SFD Report

Kamalamai Municipality
Nepal

Final Report

This SFD Report - SFD level 2 - was prepared by:

Environment and Public Health Organization (ENPHO)

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SFD Report Kamalamai Municipality, Nepal, 2024

Produced by:

Rupak Shrestha, ENPHO
Sabuna Gamal, ENPHO
Jagam Shrestha, ENPHO
Buddha Bajracharya, ENPHO
Anita Bhuju, ENPHO

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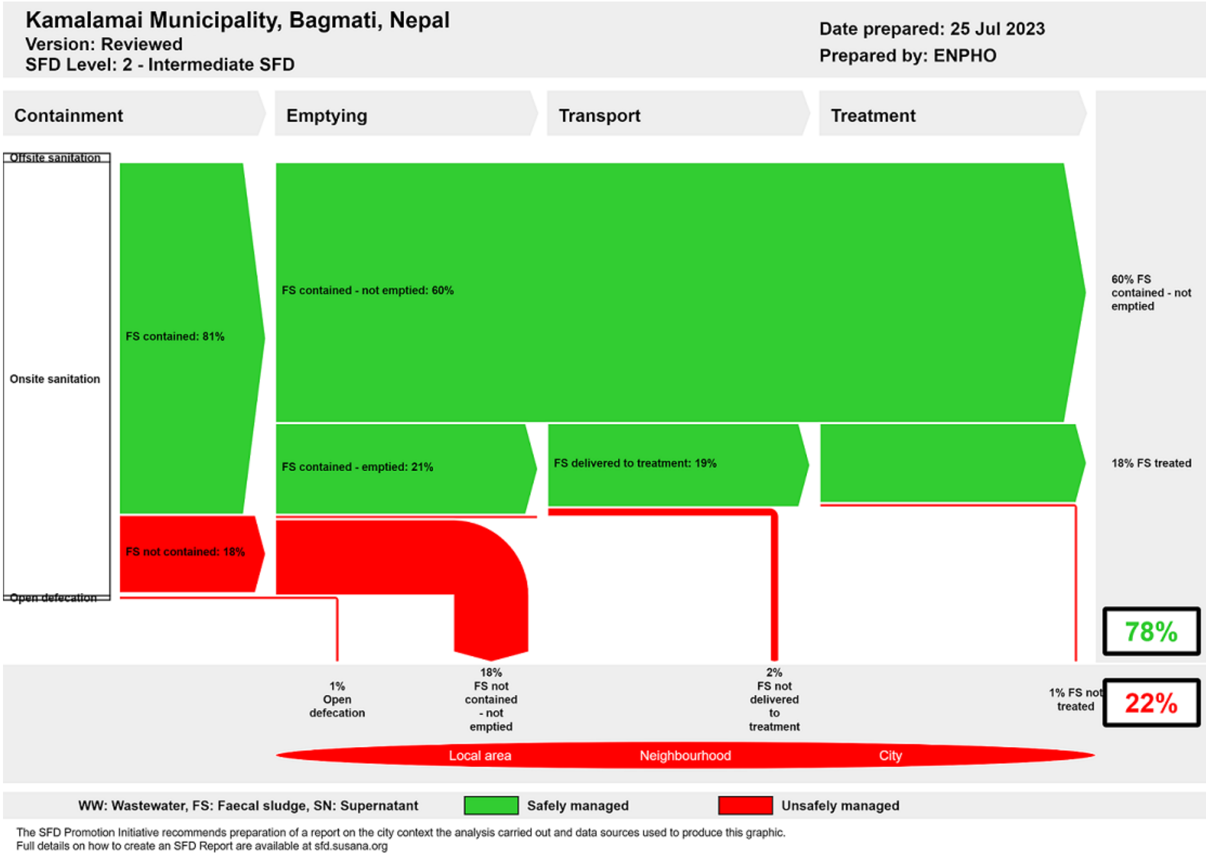
1. The SFD Graphic



2. Diagram information

SFD Level:

This SFD is a level 2- Intermediate report.

Produced by:

Environment and Public Health Organization (ENPHO).

Collaborating partners:

Kamalamai Municipality, Municipal Association of Nepal (MuAN), United Cities and Local Government – Asia Pacific (UCLG-ASPAC).

Status:

Final SFD report.

Date of production: 21/02/2024

3. General city information

Kamalamai Municipality was declared as municipality in 1996. It is in Sindhuli District, Bagmati Province in the Central South Nepal. It is divided into 14 political wards.

The municipality has a total population of 71,016 with 34,416 males and 36,700 females (Census 2021, n.d.). Out of total wards, ward number 6 has the largest population (12,498) while ward number 3 has the least population with (1,359). The municipality has a total of 18,135 households. Ward number 6 has the most households with a total of 3,440, while ward number 3 has the least number of households with a total of 384.

The climate here is mild, and generally warm and temperate. The temperature in this location is approximately 21.0 °C (69.7 °F), as determined by statistical analysis. About 1,930 mm (76.0 inch) of precipitation falls annually.

4. Service outcome

The overview of different sanitation technologies across the sanitation value chain in the municipality is briefly explained in this section (ENPHO, 2023). Basic sanitation coverage in the municipality is 98.71% where, basic sanitation is defined as having access to facilities for the safe disposal of human waste (faeces and urine), as well as having the ability to maintain hygienic conditions, through services such as garbage collection, industrial/hazardous waste management, and wastewater treatment and disposal. The families without toilets defecate in open places, public toilets or use neighbour's toilet. All the households that have their own toilets depend on onsite sanitation systems.

Containment:

Different types of containment used to store faecal sludge in onsite sanitation systems are fully lined tanks (36%), lined tanks with impermeable walls and open bottom (33%), lined pits with semi-permeable walls and open bottom (14%), unlined pits (16%) and 1% of the households practise open defecation.

Emptying and Transportation:

There are no regular emptying practices of the containments. However, 21.88% of the households had emptied the containment at least once since installation. Both manual and mechanical desludging mechanism is practised.

Treatment and Disposal:

The municipality lacks a faecal sludge treatment facility. The majority of Faecal Sludge (FS) emptied is used in agricultural lands untreated. Households using biogas digesters utilize its energy in cooking and other purposes.

The SFD graphic shows that 78% of the excreta generated are safely managed while 22% of the excreta generated are unsafely managed. The safely managed percentage of FS generated by 60% of the population is temporary until the tanks and pits become full and FS from the containment is emptied.

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 enforced the Water Supply and Sanitation Law 2022 which emphasized 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, NSHMP 2011 has proved to be an important strategic document for all stakeholders to develop uniform programs and implementation mechanisms at all levels. It strengthened institutional set up with the formation of Water and Sanitation Coordination Committee (WASH-CC) to actively engage in sanitation campaigns. The sanitation campaign was implemented throughout the country mainly focusing on achieving universal access to improved sanitation.

Nepal committed to the SDGs early on, and this commitment has been reaffirmed in key policy documents, such as the current 15th development plan and the 25-year long term vision 2100 that internalises the Goals. SDGs codes are assigned for all national development programmes through the Medium-Term Expenditure Framework. Further, Nepal has prepared the SDG status and roadmap to localize the SDG indicators with baselines and targets 2030.

6. Overview of stakeholders

The major stakeholders envisioned by the regulatory framework for Faecal Sludge Management (FSM) in urban cities are presented in Table 1.

Table 1: Overview of Stakeholders.

Key Stakeholders	Institutions / Organizations
Public Institutions at Local Government	Kamalamai Municipality
Non-governmental Organizations	Environment and Public Health Organization (ENPHO)
Private Sector	Public Toilet Operators.
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC

7. Credibility of data

The major data were collected from random household sampling (ENPHO, 2022). Altogether, 389 households and 44 institutions were surveyed from 14 wards of Kamalamai Municipality. Primary data on emptying, transportation and current sanitation practices in the municipality were triangulated with the data obtained from Key Informant Interviews (KIIs) with Municipal Officers, Chairperson and Manager of Kamalamai Water Users Committee and the operator of the public toilet. Also, a data sharing and validation workshop with key stakeholders was performed.

8. Process of SFD development

Data on sanitation situations were collected through household and institutional surveys. Enumerators from the municipality were mobilized after providing orientation on sanitation technologies, objectives of the survey and proper use of mobile application, KOBOCOLLECT for collection of data for survey. Along with this, KIIs were conducted with officers and engineers of the municipality and Water Supply and Sanitation Users Committee. Types of sanitation technologies used in various locations were mapped using ARCGIS. For the Shit Flow Diagram (SFD) graphic production, initially, a relationship between sanitation technology used in questionnaire survey and Shit Flow Diagram Promotive Initiative (SFD PI) methodology was made. Then, data was fed into 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:

- ADB., A. D. (2021). Environmental Monitoring Report. Government of Nepal for the Asian Development Bank, Nepal: Third Small Towns Water Supply and.
- CBS. (2021). National Population and Housing Census 2021. Kathmandu, Nepal: Central Bureau of Statistics. Retrieved from chrome-extension:// https://censusnepal.cbs.gov.np/results /downloads/ward
- MoFAGA. (2017). Ministry of Federal Affairs & General Administration. Retrieved from Government of Nepal, Ministry of Federal Affairs & General Administration: https://www.sthaniya.gov.np/gis/.

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Abbreviations

ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
GoN	Government of Nepal
HH	Household
JMP	Joint Monitoring Programme
KII	Key Informant Interview
KM	Kilometres
mm	Millimetre
MoEST	Ministry of Education, Science and Technology
MoFAGA	Ministry of Federal Affairs and General Assembly
MoH	Ministry of Health
MoHP	Ministry of Health and Population
MoUD	Ministry of Urban Development
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NPC	National Planning Commission
NUWSSP	National Urban Water Supply and Sanitation Sector Policy
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
RWSSNP	Rural Water Supply and Sanitation National Policy
SCEIS	Sector Coordination and Efficiency Improvement Section
SDG	Sustainable Development Goal
SDP	Sector Development Plan
SFD	Shit Flow Diagram
SFD PI	Shit Flow Diagram Promotion Initiative
SN	Supernatant
UCLG ASPAC	United Cities and Local Governments Asia Pacific
UNICEF	United Nations Children's Education Fund
VDC	Village Development Committee
WASH	Water, Sanitation and Hygiene
WASH-CC	Water, Sanitation and Hygiene Coordination Committee
WHO	World Health Organization
WSP	Water Supply Providers
WSUC	Water Supply and User's Committee
WW	Wastewater

1. City context

Kamalamai Municipality is in Sindhuli District, Bagmati Province of the Central South Nepal. It was declared as municipality in 1996. The municipality is divided into 14 political wards. It covers 482.6 square kilometres of area. It is surrounded by Tinpatan and Dudhouli Village Development Committee (VDC) in the east, Ghanglekh and Marin VDC in the west, Sunkoshi and Golanjor VDC in the north and Sarlahi, Mahottari and Dhanusha District in the south (MINISTRY OF FEDERAL AFFAIRS & GENERAL ADMINISTRATION, n.d.). Figure 1 shows the Geo-political map of Kamalamai Municipality.

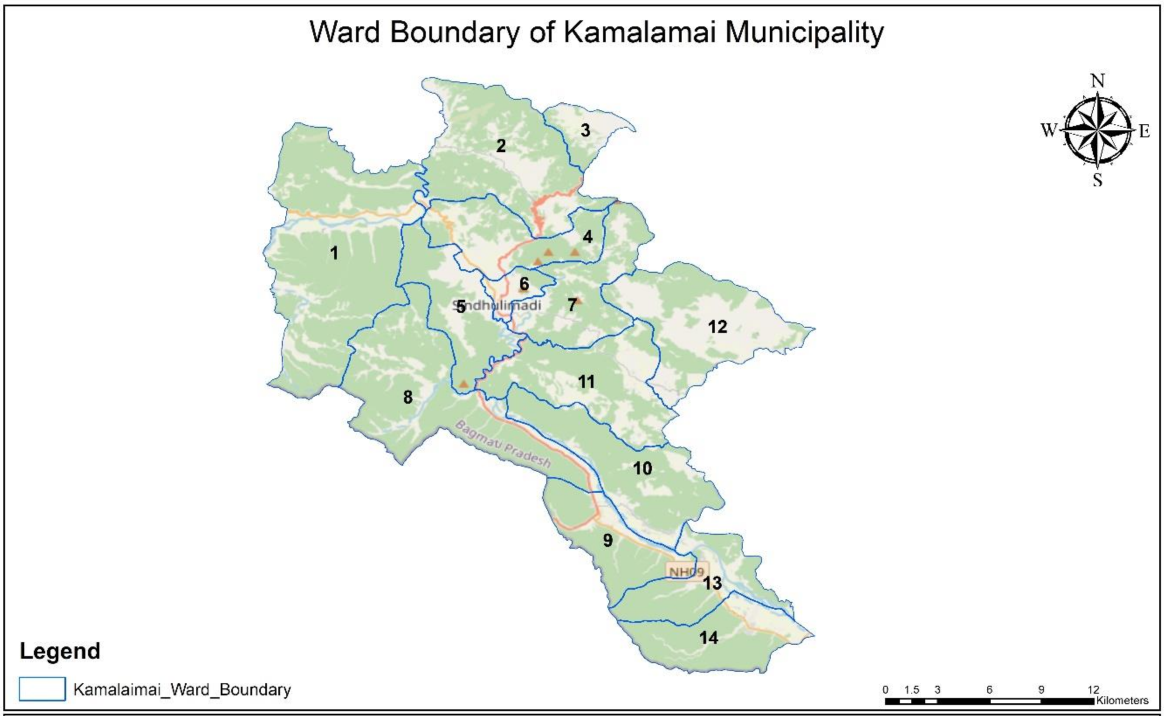

Figure 1: Map of Kamalamai Municipality with ward boundaries.

1.1 Population

The National housing and population census 2021 has reported 71,016 people who reside in the municipality. The total male and female population are 34,316 and 36,700 respectively (Table 1). The ward number 6 has the most residents (12,498), while ward number 3 has the fewest (1,359). The total number of households in the municipality is 18,135. Ward number 6 has the most households with a total of 3,440, while ward number 3 has the least number of households with a total of 384 (Census 2021, n.d.).

Table 1: Ward Wise Household and Population Data.

Wards	Households	Population	Male	Female	Average Household Size
1	1,104	4,565	2,197	2,368	3.50
2	929	3,790	1,852	1,938	3.78
3	384	1,359	620	739	4.21
4	2,346	8,818	4,309	4,509	3.85
5	2,102	8,292	3,931	4,361	4.08
6	3,440	12,498	6,140	6,358	4.14
7	1,735	6,828	3,233	3,595	4.06
8	927	3,672	1,803	1869	4.03
9	1,228	4,728	2,246	2,482	4.02
10	821	3,375	1,629	1,746	4.30
11	935	3,800	1,842	1,958	4.06
12	884	3,822	1,914	1,908	4.18
13	556	2,258	1,057	1,201	4.14
14	744	3,211	1,543	1,668	4.02
Total	**18,135**	**71,016**	**34,316**	**36,700**	**3.93**
					(Census 2021, n.d.)

1.2 Climate

The climate here is mild, and generally warm and temperate. In Kamalamai, the quantity of rainfall during summers surpasses that of winter. According to Köppen and Geiger, this climate is classified as Cwa (Classification: Cwa: C = Mild temperate w = Dry winter a = Hot summer). The temperature in this location is approximately 21.0 °C (69.7 °F), as determined by statistical analysis. About 1,930 mm (76.0 inch) of precipitation falls annually (Climate Data, n.d.).

1.3 Topography

Sindhuli District is situated north of Mahabharat range and south of Chure range. It is located between latitude 26°55'N to 27°22'N and longitude 85°15' E to 86°25' E (Dhakal, n.d.) with an elevation of 510 metres above sea level (Worldwide Elevation, n.d.).

2 Service Outcomes

2.1 Overview

Data on sanitation situation were collected through household and institutional surveys(ENPHO, 2023). A total of 389 households were sampled from 18,135 households distributed in 14 wards (further details are presented in section 4). The results obtained after the triangulation and validation of the data with all the data sources including literature reports, Key Informant Interviews (KIIs) and a validation workshop is presented in this section.

2.1.1 Sanitation Status

Kamalamai Municipality was declared an Open Defecation Free (ODF) zone on March 2011 (ODF Declaration, 2019). It suggests that everyone has access to basic sanitation facility. Basic sanitation facilities are defined as functional improved sanitation facilities separated for males and females on or near the premises. Whereas Basic Sanitation is defined as having access to facilities for the safe disposal of human waste (faeces and urine), as well as having the ability to maintain hygienic conditions, through services such as garbage collection, industrial/hazardous waste management, and wastewater treatment and disposal. However, the sanitation situation assessment conducted by ENPHO in 2023 showed that the municipality's basic sanitation coverage is 98.71% (ENPHO, 2023).The remaining households still defecate in the forests or open spaces.

Onsite sanitation refers to a sanitation technology or sanitation system in which excreta (referred to as faecal sludge) is collected and stored and emptied from or treated on the plot where they are transport (Susana, 2018) whereas offsite sanitation refers to a sanitation system in which excreta (referred to as wastewater) is collected and transported away from the plot where they are generated. An offsite sanitation system relies on a sewer technology for transport (Susana, 2018).

Onsite sanitation systems are prevalent in the municipality. 100% of surveyed households rely on onsite sanitation technologies in the municipality. Figure 2 shows the availability of basic sanitation coverage in the municipality.

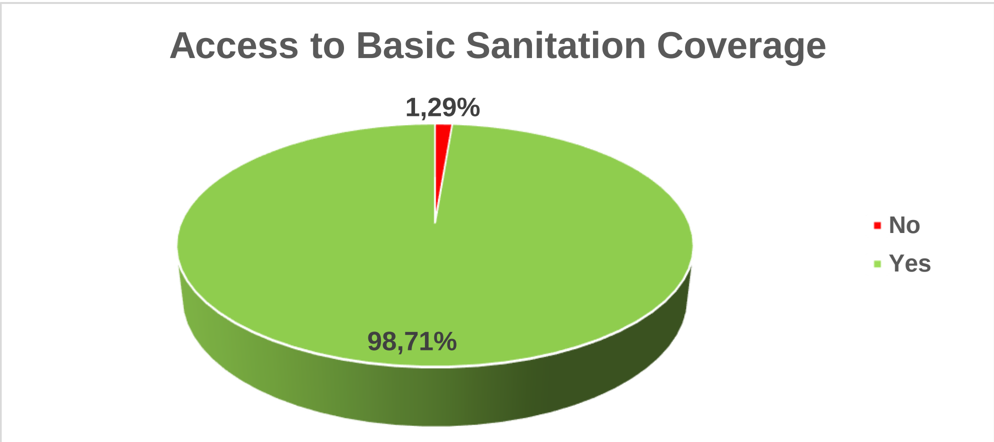

Figure 2: Availability of Basic Sanitation Coverage in Kamalamai Municipality.

2.1.2 *Types of Containment*

The different types of containment installed to store faecal sludge is explained as follows.

17.45% of households use fully lined tanks in their houses that are rectangular in shape with no outlets or overflow to discharge effluent which is used to safely store faecal sludge. The walls and bottom of the tanks are totally lined and sealed. Figure 3 shows the types of fully lined tanks constructed in a household at Kamalamai Municipality.

Figure 3: Fully Lined Tank.

Also, 19.01% of the households in the municipality connected their toilet to a biogas digester that uses natural anaerobic decomposition of organic matter under controlled conditions. The digester is usually a large, sealed container for organic matter such as manure from livestock, green waste from agriculture, sewage or food waste which is digested by bacteria in the absence of oxygen to produce a gas containing methane and carbon dioxide. The gas is piped away from the digestor and burnt to produce heat energy. Figure 4 shows a biogas digester built in a household at Kamalamai Municipality.

Figure 4: Biogas Digester.

33.33% of the households in the municipality have built lined tanks with impermeable walls and open bottom, which are rectangular in shape where the walls of the tanks are lined with plaster or concrete wall and the bottom of the tanks is not lined, just left as it is or with soiling that allows infiltration of effluents.

Twin pits and single pits are also popular in the municipality. Together, 14.58% of the households have such types of pits installed by assembling pre-cast concrete rings one after another. Figure 5 shows a twin pit installed at household level. 15.63% of the households in the municipality use unlined pits. An unlined pit is a containment constructed with mud mortar stone or brick wall or dry-stone walls and open bottom or could be of no lining. An unlined pit with dry stone wall is popular in the rural areas of the municipality.

Figure 5: Twin pit installed in the household at Kamalamai Municipality.

Table 2 shows the percentage of households with different types of containments in the municipality.

Table 2: Types of containments in households of Kamalamai Municipality (ENPHO, 2022).

Containments	Percentage of Households
Biogas digester	19.01%
Fully lined tank	17.45%
Lined tank with Impermeable walls and open bottom	33.33%
Single offset pit	12.50%
Twin pit	2.08%
Unlined pit	15.63%
Grand Total	**100.00%**

Figure 6 shows the distribution of various types of sanitation technologies in different wards of Kamalamai Municipality.

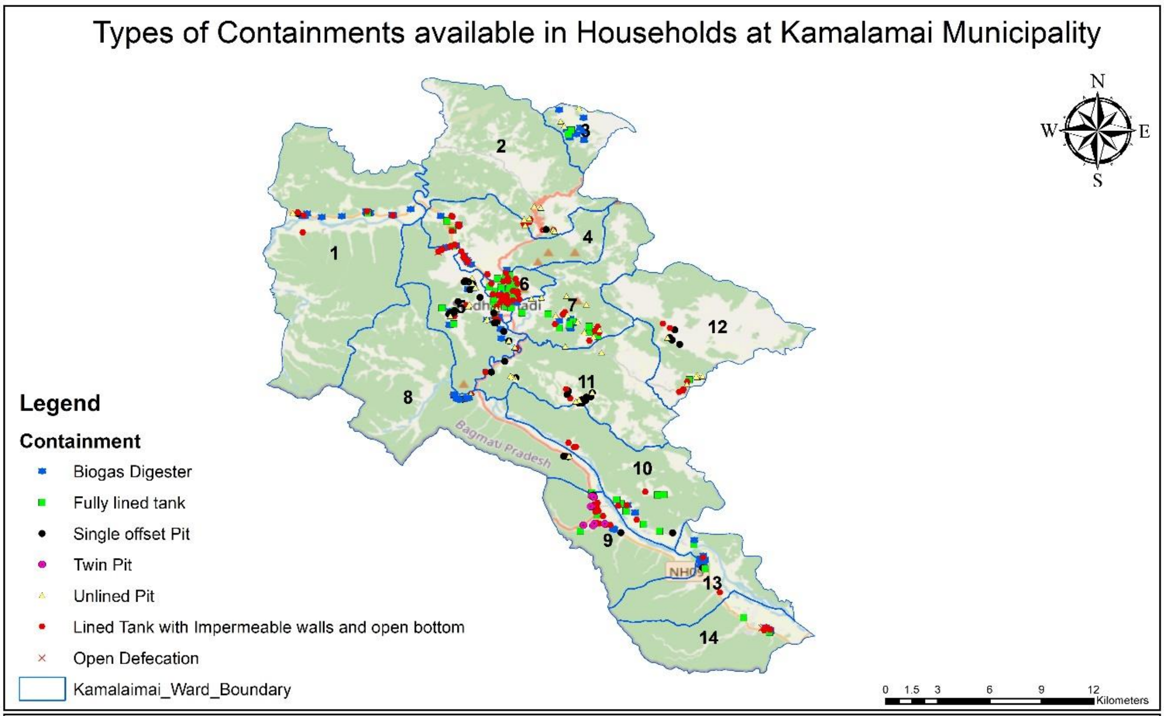

Figure 6: Sanitation Technologies installed in household levels (ENPHO, 2022).

The types of household containments in the municipality are re-categorized to match the containments defined by Shit Flow Diagram Promotive Initiative (SFD PI). The anaerobic biogas digester used to treat household organic waste is also utilized by households to store and treat their faecal sludge. For the purpose of generating the SFD graphic, the biogas digester is modelled as a fully lined tank. Table 3 show types of containment re-categorized according to the SFD PI.

Table 3: Types of containment re-categorized according to Shit Flow Diagram Promotive Initiative (SFD PI) (ENPHO, 2022).

Types of Containments	Percentage of Households
Fully lined lank (T1A3C10)	36.0%
Lined pit with semipermeable walls and open bottom (T1A5C10 and T2A5C10)	14.0%
Lined tank with Impermeable walls and open bottom (T1A4C8, T1A4C10 and T2A4C10)	33.0%
Open defecation (T1B11 C7 TO C9)	1.0%
Unlined pit (T1A6C10 and T1A6C10)	16.0%
Grand Total	**100.0%**

2.1.3 Emptying and Transportation

Emptying is one of the major components of the sanitation value chain. It ensures proper functioning of containment basically for septic tank which functioned well until the volume of sludge is one-third of the total column of the tank. Also, in other containments, regular emptying prevents overflow of the sludge and blockages (Linda Strande, 2014).

21.88% of the surveyed households have emptied the containment at least once since installation through manually or mechanical emptying services, whereas 78.13% of the households did not empty their containment as it has not been filled yet. Table 4 represents the overall emptying percentage of containment at least once since installation.

Table 4: Overall Emptying percentage of Containment at least once since installation (ENPHO, 2022).

Containment	Never emptied	Emptied at least once
Biogas digester	0.00%	19.01%
Fully lined tank	16.15%	1.30%
Lined tank with Impermeable walls and open bottom	32.55%	0.78%
Single offset pit	11.72%	0.78%
Twin pit	2.08%	0.00%
Unlined pit	15.63%	0.00%
Grand Total	**78.13%**	**21.88%**

Figure 7 represents the map of Kamalamai Municipality showing the status of sanitation technology that has been emptied at least once.

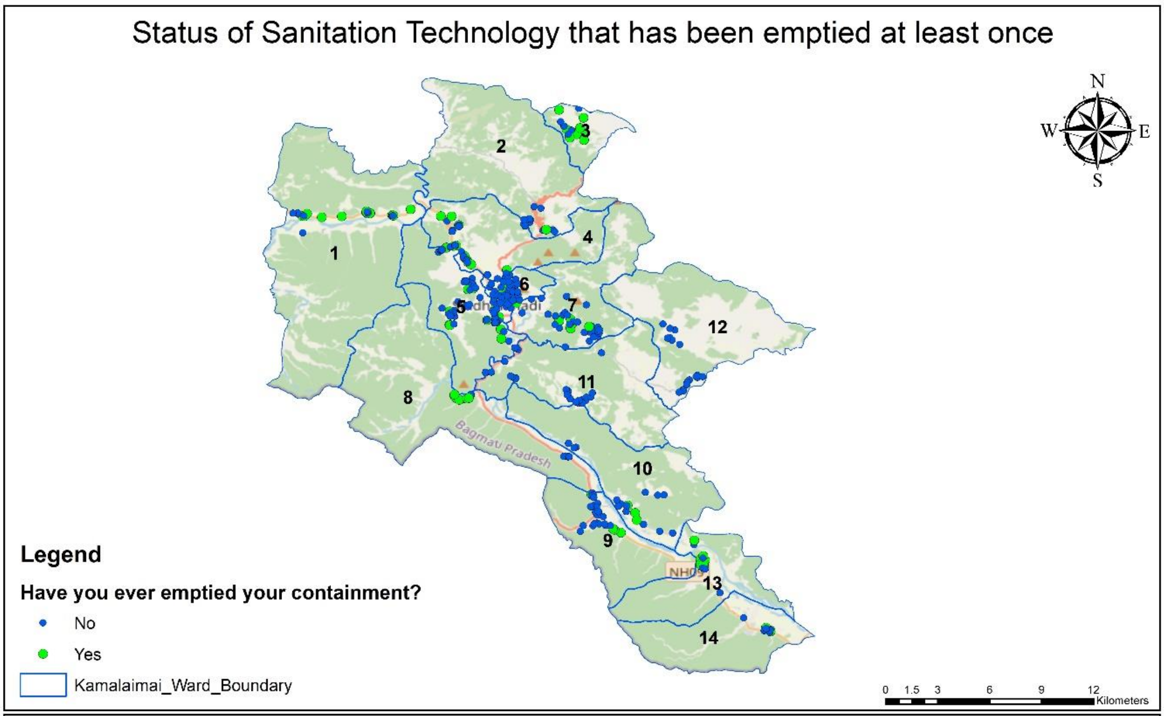

Figure 7: Status of household which have emptied their containment at least once.

The municipality has its own desludging vehicle with a capacity of 3,500 litres. It has been providing services since 2019 in urban areas of Kamalamai Municipality. One driver and two helping staff works in the desludging vehicle. The staff do not have any uniforms but are equipped with gloves, boots and masks for safety during work. It charges NPR 4,500 (USD 33) per trip for the rectangular or circular containments which also varies according to travel distance (KII-3, 2023). Figure 8 shows the desludging vacuum truck available in Kamalamai Municipality.

Figure 8: Mechanical Desludging Vehicle available in Kamalamai Municipality.

2.1.4 Treatment and Disposal/Reuse

Kamalamai Municipality does not have any form of treatment plant for Faecal Sludge (FS). The majority of FS emptied is applied in farmlands and a few percentages of FS emptied are disposed through dig and dump method, which are both considered as an unsafely managed practise. Fewer households in the city have illegal connection of toilet to open drainage.

After the manual emptying, the majority of FS emptied is disposed of through dig and dump method, while the remaining percentage of FS emptied is applied in farmlands, which are both considered as an unsafely managed practice. Figure 9 shows the percentage of disposal practice of FS after manual emptying in the municipality.

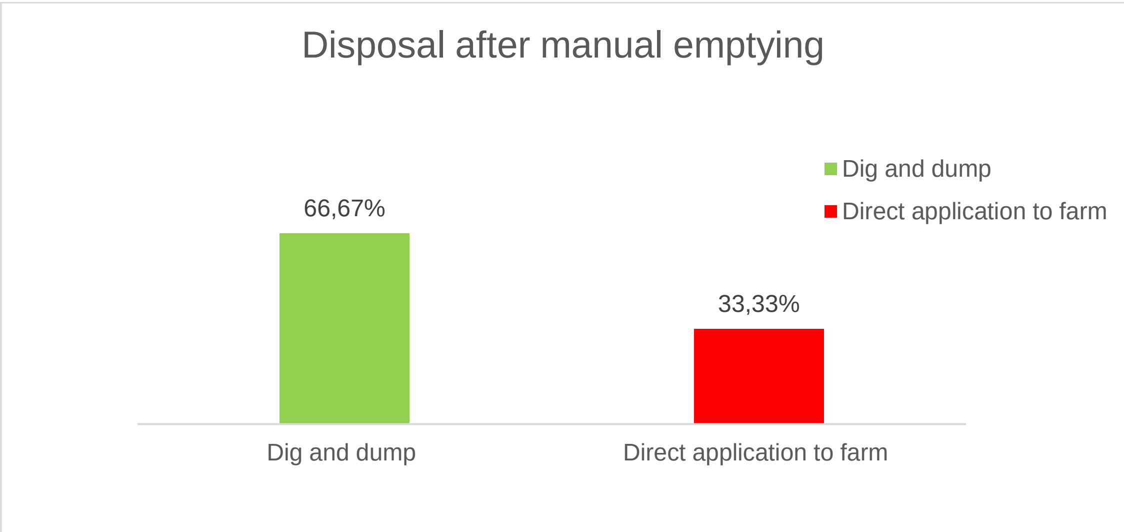

Figure 9: Disposal of manually emptied faecal sludge (ENPHO, 2022).

2.1.5 Sanitation System at Institutional Level

Altogether 44 institutions from educational institutions, governmental and non-governmental offices, health care centres and hotels were assessed randomly. It was revealed that 100% of such buildings had connected their toilet to onsite sanitation technologies. The percentage of types of onsite sanitation technologies in these buildings are shown in Figure 10.

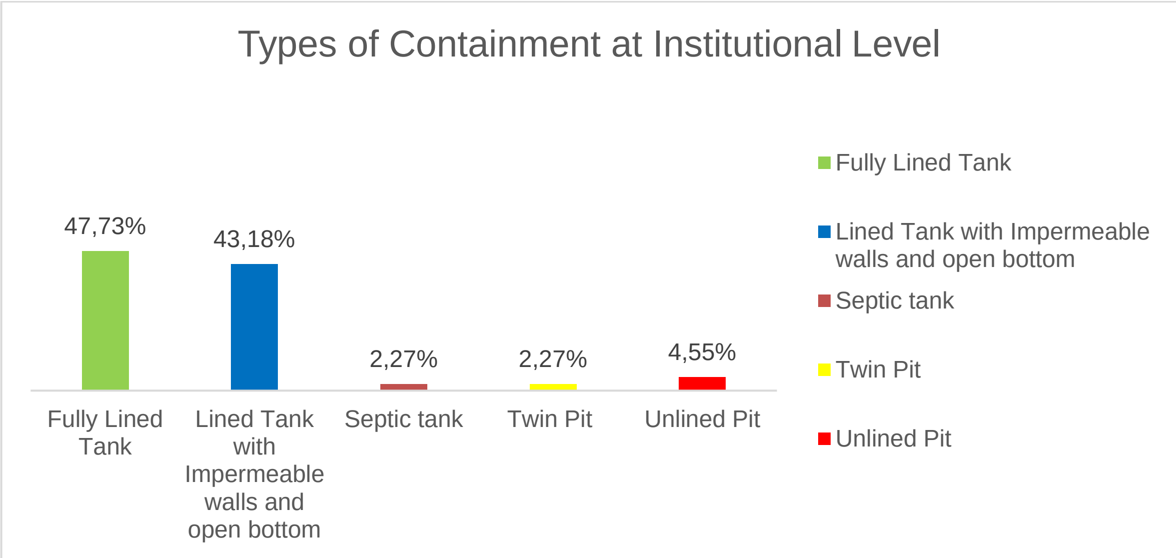

Figure 10: Types of containment in institutions of Kamalamai Municipality (ENPHO, 2023).

From the institutional survey, 6.82% of institutions in Kamalamai Municipality have emptied their containments and 93.18% of institutions have not emptied because they were never filled. Distribution of different types of onsite sanitation technologies of institutions in various wards of Kamalamai Municipality is shown in Figure 11.

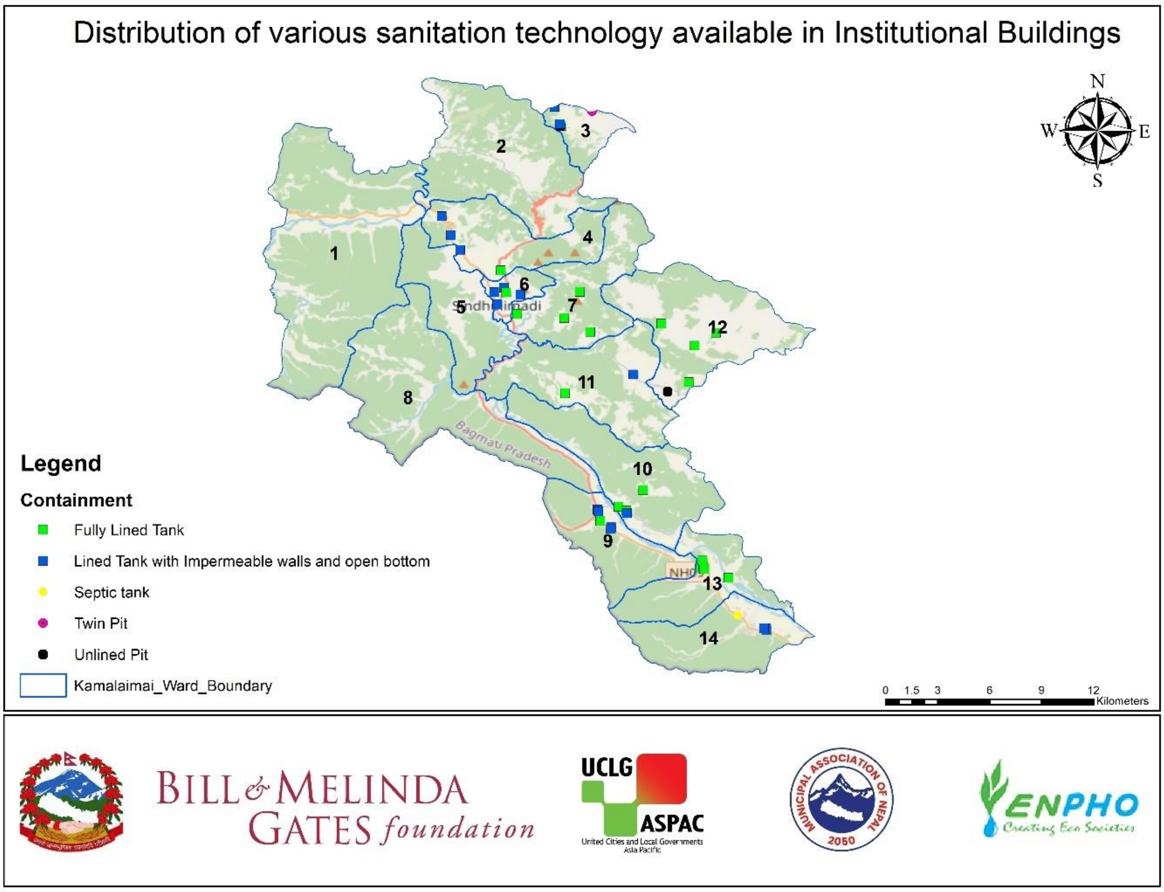

Figure 11: Types of onsite sanitation systems in institutions of Kamalamai Municipality (ENPHO, 2023).

2.1.6 Public Toilets

Kamalamai Municipality has four public toilets (Figure 12), one of the public toilets is operated by the local community near BP highway and three public toilets that lies near the bus park area is operated by the municipality through private operators (KII-1, 2023).

Figure 12: Public Toilets available in Kamalamai Municipality.

2.1.7 Risk of Groundwater Pollution:

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

2.1.8 Source of Drinking Water and Water Production

a) Water Supply:

Siddheshwor Water Supply and Sanitation Users Committee has been providing piped drinking water in Kamalamai since 1997. It has been providing drinking water in ward 4, 5, 6, 7 and 9 of the municipality.

Currently the system consists of two major spring sources Gadeuli Khola and Lapta Khola. Additionally, the system is connected to two sump wells whereas one sump well is in construction phase from Gadeuli Khola to meet the water demand of the municipality. The water is then transferred to the treatment site. The system consists of conventional treatment plant with pressure filter, roughing filter slow sand filter and chlorination unit. Hence the water is pumped in numerous stages.

At present, Siddheshwor Water Users Committee is serving drinking water to 3,426 Households. The water is collected in 3 major reservoir tanks with capacity of 200 m^3 per tank. Figure 13 shows distribution of the piped drinking water supply system in Kamalamai Municipality.

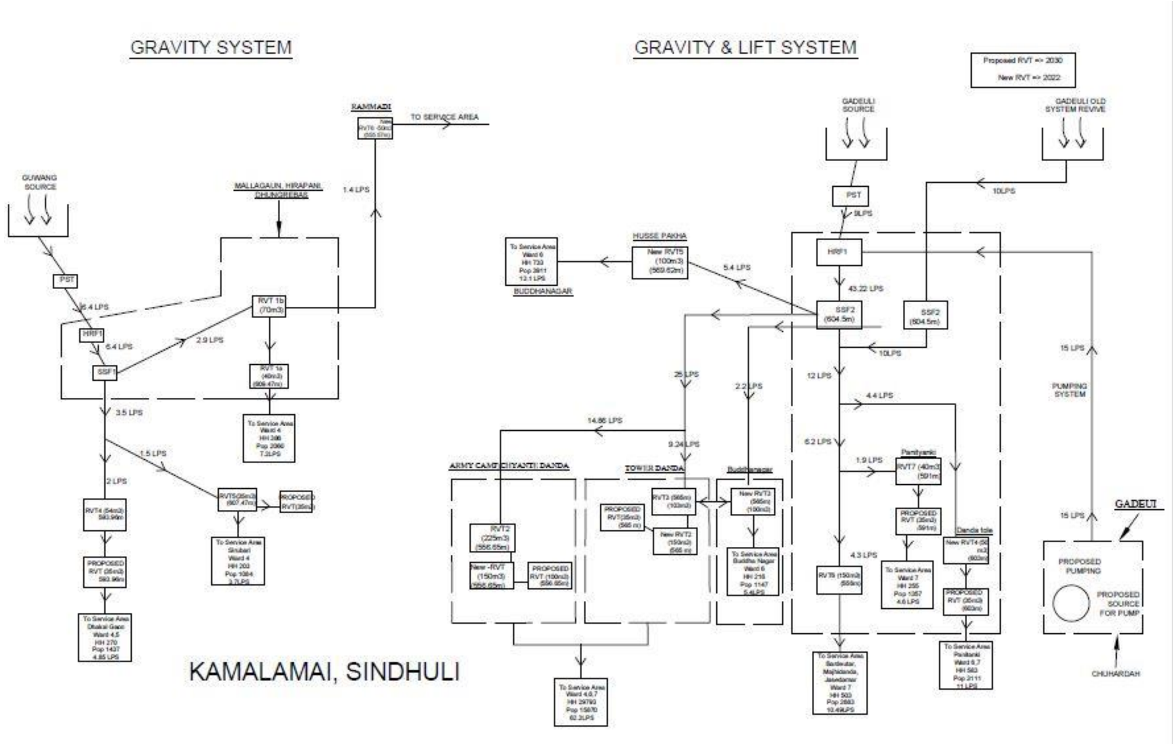

Figure 13: Transmission and Distribution Lines.

However, most households in the municipality rely on private taps for drinking water supply. 67% of the households in the municipality depend on private tap water for drinking and other daily activities. The remaining households depend on spring sources and groundwater for drinking and a small percentage of the population depend on public tap water as well. Figure 14 shows the various sources of drinking water available in the municipality.

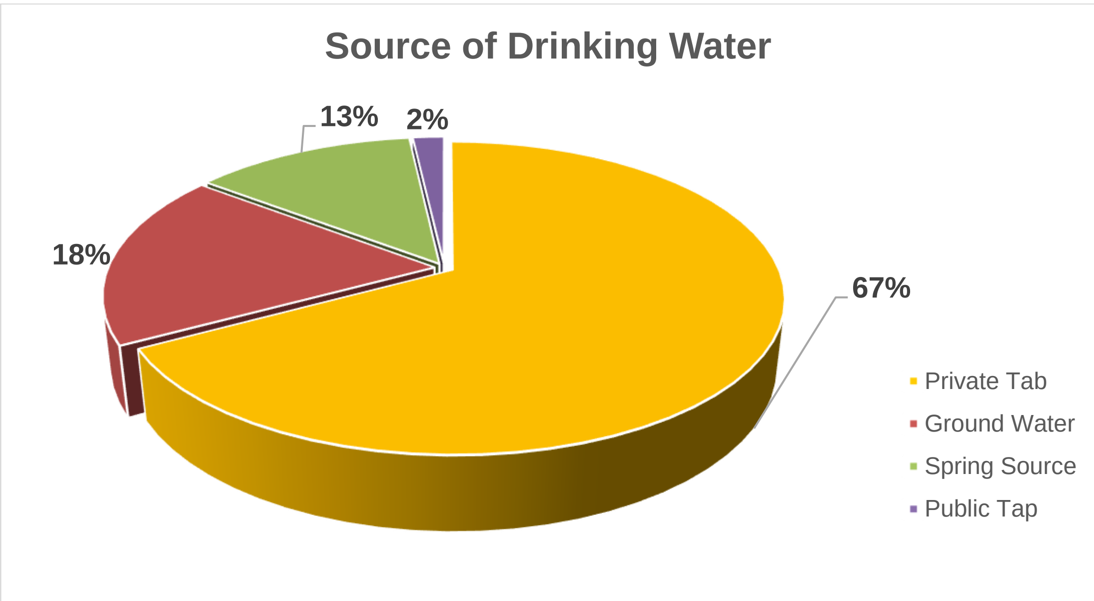

Figure 14: Types of Sources of Drinking Water in the Municipality (ENPHO, 2023).

b) **The vulnerability of the aquifer and lateral spacing between sanitation system and groundwater source**

The term aquifer pollution vulnerability is intended to represent the varying level of natural protection afforded by the contaminant attenuation capacity of the unsaturated zone or semi-confining beds above an aquifer, because of physicochemical processes (filtration, biodegradation, hydrolysis, adsorption, neutralization, volatilization, and dispersion)—all of which vary with their texture, structure, clay content, organic matter, pH, redox and carbonate equilibria. Groundwater vulnerability is specific to containment type and pollution scenarios (Andreo, 2013) Here, among the various types of onsite sanitation technologies, lined tanks with impermeable walls and open bottom and lined pits are more prone to contribute to aquifer pollution as the nature of such containments impose more containment load from the land surface to groundwater.

A key determinant of risk variation is the soil and geological setting. Especially for consolidated hard rock sediments with poor soil cover and shallow water tables, the risk is higher. According to WHO criteria, if the travel time of pollutant to groundwater source is less than 25 days, there is significant risk to contamination; low risk, if the travel time is between 25 and 50 days; and very low risk if the travel time is greater than 50 days (Krishnan, 2011). The size of pores in the soil determines the infiltration rate. In the sandy loam soil, the permeability is approximately 2.5 cm per hour. Thus, between 25 and 50 days the pollutant could travel to the depth of approximately 30 metres (98.67 feet) in sandy loam soil. Hence, the people using open bottom tanks and consuming water from the handpumps with the depth up to 98.67 feet (30 m) and horizontal distance of the pump within 25 feet (7.62 m) from the source of pollutants are assumed at significant risk to groundwater pollution.

Figure 15 demonstrates the depth of hand pumps and tube wells and horizontal distance of it with the containment type lined tank with impermeable walls and open bottom. Altogether 30% of the households have installed lined tanks with impermeable walls and an open bottom. Among them, 91% of the households rely on groundwater and spring for drinking water. Upon assessing the depth of groundwater and horizontal distance of the handpumps/tube wells from the source of pollution, it was found that 42% of these households are at higher risk to consumption of contaminated water. Thus, the population with lined tanks with impermeable walls and open bottom without outlet or overflow with significant risk to groundwater pollution (T2A4C10) is 11% (30% x 91% x 42% = 11%).

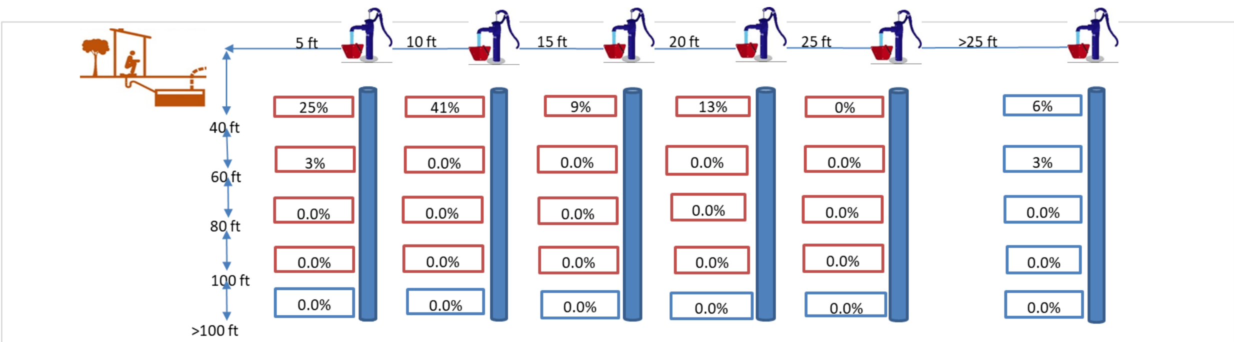

Figure 15: Depth of handpumps and lateral spacing of it with containment types lined tank with impermeable walls and open bottom (ENPHO, 2023).

Figure 16 demonstrates the depth of hand pumps and tube wells and horizontal distance of it with the containment type lined pit with semi-permeable walls and open bottom. Altogether 14% of the households have installed lined pits with semi-permeable walls and open bottom. Among them, 100% of the households rely on groundwater and spring for drinking water. Upon assessing the depth of groundwater and horizontal distance of the handpumps/tube wells from the source of pollution, it was found that 14% of these households are at higher risk to consumption of contaminated water. Thus, the population with lined pit with semi-permeable walls and open bottom without outlet or overflow with significant risk to groundwater pollution (T2A5C10) is 2% (14% x 100% x 14% = 2%).

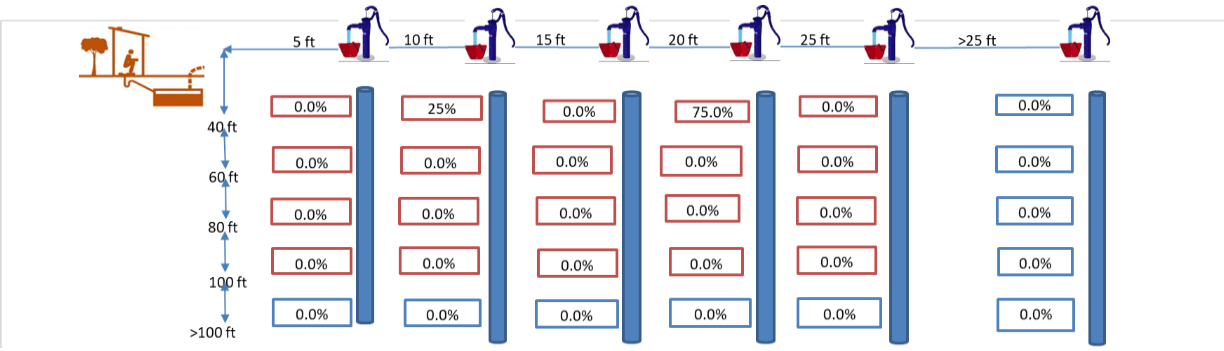

Figure 16: Depth of hand pumps and lateral spacing of it with containment types lined pit with semi-permeable walls and open bottom (ENPHO, 2023).

2.2 SFD Selection Grid

Types of sanitation technologies selected in the SFD selection grid in the municipality are shown in Figure 17. The vertical column in the left side of the SFD selection grid has a list of technologies to which the toilet is connected to and open defecation in case of households without toilet. Similarly, horizontal row at the top of the selection grid shows options for connection for outlet or overflow discharge from toilet.

Thus, different types of sanitation systems and their outlet are selected in the selection grid and the proportion of the population using such types of systems is calculated in the SFD graphic generation process.

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					Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution					
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution					T1A3C10
Lined tank with impermeable walls and open bottom	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	Significant risk of GW pollution Low risk of GW pollution			T1A4C8		T2A4C10 T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A5C10 T1A5C10
Unlined pit										T2A6C10 T1A6C10
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							T1B11 C7 TO C9		Not Applicable

Figure 17: SFD selection grid for Kamalamai Municipality.

A brief explanation of terms used to indicate different frames selected in the SFD selection grid in Figure 17 is explained in Table 5.

Table 5: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 17.

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.
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 are considered not contained.
T1A4C10 (Low Risk)	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. However, since the tank is not fitted with a supernatant/effluent overflow this system is considered contained.
T2A4C10 (High Risk)	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 - the excreta are therefore likely to be partially treated. It includes all lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. 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.

T1A5C10 (Low Risk)	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.
T2A5C10 (High Risk)	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.
T1A6C10 (Low Risk)	This is a correctly designed, properly constructed and well-maintained unlined pit with permeable walls and base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow, so this system is considered contained.
T2A6C10 (High Risk)	This is a correctly designed, properly constructed and well-maintained unlined pit with permeable walls and 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.
T1B11C7 to C9	With no toilet, users defecate in water bodies, on open ground and to don't know where; consequently, the excreta is not contained.

2.2.1 SFD Matrix

SFD matrix is the second step to generate the SFD graphic. The SFD matrix calculates the proportion of people using each type of system and the proportion of each system from which FS and supernatant is emptied, transported and treated. A detailed instruction on how to calculate SFD proportion in SFD PI was used as guide to calculate SFD proportion. As stated on SFD PI, the default "100%" value is used for onsite containers which are connected to soak pits, 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.

The value for onsite containers that are connected to a sewer network or to open drains is used as "50%" which means half of the contents are modelled FS and 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 obtained from SFD PI used for FS proportion calculation is shown below:

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

Here, data for each selected sanitation system on the SFD Matrix is entered. The proportion of the contents of each type of onsite container (either septic tanks; or fully lined tanks (sealed); or lined tanks with impermeable walls and open bottom and all types of pits), is shown in Figure 18. The proportion of FS emptied (F3) is obtained from KIIs. The FS delivered to treatment and treated is shown in columns F4 and F5, respectively.

The municipality does not have any form of treatment plant to treat faecal sludge. The FS emptied from the containments is dumped of openly in farmlands or water bodies. Thus, values for variables F4 and F5 for all sanitation systems are set to 0%. However, FS from anaerobic biogas digesters, classified as fully lined tanks (system T1A3C10) is considered as transported (F4 = 96%) and treated with a treatment efficiency estimated at 95% (F5 = 95%).

Figure 18 shows the SFD matrix of Kamalamai Municipality.

Kamalamai Municipality, Bagmati, Nepal, 25 Jul 2023. SFD Level: 2 - Intermediate SFD
Population: 71016
Proportion of tanks: septic tanks: 0%, fully lined tanks: 100%, lined, open bottom tanks: 10(

Containment				
System type	Population	FS emptying	FS transport	FS treatment
	Pop	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	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
T1A3C10 Fully lined tank (sealed), no outlet or overflow	36.0	56.0	96.0	95.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	19.0	1.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	3.0	0.0	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	12.0	6.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	14.0	0.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	1.0			
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	11.0	4.0	0.0	0.0
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	0.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	2.0	0.0	0.0	0.0

Figure 18: SFD Matrix of Kamalamai Municipality.

2.2.2 SFD Matrix Explanation

The sanitation technologies and the corresponding percentage of the population using such technologies are shown in Figure 18 (SFD Matrix). These values are derived from the household survey (ENPHO, 2022).

2.2.3 Proportion of FS Emptied and Transported

The proportion of faecal sludge emptied (F3) is calculated based on percentage containment emptied (ENPHO, 2022) and amount of FS emptied during the process (KII-1, 2023). The information on FS emptied from containment is obtained from Key Informant Interviews (KIIs) with desludging service providers. As per the desludging service provider portion of liquid in the FS is high which can be easily pumped out by the desludging vehicle. So, almost 90% of the FS content in the containment is removed during emptying. Hence, actual proportion of FS emptied from each containment is calculated as:

$$FS\ proportion\ emptied\ from\ containment = percentage\ of\ containment\ emptied\ \times\ proportion\ of\ FS\ emptied$$

The proportion of FS emptied from the sanitation technologies are shown in Table 6.

Table 6: Sanitation Technologies and Proportion of FS Emptied (ENPHO, 2022; KII-1, 2023[(2)]).

S.N.	Sanitation Technologies	SFD Reference Variable	Percentage of Emptied Containment (1)	Proportion of FS emptied during emptying. (2)	F3
1	Fully lined tank (sealed), no outlet or overflow	T1A3C10	62.22%	90%	56%
2	Lined tank with impermeable walls and open bottom, connected to open ground	T1A4C8	0.00%	90%	0%
3	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	1.37%	90%	1%
4	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	6.42%	90%	6%
5	Unlined pit, no outlet or overflow	T1A6C10	0.00%	90%	0%
6	Open defecation	T1B11 C7 TO C9	-	-	-
7	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A4C10	4.64%	90%	4%
8	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A5C10	0.00%	90%	0%
9	Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A6C10	0.00%	90%	0%

2.3 Summary of Assumptions

Onsite Sanitation System:

- ✓ The proportion of FS in septic tanks was set to 0%, the proportion of FS in fully lined tanks was set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 100% according to the relative proportions of the systems in the municipality, as per the guidance given in the Frequently Asked Question (FAQs) in the sustainable Sanitation Alliance (SuSanA) website.
- ✓ Variables F3, F4 and F5 for all onsite sanitation systems were derived from the household survey and cross-checked with KIIs conducted.
- ✓ The municipality does not have any form of treatment plant to treat faecal sludge. The FS emptied from the containments is dumped openly in farmland or water bodies. Thus, variables F4 and F5 for all sanitation systems are set to 0%. However, FS from anaerobic biogas digesters, classified as fully lined tanks (system T1A3C10), is considered as transported (F4 = 96%) and treated with a treatment efficiency estimated at 95% (F5 = 95%).

2.4 SFD Graphic

Figure 19 shows the SFD graphic for Kamalamai Municipality. In the graphic, the percentage of FS and wastewater (WW) indicated by colour green represents safely managed excreta (78%) whereas the percentage in colour red represents unsafely managed excreta (22%). Figure also represents the sanitation value chain going from left to right.

FS contained, i.e., FS kept in a container which is safe from human contact, in onsite sanitation, either emptied or not is safe. The FS contained - not emptied is also FS stored in tanks and pits which are in safe distance from sources of drinking water. Further, FS not contained is FS kept in containment which possess risk to human health through groundwater contamination. The lack of a Faecal Sludge Treatment Plant (FSTP) in the Municipality leads to disposal of FS in farmlands and water bodies.

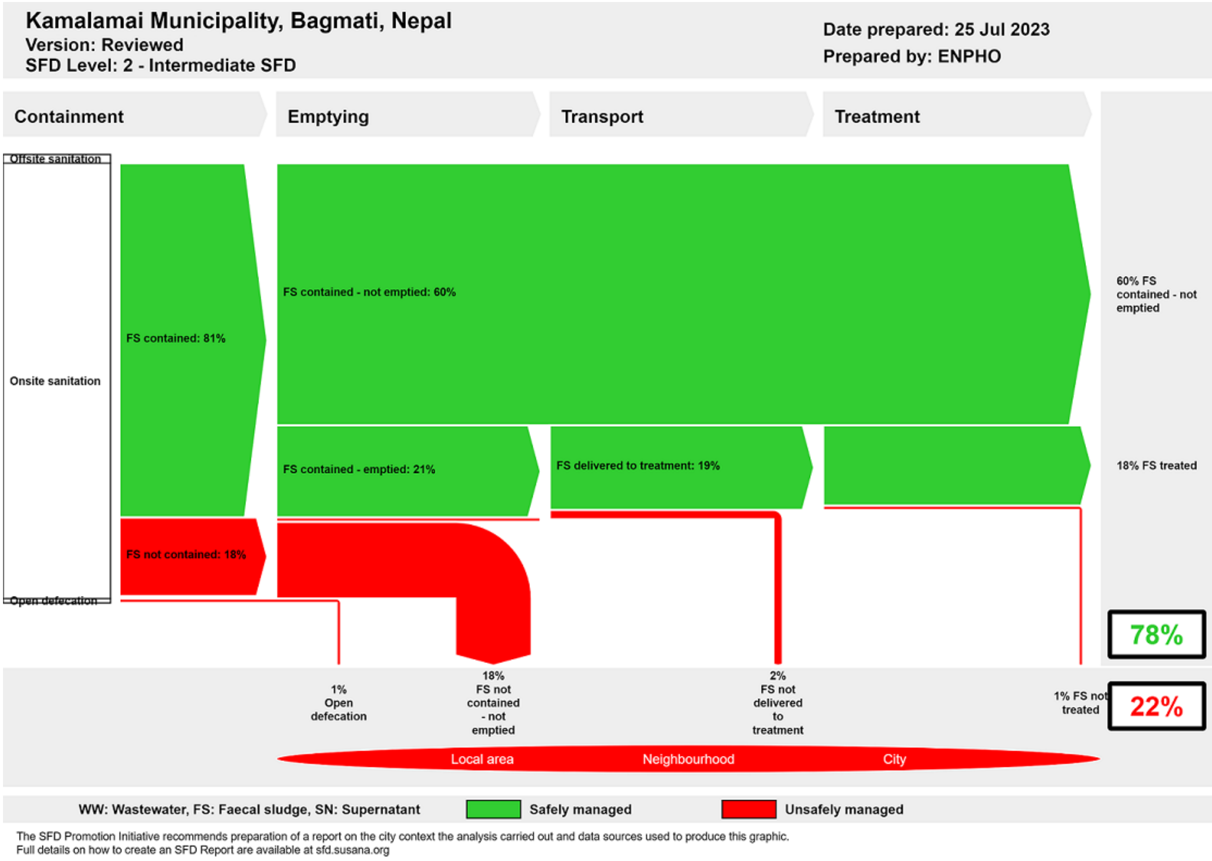

Figure 19: SFD graphic of Kamalamai Municipality.

The faecal sludge that is safely managed is further segregated as 60% of FS which is safely collected in the containment which has not been emptied. This 60% of safely managed FS should be considered as only temporary, as most of the pits and tanks have not yet filled up and the FS generated remains 'not emptied'. Therefore, these systems will require emptying services in the short and medium term as they fill up. The remaining 18% corresponds to FS safely treated and managed in the biodigesters.

The FS that is unsafely managed is divided into: FS emptied but not delivered to treatment (2%) which is unsafely disposed of into the environment and FS not contained - not emptied (18%), having a risk of groundwater contamination through seepage. A further 1% corresponds to FS not treated from the biodigesters.

Lack of FSTP in the municipality leads to disposal of FS in farmland and water bodies. Considering the SFD graphic, FS management is a concern for the municipality even through FS which is safely collected but emptied will eventually be emptied in future and will require safe management.

Off-site Sanitation

Nepal Multiple Indicator Survey (MICS) reported that among the total households in Nepal, 10.7% of households has a toilet connected to sewer network and in Bagmati province it is 39% (CBS, 2020). However, there is no sewer network available in the municipality. All the surveyed households depend on onsite sanitation systems.

Onsite Sanitation

100% of the population relies on onsite sanitation systems. Among them, 81% are using technically effective containment that safely stores faeces and 18% use unsafe containment. Kamalamai Municipality does not have a treatment plant, which was confirmed by the information collected during the KII with the municipal officer (KII-1, 2023). The majority of FS emptied is delivered to the farmland after mechanical emptying whereas manual emptied FS is disposed of to open land or farmlands. The description on the fate of FS from the onsite sanitation systems as shown in the SFD graphic is explained in Table 7.

Table 7: Description of the percentages of the SFD graphic.

Variables	Description	Percent
FS contained	Faecal sludge that is contained within an onsite sanitation technology which is technically effective.	81%
FS not contained	Faecal sludge that is stored in an unsafe onsite sanitation technology.	18%
FS contained - not emptied	FS that is contained within an onsite sanitation technology and not removed where there is no significant risk to groundwater pollution. These containments are fully lined tanks (sealed), no outlet or overflow (T1A3C10), fully lined tanks with impermeable walls and open bottom without outlet or overflow (T1A4C10), lined pit with semi-permeable walls and open bottom, no outlet or overflow (T1A5C10) and unlined pits (T1A6C10) without significant risk to groundwater.	60%
FS contained - emptied	FS that is contained in onsite sanitation technology and emptied either mechanically or manually.	21%
FS not contained - emptied	FS that is not contained within an onsite sanitation technology and not removed which may either remain in the containment or infiltrate to ground polluting groundwater.	18%
FS - treated	FS treated in a well functioned anaerobic biogas digester.	18%
FS not delivered to treatment	FS emptied from an onsite sanitation system is either FS contained or not but is not delivered to the treatment plant.	2%
FS not treated	FS emptied from an onsite sanitation system but is not delivered to the treatment plant.	1%

Open Defecation

Nepal Multiple Indicator Survey (MICS) reported that among the total households in Nepal, 5% of households still practice open defecation and only in Bagmati Province it is 1% (CBS, 2020). Despite ODF status, people residing in 1% of households still go for open defecation outside in the vicinity of forests and other open spaces. This population with a high defecation rate is economically underdeveloped (ENPHO, 2022).

3 Service delivery context

3.1 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 recognizes citizen's rights to access to clean drinking water and sanitation. In addition, Right to Clean Environment, Article 30 (1) recognizes 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 promulgated 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 promulgated 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 inspector to control pollution by federal, provincial and local government.

Water Supply and Sanitation Act, 2022

The act was promulgated to ensure the fundamental right of citizens to easy access to 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.

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 and Sanitation Users Committee (WSUC) in the framework reflects a participatory approach that would help in sustaining the interventions.

Total Sanitation Guideline, 2017

Total Sanitation Guideline was promulgated by the Ministry of Water Supply in April 2017 after the successful implementation of the 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.

3.1.1 Policies

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 marginalized and vulnerable groups. However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery (DWSSM, 2009).Thus, 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. Thus, the National Water Supply and Sanitation Policy (NWSSP) was formulated in 2014 by GON to address the emerging challenges and issues with the adoption of new approaches and resolve the inconsistency in RWSSNP and NUWSSSP.

The goal of the NWSSP was to reduce urban and rural poverty by ensuring equitable socio-economic development, improving health and the quality of life of the people and protection of environment through the provision of sustainable water supply and sanitation services. It adopted innovative technologies and knowledge emerged in the sector. Remarkably, it was the first official document that recognized discharge of untreated wastewater and dumping of septic sludge heavily polluted the surface water sources in urban areas.

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 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).

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 harmonization 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.

3.1.2 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 is the specialized 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 (DWSSM) 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 organizational structure of DWSSM is shown in Figure 20.

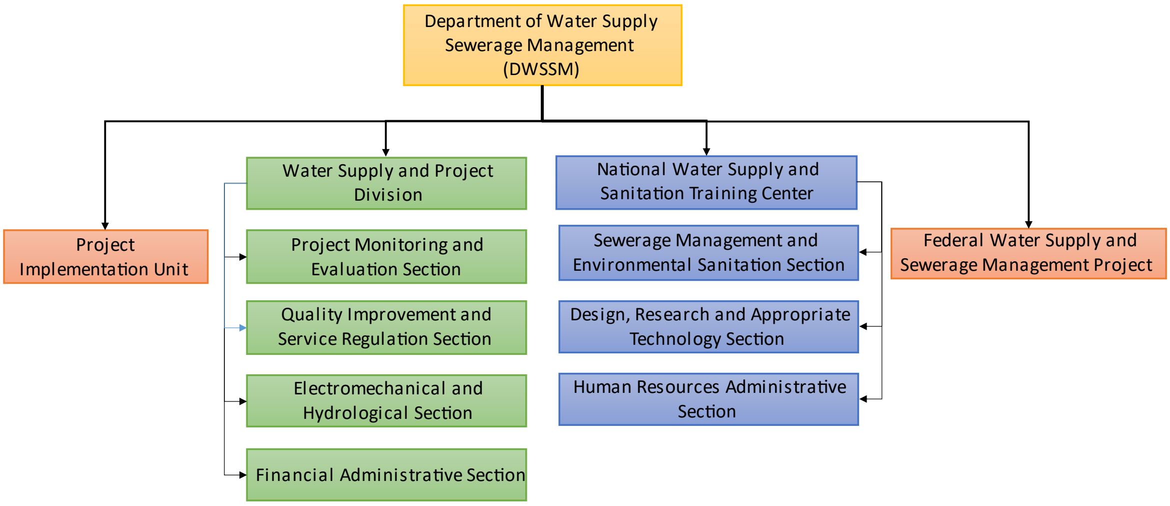

Figure 20: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).

At Provincial Level

Ministry of Physical Infrastructure: Ministry of physical infrastructure of provincial government in Madesh Province is major executing body in the province. Planning and implementation of water supply and sanitation infrastructure in the province is executed through Water supply and Sanitation Divisional Office (WSSDO). WSSDO implements the water and sanitation programs meeting the following criteria:

i. Inter local government projects

ii. Beneficiaries between 5,000 to 15,000 in the terai region, 3,000 to 5,000 in hilly region and 500 to 1,000 in Himalayan region.

3.1.3 Service Provision

Urban Water Supply and Sanitation Policy 2009 has emphasized 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 socio-economic 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).

3.1.4 Service Standards

The sanitation service standards have 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 8. However, FSM specific standards have yet to be developed and implemented.

Table 8: 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	✓	✓	✓

3.2 Planning

3.2.1 Service Targets

The plans and programs for development in Nepal is guided by a national development framework formulated by the national planning commission in coordination with sectoral ministries. The ministry of finance allocates budgets and releases them to executing agencies and coordinates with development partners to address resource gaps. Nepal is committed to the SDGs which has been reaffirmed in key documents such as the current 15th development plan and the 25-year long-term vision 2100 that internalizes the sustainable development goals (NPC, 2020). The SDGs codes are assigned for all national development programs through the Medium-Term Expenditure Framework (MTEF). The MTEF sets out three-year spending plans of the national and provincial governments which aims to ensure that budgets reflect social and economic priorities and give substance to reconstruction and development commitments (NPC, 2020). Further, Nepal has prepared the SDG status and roadmap to localize the SDG indicators with baselines and targets for 2030. Nepal has set the following target and indicator focused on sanitation based on global SDGs as shown in Table 9.

Table 9: National SDG target and indicator on sanitation.

National SDG Target and Indicator		2015	2019	2022	2025	2030
Target 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations						
6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water						
1	Households using improved sanitation facilities which are not shared (%)	60	69.3	78.7	85.7	95
2	Proportion of population using latrine (%)	67.6	75.7	83.8	90	98
3	Sanitation coverage (%)	82	86.5	89.9	93.3	99
4	Urban households with toilets connected to sewer systems/ proper FSM (%)	30	46	62	74	90

4 Stakeholder Engagement

4.1 Key Informant Interviews (KIIs)

KIIs and objective sharing of the study were conducted with the major stakeholders of sanitation sector of the municipality. Interviews were performed with Mr. Sagar Kumar Dhakal, Administration Head of Kamalamai Municipality for sanitation and desludging activities, planning and other activity that is going on sanitation sector, Mr. Ghana Shyam Devkota, Mrs. Sarada Dhakal and Kumar Shrestha, Chairpeson, Deputy Chairperson and Manager of Kamalamai Drinking Water Uses Committee. Similarly, Mr Jogendra Bahadur Tamang, Desludger from the Municipality were interviewed to understand faecal sludge management practice and business opportunities of the sector in the municipality. Table 10 shows the KIIs with the Municipal officers, Water Users committee and Desludgers (Figure 21).

Table 10: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organization	Purpose of KII	Date
1.	Sagar Kumar Dhakal (KII-1)	Administration Head	Kamalamai Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	4th June, 2023
2.	Ghana Shyam Devkota, Sarada Dhakal, Kumar Shrestha (KII-2)	Chairperson, Deputy Chairperson	Kamalamai Water Supply and Users Committee	Supply and demand of water, water sources, groundwater contamination risk	4th June, 2023
3.	Jogendra Bahadur Tamang, (KII-3)	Driver (Desludger)	Kamalamai Municipality,	Emptying practices, finances, requirement, disposal and treatment	3rd June, 2023

Figure 21: KII with member of Water Users Committee.

4.2 Household Survey

Household survey was conducted in all wards of the municipality through mobilization of enumerators selected by the municipality. The enumerators were given two days orientation about sanitation and methods for conducting the Household (HH) survey. The HH survey was conducted using mobile application "KOBOCOLLECT" after orientation. SFD team members along with municipal focal person went on field visits in households to encourage enumerators and observe household sanitation status.

4.2.1 Determining Sample Size

The number of households to be sampled in the municipality was determined by using Cochran (1963:75) sample size formula $no = \frac{z2pq}{e2}$ and its finite population correction for the proportion n= no/(1+ (no-1)/N).

Where,

Z^2	1.96	At the confidence level of 95%
p	0.5	Assuming that about 50% of the population should have some sanitation characteristics that need to be studied (this was set at 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 sites).
q	1-p	
e	+/-5%	Level of precision or sampling error.
N		A total number of population (households in the municipality).

This is followed by proportionate stratification random sampling such that each ward in the municipality is considered as one stratum. The sample sized required in each ward is calculated as

nh= (Nh/N)*n, where Nh is the total population in each stratum.

Thus, a total of 389 households were sampled from 18,135 households distributed in 14 wards with proportionate stratification random sampling which is shown in Figure 22.

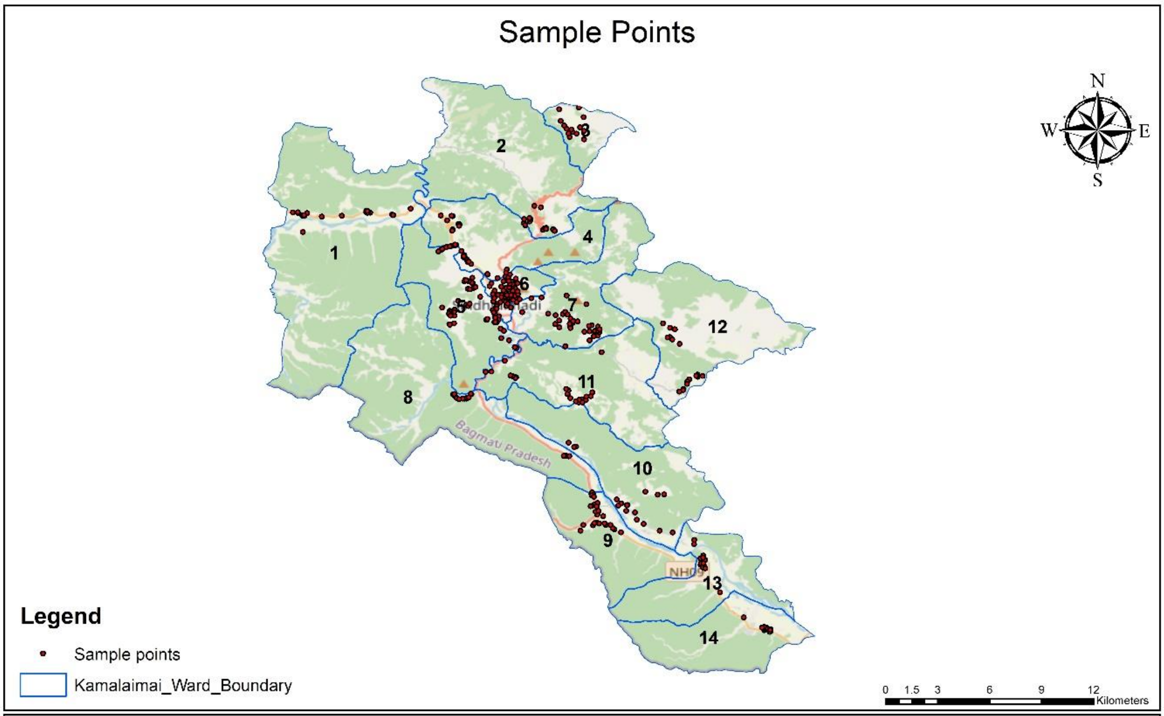

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Figure 22: Distribution of sampling points in different wards of Kamalamai Municipality.

4.2.2 Direct Observation

Various sanitation technologies in the households in all the wards were observed and visual references were kept in Figure 23. Also, observation of the toilets, water sources, storm water drainage, containments and transportation of faecal sludge were carried out.

Figure 23: Direct Observation Survey in the Municipality.

4.3 Sharing and Validation of Data

The sharing and validation of findings on sanitation status were conducted in the municipality hall in participation of the Mayor, Deputy Mayor, Ward Chairpersons, Chief Administrative Officer (CAO), Municipal Officers, General members of the municipal council and other relevant stakeholders. The participants agreed upon the findings of this study that showed the current sanitation status of the municipality and provided valuable suggestions (Figure 24). The list of participation with their designation is attached in Appendix 2.

Figure 24: Sharing and Validation at Kamalamai Municipality.

5 Acknowledgements

We would like to acknowledge United Cities Local Government – Asia Pacific (UCLG ASPAC) for funding the Municipalities Advocacy on Sanitation in South Asia – II (MuNASS-II) and Municipal Association of Nepal (MuAN) for coordination with the Municipality.

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7 Appendix

7.1 Appendix 1: List of Participants of Orientation on Survey for Shit Flow Diagram

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
Date: 21 and 22 Jestha, 2080
Venue: Kamalamai Municipality, Sindhuli

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
(1)	chetan Hari Pyakurel	Ka.na.pa-13	Enumerator	9817652526			26 year	Male	2
(2)	Sagar Danuwar	Ka.na.pa. 09	Enumerator	9812059536			23 year	Male	3
(3)	Prem B. Budhathoki	ka.na.Pa.11	Enumerator	9804[illegible]			19 year	Male	2
(4)	Hem sharah Baral	Ka.na.pa.12	Enumerator	9807886262			34 years	male	2
(5)	Gagan Bhurtel	ka.na.pa-03	Enumerator	9843278956			21 year	male	2
(6)	Sanjay Lo	ka.na.pa.07	Enumerator	9817836737			24 years	male	3
7.	Rupa Kumari Syangtan	ka.na.pa.04	Enumeator	9809226015			34 years	Female	3
8.	Nirmala dimdang	Ka.na.pa.2	Enumeator	9817696379			15 year	[illegible]	3
9.	Harihar karki	ka.na.pa.10	"	9862557247			24 year	Female	
10.	Sabitra Nepali	ka.na.pa.6	"	9804229697			30	Female	
11.	Minalama tamang	ka.na.pa.7	"	9807633640			36	Female	
12.	Sabina khadgi	ka na pa.14	"	9815822966			21	female	3
13.	~~Nirmal~~						~~34 year~~	~~Male~~	~~2~~
14.	~~Hem sharah Baral~~	~~Ka.na.pa.12~~	"	~~9807886262~~			24y.	fem	2
15.	Harihar Karki	ka.na.pa.10	"	9862557297					
16	Sanjit Tamang								
17	Sabuna Gamal	ENPHO		9843212596					
18	Rupak Shrestha	"	Engineer	9849463840					

7.2 Appendix 2: List of Participants in Sharing and Validation Workshop

आज मिति २०८० साल पौष २२ गतेका दिन कमलामाई नगरपालिकामा नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एन्फो) को प्राविधिक सहयोग, The United cities and Local Government Asia Pacific (UCLG ASPAC) को कार्यान्वयन र Bill and melinda Gates Foundation (BMGF) को आर्थिक सहयोगमा Municipallities Network Advocacy on Sanitation in South Asia (MUNASS-II) कार्यक्रम अन्तर्गत संचालन गरिएको Shit Flow Diagram (SFD) सम्बन्धी ड्राफ्ट र प्रमाणिकरण कार्यशाला कार्यक्रममा निम्न अनुसार मुख्य सरोकारवाला हरुको सहभागिता रहयो ।

उपस्थिति :-

क्र.स	नाम	कार्यालय	पद	फोन नं.	हस्ताक्षर
१	उपेन्द्र कुमार पोखरेल	नगर प्रमुख कमलामाई न.पा	नगर प्रमुख	9854046500	
२.	मन्जु देवकोटा	"	उप. न. प्रमुख	9844045830	
३.	सुर्य प्रसाद दाहाल	"	प्र. प्र. अ.	9854050111	
४.	[illegible]	कमलामाई न.पा.	कार्यपालिका सदस्य	९८४४०९१२६६	
५.	मान बहादुर दमाई	क. न. पा.	सदस्य	[illegible]	
६.	चित्र जंग थापा	क. न. पा. ६	[illegible] विद्यालय अध्यक्ष	[illegible]	
७	उज्वल कुमार थापा	क. न. पा. ६	वडा अध्यक्ष	[illegible]	
८.	राम बहादुर थिङ	क.न.पा.-११	वडा अध्यक्ष	[illegible]	
९.	केशर बहादुर कार्की	क.न.पा. १३	वडा अध्यक्ष	[illegible]	
१०.	नविन बस्नेत	क. न. पा. ६	ईन्जिनियर	[illegible]	
११.	कविन्द्र गौतम	मा.वि. [illegible]	शिक्षक	९८४४०६६४२८	
१२	सागर कुमार ढकाल	कमलामाई न.पा	अधिकृत	[illegible]	
१३	विरेन्द्र ब. श्रेष्ठ	क.न.पा.४		[illegible]	
१४	गिरिमान देवकोटा	"		[illegible]	
१५	विनोद बाबु [illegible]	कमलामाई न.पा.	इन्जिनियर	[illegible]	
१६	धन कुमारी श्रेष्ठ	[illegible] कमलामाई	का.पा. सदस्य	[illegible]	
१७	शिव कुमारी [illegible]	कमलामाई	का.पा. स०	[illegible]	

क्र.सं.	नाम	कार्यालय	पद	फोन नं.	दस्तखत
१८	भद्रीमाया हाकु	कमलामाई	का.पा.स.	[illegible]	[illegible]
१९	उमा पि. कु.	कमलामाई	कार्यपालिका सदस्य	[illegible]	[illegible]
२०	कोमल कुमार श्रेष्ठ	क.न.पा. ८ नं. वडा कार्यालय	वडा अध्यक्ष	[illegible]	[illegible]
२१	विनोद प्रधान	क.न.पा. ६	वडाअध्यक्ष	[illegible]	[illegible]
२२	नरेश गोले	कमलामाई [illegible]	वडा अध्यक्ष	[illegible]	[illegible]
२३	रुद्र कार्की	क.न.पा. ९	वडा अध्यक्ष	[illegible]	[illegible]
२४	राजन पुजोल	कार्यपालिका	कार्यपालिका सदस्य		
२५	[illegible]	कमलामाई [illegible]	,,		
26	बुद्ध बज्राचार्य	PC			[illegible]
27	रुपक श्रेष्ठ	Engineer	ENPHO	9849463840	[illegible]

SFD Promotion Initiative

SFD Kamalamai Municipality, Nepal, 2024

Produced by:

Rupak Shrestha, ENPHO
Sabuna Gamal, ENPHO
Jagam Shrestha, ENPHO
Buddha Bajaracharya, ENPHO
Anita Bhuju, ENPHO

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