap. Around 4% of the households depend groundwater such as dug well, hand pumps or deep boring and 6% depends on tanker water (ENPHO, 2024).

Kathmandu Upatyaka Khanepani Limited (KUKL) is functioning as an autonomous water company established through the Public Private Partnership (PPP) model. It has been operating the water supply and wastewater services under a License and Lease Agreement with the Kathmandu Valley Water Supply Management Board for 30 years.

KUKL operates as the primary water utility provider for the Lalitpur Metropolitan City. It has been providing the services to ward 1 to 27 of the LMC. The average daily water production from the Lalitpur branch is 16.47 MLD (KUKL, 2024).

Harisiddhi Water Supply Users and Sanitation Committee plays a crucial role in providing drinking water to wards 28 and 29 of LMC. The water supply system is based on gravity flow system, comprised of three reservoir tanks, each with capacity of 0.45 million liters, 0.225 million liters and 0.3 million liters. As of the date of the interview, approximately 2,900 taps have been installed, contributing to the effective distribution of water throughout the designated areas (KII_2, 2024) .


Figure 14: Reservoir tanks of Harisiddhi water supply.

b. The vulnerability of the aquifer and lateral spacing between sanitation systems and groundwater source

A study assessing the traditional dug well water in LMC during the pre-monsoon season revealed that 54.4% of the total water samples demonstrated high-risk levels, while 8.9% of the samples were found to be at very high risk. Only 5.1% of the total water samples were free from total coliform and considered safe according to NDWQS and WHO standards for microbial contamination (Bajracharya, 2022).

Study on groundwater quality and community health risk in LMC, revealed that the concentration of coliform bacteria Escherichia coli (E-coli) was found high in both winter and post-monsoon seasons in all the 35 groundwater samples (Ghimire, 2023) . The common reasons behind the high coliform content in groundwater include leaky sanitation systems (Pujari, 2007), and inadequate and faulty sewage management structures (Bhandari, 2021). Furthermore, the study conducted on drinking water quality in the Kathmandu Valley reveals that 94% of the sources have positive results for total coliform, fecal coliform, or both (Sarkar, 2022).

Based on the literature review on water quality testing, information obtained from stakeholders and observation, the risk of water contamination has been assessed.

Accordingly, 1% of the population relies on fully lined tanks (sealed) connected to a soak pit (T1A2C5, low risk); 13% of the population relies on lined tanks with impermeable walls and open bottom, connected to a centralised combined sewer (T2A4C1, 1%: high risk) or no outlet or overflow (T1A4C10, 6%: low risk and T2A4C10, 6%: high risk); 4% uses lined pits with semi-permeable walls and an open bottom, with no outlet or overflow (T1A5C10, 2%: low risk and T2A5C10, 2%: high risk) and 1% relies on unlined pits (T2A6C10, high risk).

2.2. SFD Matrix

2.2.1. SFD Selection Grid

The SFD selection grid consists of the types of containment technologies in vertical column in List A, while top horizontal row (List B) consists of a list where each of containment technologies are connected to. The existing containment technologies were classified to fit in the SFD grid. Prior to selection of containment technologies, single pits constructed by assembling pre-cast concrete rings one above another were categorised as lined pits with semi-permeable walls and open bottom. The various types of sanitation technologies selected for the SFD graphic generator are shown in the SFD selection grid, as shown in Figure 15 and explained in Table 2.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B	T1A1C1		T1A1C3		Significant risk of GW pollution Low risk of GW pollution		T1A1C7			Not Applicable
Septic tank	T1A2C1				Significant risk of GW pollution T1A2C5					
Fully lined tank (sealed)	T1A3C1				Significant risk of GW pollution Low risk of GW pollution					T1A3C10
Lined tank with impermeable walls and open bottom	T2A4C1 Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	T1A4C6		T1A4C8		T2A4C10 T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A5C10 T1A5C10
Unlined pit										T2A6C10 Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable									Not Applicable

Figure 15: SFD selection grid of Lalitpur Metropolitan City.

Table 2: Explanation of different variables and containment technologies selected in SFD selection grid (SuSanA, 2018).

SN	Variables	Explanation
1	T1A1C1	This is a fully functioning toilet discharging directly to a correctly designed, properly constructed, fully functioning centralised combined sewer. The excreta is raw, untreated and hazardous, but since it is captured in the sewer, all the excreta in this system will contribute to variable W2.
2	T1A1C3	This is a fully functioning toilet discharging directly to a correctly designed, properly constructed, fully functioning decentralised combined sewer. The excreta is raw, untreated and hazardous, but since it is captured in the sewer, all the excreta in this system will contribute to variable W3.
3	T1A1C7	This is a fully functioning toilet discharging directly to a water body. The excreta is raw, untreated and hazardous and since it discharges directly to a water body, all the excreta in this system is considered not contained.
4	T1A2C1	This is a correctly designed, properly constructed, fully functioning septic tank with an effluent outlet connected to a correctly designed, properly constructed, fully functioning centralised combined sewer. The supernatant/effluent flowing from the tank is only partially treated and is still hazardous, but since it is captured in the sewer, all the excreta in this system is considered contained
5	T1A2C5	This is a correctly designed, properly constructed, fully functioning septic tank with an effluent outlet connected to a correctly designed, properly constructed, fully functioning soak pit. The supernatant/effluent flowing from the tank is only partially treated and is still hazardous, but since it is captured in the soak pit, all the excreta is considered contained
6	T1A3C1	This is a correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. Since the tank is fitted with a supernatant/effluent overflow connected to a correctly designed, properly constructed and fully functioning centralised combined sewer, the excreta in this system is considered contained.
7	T1A3C10	A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. Since the tank is not fitted with a supernatant/effluent overflow this system is considered contained.
8	T1A4C6	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since the tank is fitted with a supernatant/effluent overflow connected to an open drain or storm sewer, the excreta in this system is considered not contained.
9	T1A4C8	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since the tank is fitted with a supernatant/effluent overflow connected to open ground, the excreta in this system is considered not contained.
10	T1A4C10	This is a correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, through which infiltration can occur. Since there is not a 'significant risk' of groundwater pollution, the excreta of are considered contained.
11	T1A5C10	This is a correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow, so this system is considered contained.
12	T2A4C1	This is a correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since there is a 'significant risk' of groundwater pollution, all the excreta in this system is considered not contained.
13	T2A4C10	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur - the excreta is therefore likely to be partially treated. The tank is not fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained.
14	T2A5C10	A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained.
15	T2A6C10	This is a correctly designed, properly constructed and well-maintained unlined pit with permeable walls and base, through which infiltration can occur. Since there is a 'significant risk' of groundwater pollution, the excreta of this system are considered not contained.

2.2.2. Proportion of the FS contents of each type of onsite container which is faecal sludge

A detailed instruction from the SFD PI was used as guide to calculate the proportion of the contents of each type of onsite container which is faecal sludge. It stated that the default "100%" value should be used where onsite containers are connected to soak pits, to water bodies or to open ground. This will model the contents as 100% faecal sludge and a proportion of this may be emptied periodically. The remaining not emptied fraction is made up of one or more of the following: faecal sludge which remains in the container, supernatant (when discharging to water bodies or to open ground), and infiltrate. Where onsite containers are connected to a sewer network or to open drains, a value of "50%" is used which means that half the contents are modelled as faecal sludge; a proportion of this may be emptied periodically. The remaining not emptied fraction will comprise faecal sludge which remains in the container and, in the case of open bottomed tanks, infiltrate. The other half of the contents is modelled as supernatant discharging into the sewer network or to open drains. The formula used for faecal sludge proportion calculation is shown below:

$$\frac{(onsite\ container\ connected\ to\ soak\ pit,\ \ no\ outlet\ ,\ \ water\ bodies\ or\ \ \ open\ ground) * 100 + (onsite\ container\ connected\ to\ sewer\ network\ or\ open\ drain) * 50}{onsite\ containner}$$

The proportion of FS in septic tanks was set to 75%, the proportion of FS in fully lined tanks was set 90% and lined tanks with impermeable walls and open bottom and all types of pits was set to 95% according to the relative proportions of the systems in the city, as per the guidance provided by SuSanA.

2.2.3. SFD matrix

SFD matrix is a table which contains the means to calculate the variables for each of the sanitation systems chosen in the SFD selection grid. It comprises of list of possible containment technologies in the first column and list of all possible places to which the containment technology could be connected in the top rows.

Figure 16 shows the SFD matrix of Lalitpur Metropolitan City. The sanitation technologies and the corresponding percentage of the population using such technologies. These values are derived from the HH survey (ENPHO, 2024) and KIIs with desludging service providers ((KII_4, 2024).

Lalitpur Metropolitan City, Bagmati, Nepal, 29 Apr 2024. SFD Level: 2 - Intermediate SFD
Population: 294098
Proportion of tanks: septic tanks: 75%, fully lined tanks: 90%, lined, open bottom tanks: 95%

Containment												
System type	Population	WW transport	WW treatment	WW transport	WW treatment	FS emptying	FS transport	FS treatment	SN transport	SN treatment	SN transport	SN treatment
	Pop	W4a	W5a	W4b	W5b	F3	F4	F5	S4d	S5d	S4e	S5e
System label and description	Proportion of population using this type of system (p)	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of wastewater in sewer system, which is delivered to decentralised treatment plants	Proportion of wastewater delivered to decentralised treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in sewer system, which is delivered to treatment plants	Proportion of supernatant in sewer system that is delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C1 Toilet discharges directly to a centralised combined sewer	69.0	0.0	0.0									
T1A1C3 Toilet discharges directly to a decentralised combined sewer	3.0			20.0	0.0							
T1A1C7 Toilet discharges directly to water body	1.0											
T1A2C1 Septic tank connected to a centralised combined sewer	1.0					40.0	0.0	0.0	0.0	0.0		
T1A2C5 Septic tank connected to soak pit	1.0					16.0	50.0	90.0				
T1A3C1 Fully lined tank (sealed) connected to a centralised combined sewer	1.0					0.0	0.0	0.0	0.0	0.0		
T1A3C10 Fully lined tank (sealed), no outlet or overflow	4.0					37.0	5.0	90.0				
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	6.0					31.0	23.0	90.0				
T1A4C6 Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	1.0					27.0	0.0	0.0			0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0					35.0	0.0	0.0				
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	2.0					43.0	0.0	0.0				
T2A4C1 Lined tank with impermeable walls and open bottom, connected to a centralised combined sewer, where there is a 'significant risk' of groundwater pollution	1.0					13.0	0.0	0.0			0.0	0.0
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	6.0					15.0	30.0	90.0				
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	2.0					30.0	0.0	0.0				
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	1.0					39.0	0.0	0.0				

Figure 16: SFD matrix of Lalitpur Metropolitan City.

2.2.4. Calculation of proportion of FS emptied from containment (Variable F3)

The proportion of faecal sludge emptied (F3) is calculated based on the percentage containment emptied (ENPHO, 2024) and the amount of FS emptied during the process (KII_4, 2024)). In average, 90% of total faecal sludge from the containment is emptied during emptying mechanism as per household survey conducted. Thus, actual emptied proportion of faecal sludge was taken as 90% of the emptied containment. Hence, the proportion of FS emptied from the sanitation technology is calculated as 90% on the sanitation technology emptied. Table 3 shows the calculation of variable F3.

Table 3: Actual emptying proportion for existing containment technologies (ENPHO, 2024)[1,2] (KII_4, 2024)[2].

SN	Reference Variables	Containment technologies	Percentage of emptied containment (1)	Emptied proportion of FS (2)	Actual proportion of emptied FS (F3)
1	T1A2C1	Septic tank connected to a centralised combined sewer	44.44%	90.00%	40%
2	T1A2C5	Septic tank connected to soak pit	18.18%	90.00%	16%
3	T1A3C1	Fully lined tank (sealed) connected to a centralised combined sewer	0.00%	90.00%	0%
4	T1A3C10	Fully lined tank (sealed), no outlet or overflow	41.30%	90.00%	37%
5	T1A4C6	Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	34.38%	90.00%	31%
6	T1A4C8	Lined tank with impermeable walls and open bottom, connected to open ground	30.00%	90.00%	27%
7	T1A4C10	Lined tank with impermeable walls and open bottom, no outlet or overflow	38.46%	90.00%	35%
8	T1A5C10	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	47.62%	90.00%	43%
9	T2A4C1	Lined tank with impermeable walls and open bottom, connected to a centralised combined sewer, where there is a 'significant risk' of groundwater pollution	14.29%	90.00%	13%
10	T2A4C10	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	16.95%	90.00%	15%
11	T2A5C10	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	33.33%	90.00%	30%
12	T2A6C10	Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	42.86%	90.00%	39%

2.2.5. Calculation of FS emptied delivered to treatment plant and treated (Variables F4 and F5)

The percentage of FS emptied from septic tank, fully lined tank and lined tanks with impermeable walls and open bottom, no outlet or overflow and with significant risk which is delivered to FSTP in Mahalaxmi Municipality were found to be 50%, 5%, 23% and 30%

respectively. Moreover, the treatment efficiency of the treatment plant has been assumed as 90% based on the observation and secondary data review. Thus, FS delivered to treatment plant and treated was calculated as 90% (F5 = 90%).

Currently, there is no Faecal Sludge Treatment Plant within the metropolitan city operated for treating faecal sludge (KII_1, 2024). Mechanically emptied FS are transported and treated at the FSTP located in Mahalaxmi Municipality. On the other hand, manually emptied FS is directly applied in farmlands without undergoing any treatment. Consequently, the percentages of FS transported to the treatment plant (F4) and FS treated (F5) for other containment systems, except FS transported to the FSTP in Mahalaxmi Municipality, have been designated as 0%.

2.2.6. Calculation of WW transported to treatment plant and treated (Variables W4a, W4b, W5a and W5b)

Currently, wastewater from the sewer networks is mainly connected to the Bagmati River. Thus, the percentages of WW transported to the treatment plant (W4a) and treated (W5a) from centralised sewer network was considered as 0% based on the KII and field observation.

Three wastewater treatment plants have been constructed at Harisiddhi. Among the completed plants, only one was operational, but it is currently not functioning properly (KII_2, 2024). The percentages of WW transported to the treatment plant (W4b) from decentralised sewer network was considered as 20% and WW treated (W5b) was considered 0% based on the KII and field observation since the treatment plant is not functioning properly.

2.3. Summary of Assumptions

Offsite sanitation Systems

- ✓ The proportion of wastewater in sewer system, which is delivered to centralised treatment plants (W4a) and treated (W5a) are considered as 0% based on the field observation and key informant interviews, since centralised treatment plants are under construction.
- ✓ The proportion of wastewater in decentralised combined sewer system, which is delivered to decentralised treatment plants (W4b) was considered 20% and WW treated (W5b) was considered 0% based on the field observation and key informant interviews.
- ✓ The proportion of supernatant in sewer system and open drains, which is delivered to treatment plants and treated was considered 0% based on the field observation and key informant interviews.

Onsite Sanitation Systems

- ✓ The proportion of FS in septic tank and fully lined tanks was set to 75% and 90% respectively. The proportion of FS in lined tanks with impermeable walls and open bottom, single pit and unlined pit was set to 95% according to the relative proportions of the systems in the metropolitan city, as per the guidance provided by SuSanA.

- ✓ Variables F3, F4 and F5 for all onsite sanitation systems were derived from the HH survey and cross-checked with KIIs conducted.
- ✓ Some portions of mechanically emptied FS are transported (F4) in FSTP of Mahalaxmi Municipality are calculated based on the household survey and KIIs. The FS was treated with a treatment efficiency estimated at 90% (F5 = 90%).

2.4. SFD Graphic

Figure 17 represents the fate and flow of faecal sludge, wastewater and supernatant through the sanitation service chain. It shows that FS generated from 11% of the population is safely managed and represented by “Green” colour arrowhead. However, 10% of the safely managed FS resembles the FS stored in the containment without significant risk to groundwater pollution. Thus, the safely managed percentage of FS generated by this 10% of the population is temporary until the FS from the containment is emptied. Consequently, these systems will require emptying services in the short and medium term as they fill up. Additionally, 1% of the population have treated the FS in treatment plant.

The faecal sludge, wastewater and supernatant from 89% of the population is unsafely managed, represented by “Red” arrow heads. The percentage of unsafely managed FS is generated from FS from containments where FS is not contained - not emptied (9%), FS emptied but not delivered to treatment plant (6%), SN not delivered to treatment (1%), FS not treated (1%), WW not delivered to treatment (72%) and WW not treated (1%).

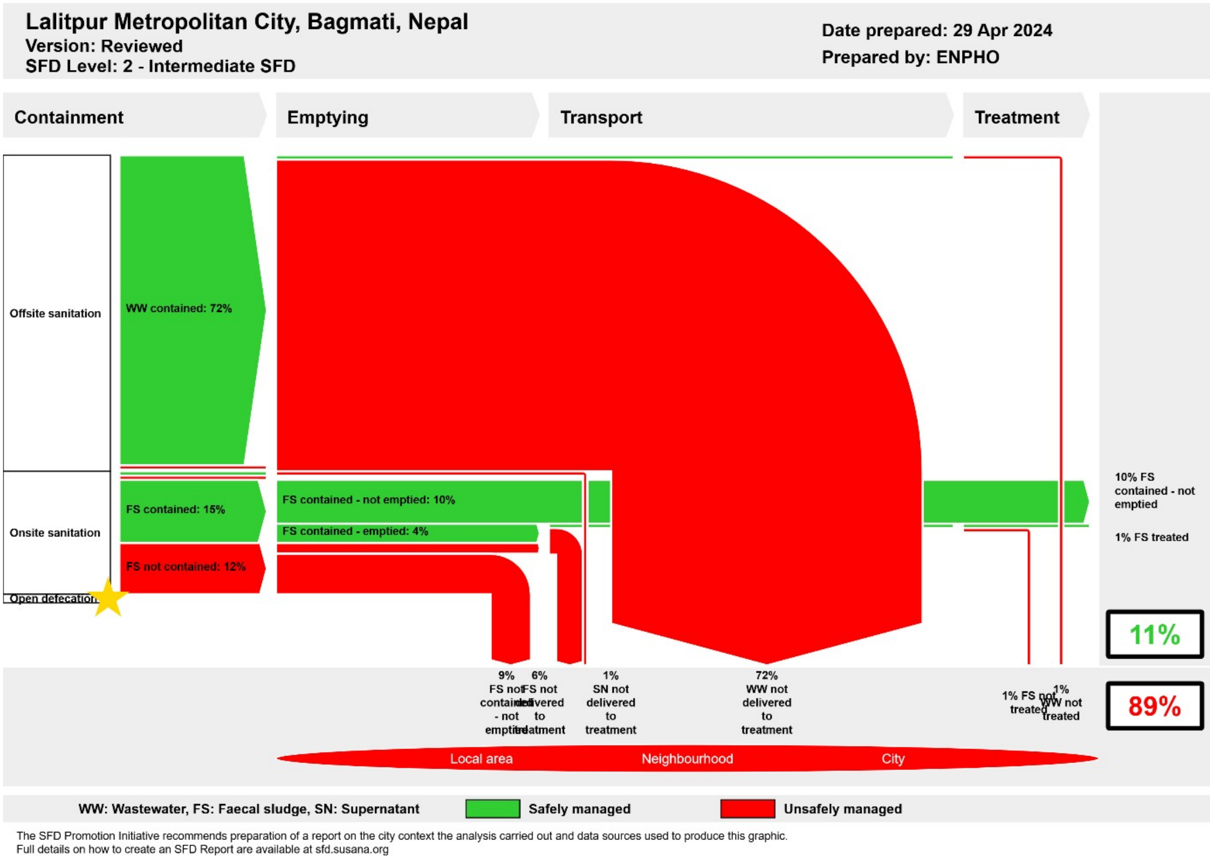

Figure 17: SFD graphic of Lalitpur Metropolitan City.

Offsite Sanitation

As shown on the SFD graphic (Figure 17), it is estimated that 72% of the population uses systems where the toilet is connected to centralised or decentralised sewer networks and 1% of the toilet discharges directly to water body.

WW contained

The value of WW contained is the summation of the percentage of population using toilet discharges directly to a centralised combined sewer (T1A1C1) and toilet discharges directly to a decentralised combined sewer (T1A1C3).

WW not contained

The value of WW contained is the summation of the percentage of population using toilet discharges directly to water body (T1A1C7).

WW not delivered to treatment

The proportion of WW not delivered to treatment is 72%.

WW not treated

The proportion of WW obtained from the system which has been delivered to treatment but not treated is 1%.

Onsite Sanitation

As shown on the SFD graphic (Figure 17), it is estimated that 15% of the population uses systems where the FS is considered contained, while 12% of the population uses systems where the FS is considered not contained.

FS contained

The definition of 'FS contained' is faecal sludge contained within an onsite sanitation technology which ensures safe level of protection from excreta i.e. pathogen transmission to the user or public is limited. These are tanks or pits that are correctly designed, properly constructed, fully functioning, and/or are causing no risk or only a 'low' risk of polluting groundwater used for drinking (SuSanA, 2018).

The value of FS contained is the summation of the percentage of population using septic tank connected to a centralised combined sewer (T1A2C1), septic tank connected to soak pit (T1A2C5), fully lined tank (sealed) connected to a centralised combined sewer (T1A3C1), fully lined tank (sealed), no outlet or overflow (T1A3C10), lined tank with impermeable walls and open bottom, no outlet or overflow (T1A4C10) and lined pit with semi-permeable walls and open bottom, no outlet or overflow (T1A5C10). Thus, the FS generated by 15% of the population is considered contained.

FS not contained

The definition of 'FS not contained' is faecal sludge contained within an onsite sanitation technology which does not ensure safe level of protection from excreta i.e. pathogen transmission to the user or public is likely. These are tanks or pits that are incorrectly designed, or poorly constructed, or poorly functioning, and/or are causing a ‘significant’ risk of polluting groundwater used for drinking (SuSanA, 2018).

The value FS not contained is obtained from the summation of percentage of population using lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer (T1A4C6), lined tank with impermeable walls and open bottom, connected to open ground (T1A4C8), lined tank with impermeable walls and open bottom, connected to a centralised combined sewer, where there is a 'significant risk' of groundwater pollution (T2A4C1), lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A4C10), lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A5C10), unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A6C10). Thus, the FS generated by 12% of the population is considered not contained.

FS contained - emptied

The proportion of FS contained - emptied is 4% and emptied either mechanically or manually.

FS not contained - emptied

The proportion of FS not contained - emptied (2%) is FS that is not contained in onsite sanitation technologies and emptied either mechanically or manually.

FS not delivered to treatment

The proportion of FS not delivered to treatment (6%) is the summation of FS contained - emptied and FS not contained - emptied.

SN not delivered to treatment

The proportion of SN obtained from containment which has not been transported to treatment is 1%.

FS treated

The proportion of FS obtained from containment which has been transported to treatment and treated is 1%.

FS not treated

The proportion of FS obtained from containment which has been transported to treatment but not treated is 1%.

3. Service Delivery Context

1.1 Policy, legislation and regulation

The constitution of Nepal 2015 has established right to access to clean drinking water and citizen as fundamental right. In Article 35 (4) related to right to health recognises citizen's rights to access to clean drinking water and sanitation. In addition, Right to Clean Environment, Article 30 (1) recognises that every person shall have the right to live in a healthy and clean environment (GoN, 2015). To respect and promote the right of citizens to wards accessing clean drinking water and sanitation services, the government has promulgated and amended necessary laws. The most relevant legislation for promotion of safe sanitation services is discussed here.

Local Government Operation Act, 2017

Local Governance Operation Act 2017 has promogulated to implement the rights of local government and promote co-operation, co-existence, and co-ordination among federal, provincial, and local government. The act defined roles and responsibility of municipalities along with provision and procedure for approving laws and regulations at local level. Regarding the management of sanitation, the act entitles local government to conduct awareness campaigns, design and implement sanitation programs at the local level.

Environment Protection Act, 2019

Environment Protection Act 2019 is promogulated to prevent and control pollution from different development activities. It defines "Pollution" as the activities that significantly degrade, damage the environment, or harm the beneficial or useful purpose of the environment, by changing the environment directly or indirectly because of wastes, chemical, heat, noise, electrical, electro-magnetic wave, or radioactive ray. It provides the mechanism for appointing environmental inspectors to control pollution by federal, provincial, and local government.

Water Supply and Sanitation Act, 2022

The act was promogulated to ensure the fundamental right of citizen to easy access on clean and quality drinking water, sanitation services and management of sewerage and wastewater. It defines sewerage and wastewater management as construction of sewer networks and treatment plants to preserve sources of water. It has entitled federal, provincial, and local level for the operation and management of water and sanitation services. The act also explicitly defines the responsibility of every citizen to preserve, conserve and maintain the sources of water and use responsibly (MoWS, 2022a).

Environment Friendly Local Governance Framework 2013

The environment-friendly local governance framework 2013 has been issued to add value to environment-friendly local development concept encouraging environmental protection through local bodies. The framework has set basic and advanced indicators for households, settlement, ward, village, municipality, and district levels for declaration of environment friendly. The use of water sealed toilets in households as basic indicators for sanitation and health. Provision of toilet with safety tank and use as advanced indicators for sanitation. Provision of gender, children and disabled friendly public toilets in parks, petrol pumps and main market as basic indicator for municipal level. Advance indicators such as drainage discharged only after being processed through biological or engineering technique. While it has failed to identify the necessity of faecal sludge treatment plants as it has assumed safety tank in the households is sufficient for treating faecal sludge.

Institutional and Regulatory Framework for Faecal Sludge Management, 2017

Ministry of Water Supply through its Department of Water Supply and Sewerage Management (DWSSM) articulated and endorsed Institutional and Regulatory Framework (IRF) for Faecal Sludge Management in Urban Areas of Nepal in 2017. The main objective of the IRF is to define the specific roles and responsibilities of key institutions for the effective management and regulation of Faecal Sludge Management (FSM). The framework primarily envisioned featuring FSM in the national policy and issuing policy directives into local government to incorporate FSM in their urban planning along with strengthening and enhancing the capacity of the local government to deliver effective services. A local government has been endowed with overall responsibility to plan, implement, and regulate the FSM services within its jurisdiction. The provision of the ability to engage the private sector and other relevant stakeholders such as the Water Users and Sanitation Committee in the framework reflects a participatory approach that would help in sustaining the interventions (MoWS, 2017a).

1.1.1 Policy

Historically, the National Sanitation Policy (1994) was the guideline for the planning and implementation of sanitation programs. The policy had promoted sanitation issues together with issues on water supply in rural communities. Also, Rural Water Supply and Sanitation National Policy (RWSSNP) 2004, has set a new target to provide safe, reliable, and affordable water supply with basic sanitation facilities. The policy focused on delivering quality services on water and sanitation to the marginalised and vulnerable groups. Participatory approach, community leadership project development, optimisation of local resources and installation of locally appropriate technologies were major principles in the policy (DWSSM, 2004). However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery (DWSSM, 2009) . Thus, the National Urban Water Supply and Sanitation Sector Policy (NUWSSSP) was formulated and enforced in 2009. It focused on achieving coherent, consistent, and uniform approaches of development in urban areas with the involvement of different agencies and institutions. Both these policies were limited to addressing emerging issues and challenges in the rural and urban areas. National Water, Sanitation and Hygiene Policy (NWASHP), 2023 resolves both Rural Water Supply and Sanitation National Policy, 2004 and National Urban Water Supply and Sanitation Sector Policy, 2009.

The National Water, Sanitation, and Hygiene Policy, endorsed by the Government of Nepal in 2023, aims to safeguard the universal right to access safe water and sanitation and upholds the right to reside in a clean and healthy environment. This policy advocates for a sectoral distribution of responsibilities among the three tiers of government, grounded in the principles of collaboration, cooperation, and coexistence. The goal is to ensure the effective management of water, sanitation, and hygiene development across the nation. It emphasises formulating Water, Sanitation, and Hygiene plans at the federal, provincial, and municipal levels. The policy prioritises the integration of climate and disaster-resilient development, along with a focus on research and institutional capacity building. It advocates for the delivery of WASH services that are of high quality, transparent, and accountable, with the goal of ensuring universal access to these services for all. Further, the policy encompasses a broad spectrum of sanitation services, incorporating the treatment and safe disposal or reuse of faecal sludge and wastewater (MoWS, 2023).

Nepal is a signatory of the historical resolution of 2010 United Nations General Assembly on the Human Right to Water and Sanitation (UNGA, 2010) . Nepal committed to Millennium Development Goals (MDGs) for 2000 - 2015. The goal was accomplished through declaration of the country as free from open defecation on 30th September 2019. National Sanitation and Hygiene Master Plan, 2011 was developed for coordinated planning and implementation of National Sanitation Campaign. The campaign strengthened institutional setup tier of government in a participatory approach. In an alignment, the total sanitation campaign was initiated formally to sustain ODF. The guideline set various indicators to assess the sustainability of sanitation services. Remarkably, it extended sanitation definition as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish the hygienic environment and promote public health (NPC, 2017).

Together with a national commitment to pursuing and achieving the Sustainable Development Goals (SDGs) by 2030, the National Planning Commission formulated targets and indicators for coordinated efforts to achieve the goals. This commitment has been reaffirmed in key policy documents, such as the current 15th Development Plan. Furthermore, Nepal has undertaken various initiatives to localise the SDG indicators by developing the SDG Status and Roadmap, which includes baselines and targets for 2030 (NPC, 2017).

Similarly, Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (SDP 2016-2030) was formulated in 2016 for sector convergence, institutional and legal reforms, capacity development and establishing coordination and harmonisation in the sector. The SDP classified service system and delineated roles and responsibilities for effective and sustainable service delivery. The SDP highlighted that majority of households rely on onsite sanitation system (70%) that requires effective treatment of faecal sludge. However, there is lack of concrete policies, guidelines, and indicators on faecal sludge management in the sector for effective planning, implementation, and service delivery. Nepal achieved the commendable milestone of being declared an Open Defecation Free nation on September 23, 2019. However, the overarching target of connecting 90% of households to either a sewer system or implementing proper FSM is yet to be achieved.

Total Sanitation Guideline was promulgated by the Ministry of Water Supply in April 2017 after the successful implementation of National Sanitation and Hygiene master Plan (NSHMP) 2011. It provides guidelines for sustaining ODF outcomes and initiating post-ODF activities through an integrated water, sanitation and hygiene plan at municipalities and districts. The guideline redefined sanitation as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish a hygienic environment and promote public health. Indicators are set to guide total sanitation movement with an arrangement for resource management, monitoring and evaluation, capacity building.

National Drinking Water Quality Standard 2022 has been published by Ministry of Water Supply in National Gazette with standards values for physical, microbiological, and chemical parameters. Altogether, 19 parameters have been set as mandatory parameters to be test by the water service providers (MoWS, 2022b) .

Local Acts, Policies and Procedures

The Lalitpur Metropolitan City enacted the Waste Management Act in 2019 to ensure a clean and healthy environment by reducing potential risks to public health and the environment. It aims to minimise waste generation, promote reuse, and ensure the safe treatment and disposal of waste (LMC, 2019).

1.1.2 Institutional Roles

Federal, provincial, and local government are entitled for implementation of water and sanitation programs to ensure the rights on access to safe water and sanitation.

At Federal Level

National Planning Commission: At the federal government, the National Planning Commission (NPC) is the specialised and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs, identifies sources of funding, and allocates budget. It serves as a central agency for monitoring and evaluating development policy, plans and programs. It supports, facilitates and coordinates with federal, provincial, and local government for developing policy plans and implementation.

Ministry of Water Supply: Ministry of Water Supply is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015) . Under the MoWS, Department of Water Supply and Sewerage Management plan and implement water and sanitation projects funded by foreign donors or inter provincial projects or serves at least 15,000, 5,000 and 1,000 people in terai, hilly and mountain region respectively (GoN, 2015). The organisational structure of DWSSM is shown in Figure 18.

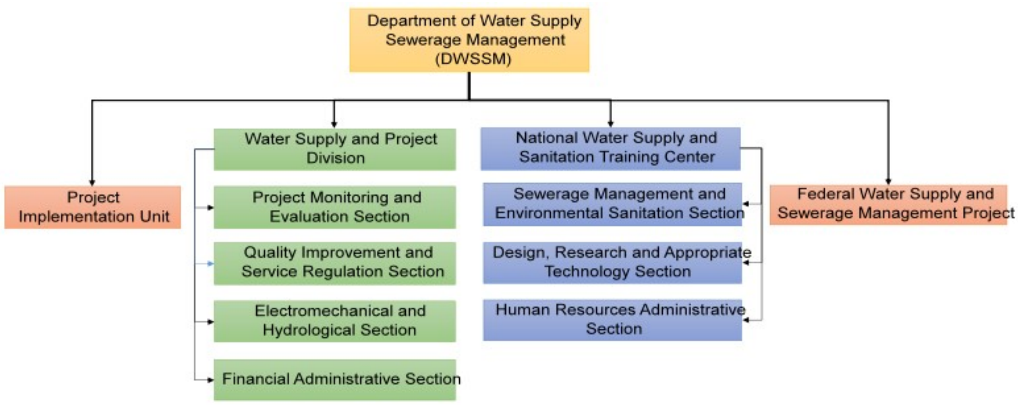

Figure 18: Organisational structure of DWSSM.

Ministry of Urban Development: The Ministry of Urban Development (MoUD) works on integrated urban planning and development in municipalities, including faecal sludge management. The Department of Urban Development and Building Construction (DUDBC) under MoUD is implementing body and sets standards for safe, affordable building construction and implementation for managed residential environment.

At Provincial Level

Ministry of Water Supply, Energy and Irrigation: Ministry of Water Supply, Energy and Irrigation of provincial government in Bagmati province is major executing body in the province. Planning and implementation of water supply and sanitation infrastructure in the province is executed through the Water Supply and Sanitation Divisional Office (WSSDO). WSSDO implements the water and sanitation programs meeting the following criteria:

- Inter local government projects
- Beneficiaries between 5,000 to 15,000 in terai region, 3,000 to 5,000 in Hilly region and 500 to 1,000 in Himalayan region.

At Local Government

The metropolitan city is organised into 10 divisions and various sections. The metropolitan city comprises separate environment division which includes sanitation sub-section. This sub-section is particularly focused on effective planning, coordination, and implementation related to waste management. The activities related to sewer networks construction and maintenance are undertaken by the sewer network section.

1.1.3 Service Provision

Urban Water Supply and Sanitation Policy 2009 has emphasised the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, the Public-Private Partnership Policy, 2015 encourages private sector investment in the development and operation of public infrastructure services for comprehensive socioeconomic development. The policy has aimed to remedy challenges such as structuring of projects, land acquisition, coordination and approval, payments to private sectors and approval for environment impact (MoF, 2015).

To ensure the safe, sustainable, and equitable use of water sanitation and hygiene by all, the metropolitan city has been collaborating with local, national and international development partners. It focuses on improving behavior change intervention for improved WASH facilities and practices, and WASH service provision leading to increased availability and affordability of WASH products and services which contributes to sustainable and equitable access to WASH for all. The metropolitan city has collaborated with the organisations and private sector to construct and operate the public toilets.

1.1.4 Service Standards

The sanitation service standards have been set by Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030). It classifies sanitation services as high, medium, and basic based on sanitation facilities in place. The sanitation service levels with indicators are shown in Table 4. However, FSM specific standards have yet to be developed and implemented.

Table 4: Sanitation Service Level and its Components.

S.N.	Service Components	Service Level		
		High	Medium	Basic
1	Health and Hygiene Education	✓	✓	✓
2	Household Latrine	✓	✓	✓
3	Public and School Toilets	✓	✓	✓
4	Septic tank sludge collection, transport, treatment, and disposal	✓	✓	✓
5	Surface drains for collection, transmission, and disposal of greywater	✓	✓	✓
6	Small-bore sewer collection for toilet and septic tank effluent, low-cost treatment and disposal		✓	
7	Sanitary sewers for wastewater collection, transmission, non-conventional treatment, and disposal	✓		
8	Sanitary sewers for wastewater collection, the transmission of conventional treatment and disposal	✓		
9	Limited solid waste collection and safe disposal	✓	✓	✓

4. Stakeholder Engagement

4.1. Key Informant Interviews

Key Informant Interviews (KIIs) are qualitative in-depth interviews with people who know what is going on in the community. The purpose of key informant interviews is to collect information from a wide range of people who have first-hand knowledge about the concerned topic. KIIs were conducted with environment and sanitation related stakeholders. The KIIs were conducted with municipal officials, water supply service provider, desludging service providers and public toilet service provider (Figure 19). Face-to-face interviews were conducted to get the required information. The information was collected with key stakeholders about the status of sanitation services and water supply schemes. List of key informant stakeholders from the municipalities along with their organisation and purpose are as shown in Table 5.

Table 5: List of key stakeholders for KIIs.

KII code	Name	Designation	Organisation	Purpose	Date
KII_1	Pradip Amatya	Engineer	Lalitpur Metropolitan City	Sanitation Status of Lalitpur Metropolitan City	4 Jan,2024
KII_2	Rajesh Maharjan	Treasurer	Thaiba Harishiddhi Supply Consumers and Sanitation Committee	Water supply, coverage, treatment, water quality	6 Jan,2024
KII_3	Simran Deula	Public toilet operator	AEROSAN (Patandhoka Public toilet)	Status of Public Toilet	6 Jan,2024
KII_4	Dhana Ram Tamang	Service provider	Desludging service providers	Faecal sludge desludging service	6 Jan,2024

Figure 19: Key informant interviews with public toilet operator and water service provider.

4.2. Household Survey

In each ward of the metropolitan city, a random household survey was conducted. The two-day orientation was provided to local enumerators chosen by metropolitan city representing each ward (Figure 20). They were oriented on each component of the sanitation service chain, starting from user interface to reuse/ safe disposal along with the use of mobile application for data collection. They were mobilised in the community level to gather data from households and institutional level. The list of the enumerators has been attached in Appendix 2. The data was collected using the *KoboCollect* application.

Figure 20: Photos of enumerators during their orientation on effective data collection techniques.

Determining Sample Size

The sample size for the household survey in Lalitpur Metropolitan City was determined by using Cochran (2963:75) sample size formula $n_0 = \frac{z^2pq}{e^2}$ and its finite population correction for the proportions:

$$n = \frac{n_0}{1+\frac{(n_0-1)}{N}}$$

Where,

n_0		Sample size
z	1.96	z value found in z table at 95 % of the confidence level
p	0.5	Assuming that about 50% of the population should have some sanitation characteristics that need to be studied (this was set as 50% since this percentage would yield the maximum sample size as the percentage of the population practising some form of sanitation is not known at the intervention)
q	1-p	
e	± 3 %	desired level of precision or sampling error
n		Reduced sample size
N		Total number of population (households in the metropolitan city)

This is followed by proportionate stratification random sampling such that each ward in the metropolitan city is considered one stratum. The sample size required in each ward of the metropolitan city was calculated as $n_h = \frac{N_h}{N} \times n$ where, N_h is total population of each ward of metropolitan city.

Thus, 1,053 households out of 77,159 households distributed in 29 wards were sampled using proportionate stratification random sampling. The number of ward wise sample size has been attached in Appendix 3. The distribution of sampling points in the city are shown in Figure 21.

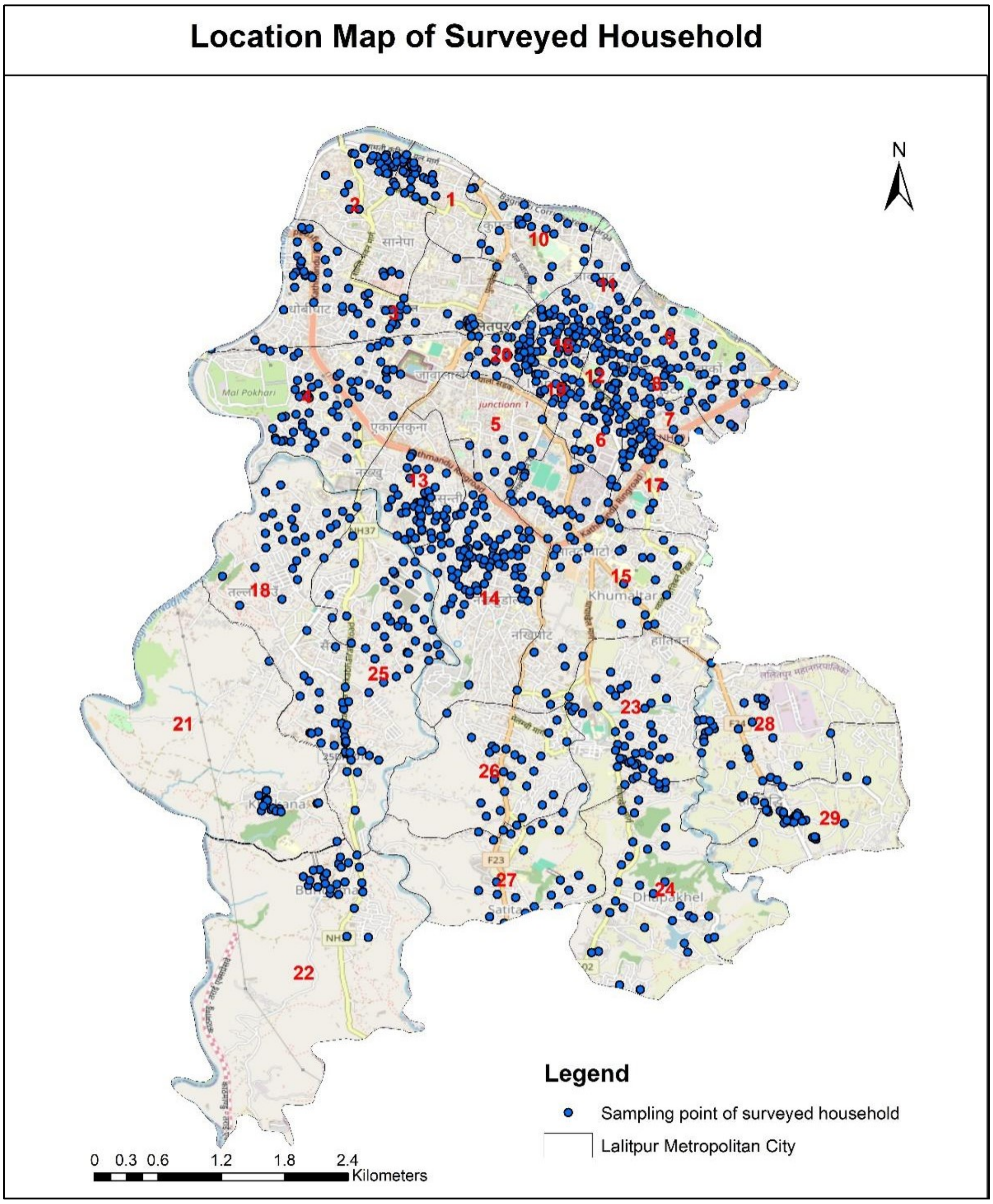

Figure 21: Distribution of sampling points in all wards of Lalitpur Metropolitan City.

5. Comparison with the SFD report from 2020

This section presents a comparison of the data sources and results from the current analysis with those from a previous SFD lite report of Lalitpur Metropolitan City published in 2020 by the City-wide Inclusive Sanitation Technical Assistance Hub, South Asia (CWIS TA Hub, South Asia)/Environment and Public Health Organization (ENPHO) and Kathmandu Valley Water Supply Management Board (KVWSMB) (CWIS TA Hub, 2020) . Table 6 provides a side-by-side comparison of the data collected in both reports.

Table 6: Comparison of data gathered in the two SFD reports.

	SFD lite report (2020)	SFD intermediate report (2025)
Sources of data	Household survey	Literature review, Household survey, Institutional Surveys, KIIs
Service delivery context description	No information on policy, legislation and regulation of the sanitation service delivery chain is provided.	Information on policy, legislation and regulation of the sanitation service delivery chain is provided.
Data validation	Field visits	Field visits, KIIs
Findings validation	Discussions were held with Co-coordinator of Environmental Committee, Municipal Engineer, Private Mechanical Desludging Service Provider, and users.	Discussions were held with Municipal Engineer, Treasurer, Public Toilet Operator, Water Supply Service Provider, Private Mechanical Desludging Service Provider, and users.

Table 7 shows a comparison of the sanitation systems in the city according to the two SFD reports.

Table 7: Comparison of sanitation systems according to the two SFD reports.

Sanitation systems	SFD lite report (2020)	SFD intermediate report (2025)
Toilet discharges directly to a centralised combined sewer (T1A1C1)	71.0%	69.0%
Toilet discharges directly to a dentralised combined sewer (T1A1C3)	-	3.0%
Toilet discharges directly to water body (T1A1C7)	-	1.0%
Septic tank connected to a centralised combined sewer (T1A2C1)	-	1.0%
Septic tank connected to soak pit (T1A2C5)	-	1.0%
Fully lined tank (sealed) connected to a centralised combined sewer (T1A3C1)	8.0%	1.0%
Fully lined tank (sealed), no outlet or overflow (T1A3C10)	3.0%	4.0%
Fully lined tank (sealed) connected to a soak pit (T1A3C5)	2.0%	-
Lined tank with impermeable walls and open bottom, no outlet or overflow (T1A4C10)	16.0%	6.0%
Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer (T1A4C6)	-	1.0%

Lined tank with impermeable walls and open bottom, connected to open ground (T1A4C8)	-	1.0%
Lined tank with semi-permeable walls and open bottom, no outlet or overflow (T1A5C10)	-	2.0%
Lined tank with impermeable walls and open bottom, connected to a centralised combined sewer, where there is a 'significant risk' of groundwater pollution (T2A4C1)	-	1.0%
Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A4C10)	-	6.0%
Lined tank with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A5C10)	-	2.0%
Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A6C10)	-	1.0%
SFD graphic outcome	17% safely managed excreta. 83% unsafely managed excreta.	11% safely managed excreta. 89% unsafely managed excreta.

As shown in Tables 6 and 7, the main differences between the two reports lie in the disaggregated representation of sanitation systems and the broader set of data sources used in the 2025 analysis. In particular, several sanitation categories that were not previously identified in the 2020 SFD Lite Report have been captured in the current report, such as toilet discharges to decentralised combined sewers, direct discharges to water bodies, and various forms of lined and unlined tanks with differing risks of groundwater contamination. This more detailed classification provides a clearer picture of the sanitation situation in the city.

Consequently, the SFD graphic outcomes also differ. While the 2020 report indicated that 17% of excreta was safely managed, the updated analysis from 2025 shows only 11% safely managed, with 89% unsafely managed. This decline in the proportion of safely managed excreta is largely due to the reclassification of containment systems previously assumed to be safe but which, upon closer inspection, present significant risks of leakage or groundwater pollution. For instance, the proportion of lined tanks with impermeable or semi-permeable bases and open bottoms – systems prone to contaminant seepage – was captured in the 2025 analysis but not in the 2020 report.

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8. Appendix

8.1. Appendix 1: Roles and Responsibility of Various Tiers of Governments Delineated in Drafted SDP 2016 – 2030

System Classification		Minimum Key HR Required	Regulation & Surveillance	Financing & Construction	Ownership of System	Service Delivery	
Size	**Sanitation**					**Provision**	**Production**
Small	Onsite sanitation	Water Supply and Sanitation Technician (WSST)	Federal and or Provincial Government	User+/ community+/ other			
Medium	Septage Management	Sub-engineer	Federal and or Provincial Government	Provincial+/ Local Govt+/ Community+/ Private Sector		Local Govt	Users committee/ Utility manager
Large	Septage or FSM Management	WASH Engineer + finance & admin staff	Federal and or Provincial Government	Provincial+/ Local Govt+/ Community+/ Private Sector		Local Govt	Utility Manager
Mega	Septage/ FSM Management	WASH Engineer + finance & admin staff	Federal and or Provincial Government	Provincial+/ Local Govt+/ Community+/ Private Sector		Local Govt	Utility Manager

8.2. Appendix 2: List of Participants of SFD orientation

UCLG ASPAC ENPHO

Municipalities Network Advocacy on Sanitation in South Asia(MuNASS) - II

1- Dalit
2- Brahmin/Chettri/Thakuri
3- Janajati
4- Muslim
5- Madhesi
6- Others

Program: Orientation on Shit Flow Diagram (SFD) data collection Attendance Sheet
Date: 18-19 Paush, 2080
Venue: Lalitpur Metropolitan City

S.N	Name	Organization	Designation ward	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
19.	Vijwal Dangol	lalitpur	21	986921005			19	M	Janjati
20	Ashrisha Shrestha	Lalitpur	22	9869090770			22	F	Janajati
21	Purusottam Khadka	Lalitpur	25	9813723717			34	M	2
22	Suresh Shrestha	Lalitpur	~~25~~ 17	9849751490			26	M	3
23	Sajana Tandukar	Lalitpur	11	9818283753			40	F	3
24	Sanjila Shakya	Lalitpur	20	9746292520			18	F	3
25	Bidhya Maharjan	Lalitpur	6	9849674669			38	F	3
26	Siyon Maharjan	Lalitpur	19	9749355936			18	F	63
27	Susan K.C	lalitpur	13	9745862463			23	M	
28	Salina Maharjan	lalitpur	29	9823399139			20	F	
29	Mohit Maharjan	Lalitpur	28	9843433782			20	M	
30	Pradina Shrestha	Lalitpur	11	9813307274	Pradna	Pradna	24	F	
~~31~~	~~Sanjit Thapa Magar~~	~~Lalitpur.~~	~~3~~	~~9803703448~~			~~42~~	~~M~~	
~~32~~	~~8~~								
32	~~Suresh Shrestha~~	Lalitpur	~~17~~	~~9849251490~~			~~26~~	~~M~~	
~~32~~	~~Vijwal Dangol~~	lalitpur							

UCLG ASPAC ENPHO

Municipalities Network Advocacy on Sanitation in South Asia(MuNASS) - II

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6- Others

Orientation on Shit Flow Diagram (SFD) Attendance Sheet
Program: Lalitpur Metropolitan City
Date: 18-19 Poush, 2080
Venue:

S.N	Name	Organization	Designation Ward.	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1.	Arlesh Maharjan	Lalitpur,	9	9843777818			29	M	Janjati
2.	Rajesh Nepali	lalitpur	18	9860802539			24	M	1
3.	Saroj Maharjan	lalitpur	12	9813871743			26	M	Janjati
4.	Sujata Khadka	Lalitpur	14	9863270224			24	F	2
5.	Binita Barahi	Lalitpur	8	9761694151			16	F	2
6.	Sanjit Thapa Magar	Enumerator "	3	9803703448			42	M	Janjati
7.	Dibina Dangol	Lalitpur	16	9808103666			19.	F	"
8.	Jharana Maharjan	"	23	9860035969			29	F	"
9	Saroj Bhandari	"	10	9847761663			40	M	~~[illegible]~~
10	Anjali Shakya	"	6	9841130663			31	F	
11	Sachina Maharjan	Lalitpur	04	9861289325			33	F	
12.	Aarsee Dhakal	Lalitpur	01	9861222318			21	F	Brahmin
13	Sohan Bajracharya	Lalitpur	15	9840254481	Sohan	Sohan	22	M	Newar
14.	Nivanjan Kapali	Lalitpur.	05.	9864475744			20.	M.	Newar
15.	Sabitri Maharjan	"	26	9860541909			36	F	"
16	Laxmi Magrati	"	04	9803615328			19	F	1
17	Shanti Maharjan	"	24	9841616913			40	F	3
18	Rajan Maharjan	Lalitpur		9861333896			26	M	3

UCLG ASPAC ENPHO

Municipalities Network Advocacy on Sanitation in South Asia(MuNASS) - II

1- Dalit
2- Brahmin/Chettri/Thakuri
3- Janajati
4- Muslim
5- Madhesi
6- Others

Attendance Sheet

Program: Orientation on Shit Flow Diagram (SFD) Data Collection
Date: 18, 19 Paush, 2080
Venue: Lalitpur Metropolitan City

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1.	Chiri Babu Maharjan	L.M.C	Mayor						
2.	[illegible]	L.M.C.		[illegible]					
3.	[illegible]	LMC	Secti chief	9841359443					
~~4.~~	~~Sujata Khadka~~	~~LMC~~	~~14~~	~~9863270224~~			~~24~~	~~F~~	~~2~~
4.	Pradeep Amatya	LMC	Engineer	9851084081					
5.	Asmita Shrestha	E.N.PHO	A.P.O	9861960579					
6	Sabuna Gamal	ENPHO	APO	9845412596					

8.3. Appendix 3: Ward wise sample size distribution in Lalitpur Metropolitan City

Wards	Households	Population	Proportion	Required sample HH	Sample difference
1	2,046	7,265	3%	28	73
2	4,094	15,743	5%	56	73
3	3,098	11,376	4%	42	73
4	4,912	18,188	6%	67	73
5	983	3,971	1%	13	73
6	1,297	5,270	2%	18	73
7	1,329	5,347	2%	18	73
8	2,606	9,926	3%	36	73
9	3,468	12,972	4%	47	73
10	1,613	5,758	2%	22	73
11	2,491	9,496	3%	34	73
12	1,522	6,554	2%	21	73
13	3,956	14,235	5%	54	73
14	6,149	22,841	8%	84	73
15	4,414	16,454	6%	60	73
16	1,876	7,766	2%	26	73
17	2,893	10,954	4%	39	73
18	3,567	13,746	5%	49	73
19	1,367	5,453	2%	19	73
20	2,470	9,239	3%	34	73
21	1,235	5,274	2%	17	73
22	1,940	7,894	3%	26	73
23	3,205	11,928	4%	44	73
24	2,252	9,104	3%	31	73
25	4,346	16,461	6%	59	73
26	2,057	7,909	3%	28	73
27	1,609	6,290	2%	22	73
28	2,869	10,778	4%	39	73
29	1,495	5,906	2%	20	73
Total	**77,159**	**294,098**		**1,053**	

SFD Lalitpur Metropolitan City, Nepal, 2025

Produced by:
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This Executive Summary and the SFD Report are available from:

www.sfd.susana.org

SFD Promotion Initiative