SFD Report

Mahakali 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 Mahakali Municipality, Nepal, 2023

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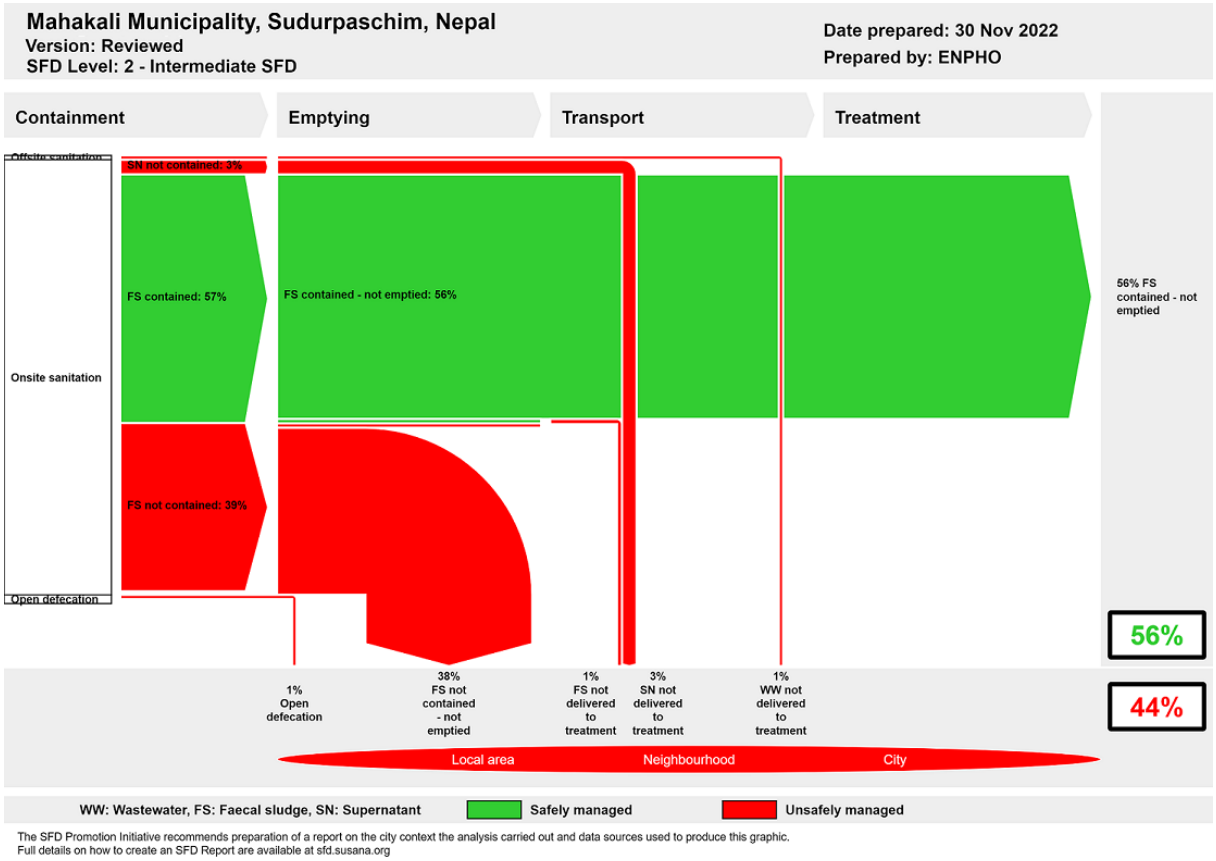
1. The SFD Graphic



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 level 2– Intermediate report.

Produced by:

Environment and Public Health Organization (ENPHO).

Collaborating partners:

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

Status:

Final SFD report.

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3. General city information

Mahakali Municipality is in Darchula District of Sudurpaschim Province, Nepal. It is divided into nine wards and covers an area of 135.11 sq. km. It is formed by merging the former headquarters of Darchula district i.e., Khalanga, ward 4 to 17 of Api Municipality and Dattu Village Development Committee (VDC). It lies in the lesser Himalaya region with an elevation of 900 m to 3,100 m above mean sea level (amsl) at 29.36° N to 29.45° N latitude and 80.24° E to 80.31° E longitude.

A population of 21,231 is residing in the municipality with a growth rate of 1.6% per annum. The municipality has a temperate climate with dry winters and warm summers. It has an average high temperature of 18.6°C and an average low temperature of 7.7°C. It receives 2,129 mm of rain per year.

4. Service outcomes

Mahakali Municipality was declared Open Defecation Free (ODF) on May 6, 2018. The coverage of improved sanitation facilities in the municipality is 97.61%. The households without improved sanitation facility opt for either open defecation or neighbour's toilet.

Among the households with improved sanitation facilities, 99.73% rely on the onsite sanitation system and 0.27% rely on offsite sanitation system. From the households with onsite sanitation systems, only 1.07% of households have fully lined tanks whereas 62.20% have lined tanks with impermeable walls and open bottom. There are 0.27% of single pits and 36.46% of unlined pits. Only 1.34% of containments have been emptied at least once since the installation. Most regions of the municipality lack motorable road connections and thus, all the containments are emptied manually. The municipality does not have a treatment facility for Faecal Sludge (FS). So, emptied FS is composted in a traditional way (not following the WHO recommendations), dug and dumped or applied to farmlands directly untreated.

Overall, the SFD graphic shows that 56% of the excreta generated are safely managed while 44% of the excreta generated are unsafely managed. The safely managed FS generated by 56% of population is temporary as the FS generated has not been emptied. With the current practice of Faecal Sludge Management (FSM), the proportion of safely managed FS will become unsafely managed once the containments start filling up since the emptied FS will end up untreated into the environment.

Spring water sources such as rivers, streams and boreholes are the main source of drinking water in the municipality whereas some areas of ward 4 and 5 access drinking water via private taps and community faucets distributed by Water Supply Users' Committee (WSUC).

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 endorsed the Water Supply and Sanitation Act 2022 which has 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, 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 sanitation campaign throughout the country focused on achieving universal access to improved sanitation.

The draft Sector Development Plan (SDP) has envisioned the delineation of roles and responsibility of federal, provincial, and local government to initiate sustainability of Open Defecation Free (ODF) outcomes.

6. Overview of stakeholders

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

Table 1: Overview of Stakeholders.

Key Stakeholders	Institutions / Organizations
Public Institutions at Federal Government	Ministry of Water Supply and Sewerage Management
Public Institutions at Local Government	Mahakali Municipality Drinking-Water Supply and Sanitation User's Committee
Non-governmental Organizations	Environment and Public Health Organization (ENPHO)
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC

7. Process of SFD development

Data on sanitation situation were collected through household and institutional survey. 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, Key Informant Interviews (KIIs) were conducted with officers and engineers of municipality and Drinking Water Supply, Sewerage and Sanitation Users' Committee to understand the situation and

practices across the service chain. Types of sanitation technologies used in distinct 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 were fed in SFD graphic generator to produce the SFD graphic.

8. Credibility of data

The major data were collected from random household sampling. Altogether, 376 households and 29 institutions were surveyed from 9 wards of Mahakali Municipality. Primary data on emptying, transportation and current sanitation practices in the municipality were validated from KIIs with municipal officials, water service providers and public toilet caretakers. The overall data and findings were shared with the stakeholders of the municipality and validated through a sharing program.

9. List of data sources

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

- CBS, 2021. *National Census 2078 Preliminary Report,* Kathmandu: National Planning Commission, Government of Nepal.
- Mahakali Municipality, 2022. *Mahakali Municipality.* [Online] Available at: http://mahakalimundarchula.gov.np/
- MoWS, 2020. *Open Defecation Free Nepal:Narration of the Journey,* Kathmandu: Secretariat of National Sanitation and Hygiene Coordination Committee, Nepal.
- GoN, 2015. *Constitution of Nepal: Goverment of Nepal.* [En línea] Available at: https://lawcommission.gov.np/en/wp-content/uploads/2021/01/Constitution-of-Nepal.pdf
- MoWS, 2020. *NEP: Urban Water Supply and Sanitation (Sector) Project (UWSSP),* Khalanga, Darchula: Ministry of Water Supply (MoWS).
- MoWS, 2022. Draft National Water, Sanitation and Hygiene Policy, s.l.: Ministry of Water Supply.

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Abbreviations

AMSL	Above Mean Sea Level
CBS	Central Bureau of Statistics
DWSSM	Department of Water Supply and Sewerage Management
DUDBC	Department of Urban Development and Building Construction
ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
GoN	Government of Nepal
HH	Household
IRF	Institutional and Regulatory Framework
JMP	Joint Monitoring Programme
KII	Key Informant Interview
KM	Kilometre
MDG	Millennium Development Goal
mm	Millimetre
MoUD	Ministry of Urban Development
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NPC	National Planning Commission
NUWSSSP	National Urban Water Supply and Sanitation Sector Policy
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
Pop	Population
PPP	Public Private Partnership
RWSSNP	Rural Water Supply and Sanitation National Policy
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
WSUC	Water Supply Users' Committee
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSSDO	Water Supply and Sanitation Divisional Office
WSUC	Water Supply and User's Committee
WW	Wastewater
WWTP	Wastewater Treatment Plant

1 City context

Mahakali Municipality is in Darchula District of Sudurpaschim Province, Nepal. The municipality is formed by merging the former headquarters of Darchula district i.e., Khalanga, ward numbers 4 to 17 of former Api Municipality and Dattu Village Development Committee (VDC). The municipality shares its boundary with Naugad Rural Municipality on east, India on the west, Dunhu Rural Municipality on the North and Shailyashikhar Municipality and Malikaarjun Rural Municipality on the South. It is divided into nine wards (Mahakali Municipality, 2022). Khalanga, situated in ward number 4 of the municipality, is the urbanized region of the municipality. Figure 1 shows the boundary map of Mahakali Municipality.

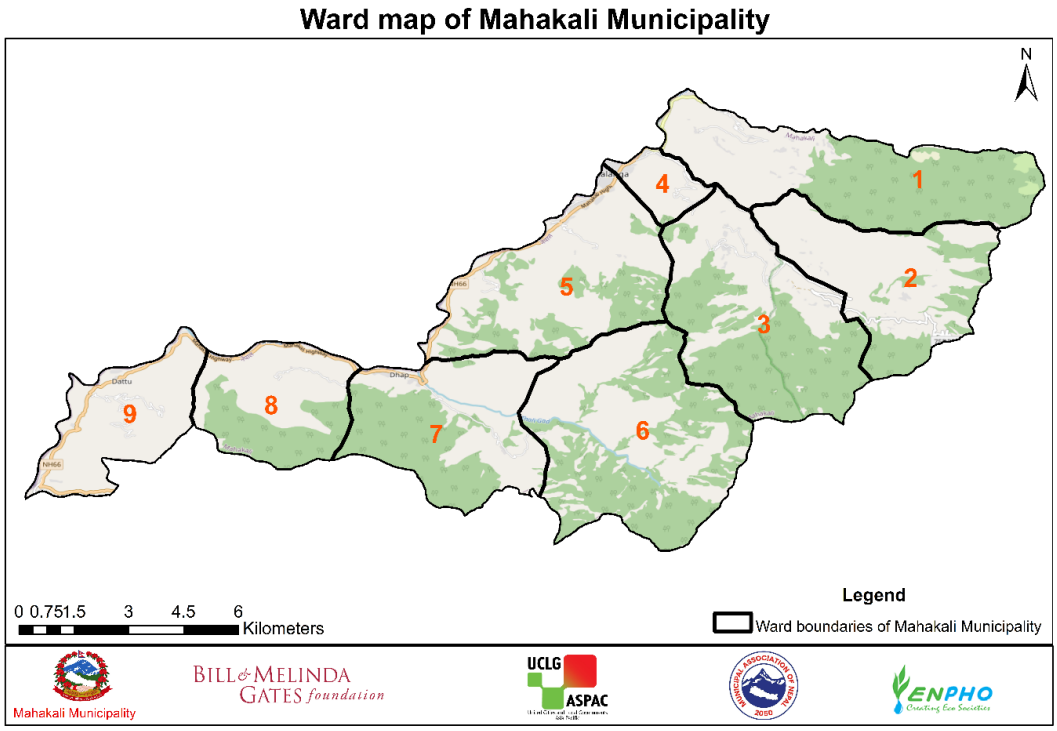

Figure 1: Ward boundary map of Mahakali Municipality.

1.1 Population

Mahakali Municipality has a total Population (Pop) of 21,231 with 10,162 male and 11,069 female population, residing on 4,526 households as per census 2011. Among nine wards of the municipality, ward number 4 has the largest population of 4,282 residing on 1,172 households whereas ward number 7 has least population of 1,354 residing on 254 households (CBS, 2011). According to the census of 2021, Mahakali Municipality has a total population of 24,572 (CBS, 2021). Based on the Central Bureau of Statistics (CBS) report, it shows that the population growth rate of Mahakali Municipality is 1.6% per annum.

1.2 Topography and Geography

The municipality spreads over 29.36º N to 29.45º N latitude and 80.24º E to 80.31º E longitude. It covers an area of 135.11 sq. km. (Mahakali Municipality, 2022). An elevation ranges from 900 m to 3,100 m above mean sea level (amsl) (Pathak, et al., 2020). It lies in the Lesser Himalaya region with geological structure consisting of highly fractured folded carbonated beds of dolomite, limestone, slate, and sandstone (Upreti, 1999).

1.3 Climate

One of the most used systems for climatic categorization is the Köppen-Geiger classification. The classification is a widely used method for portraying climates worldwide based on monthly air temperature and precipitation. Mahakali Municipality has a temperate climate with dry winters and warm summers. It has an average high and low temperature of 18.6 °C and 7.7 °C, respectively. The municipality receives 2,129 mm rain per year with the most precipitation between May and September. The monsoon season accounts for around 80% of the total yearly rainfall (Karki, et al., 2015).

2 Service Outcomes

2.1 Overview

Sanitation is defined as infrastructures, facilities or services provided for safe management of human excreta emanating from toilet while handling, storage, and treatment onsite or offsite conveying it safely to the end use or disposal to protect human health and environment (Affam & Ezechi, 2021). Sanitation is being prioritized on Sustainable Development Goal (SDG) 6.2. In line with SDG 6.2, Nepal has targeted to provide improved sanitation to 95% households by 2030 (NPC, 2017). In this context, Nepal was declared Open Defecation Free (ODF) nation on 23 September 2019 (MoWS, 2020).

2.1.1 Sanitation Status

a Household Level Sanitation Status

Mahakali Municipality was declared ODF on 6 May 2018. The status of ODF indicates accessibility to basic sanitation on each household (HH). According to the Joint Monitoring Programme (JMP), sanitation facilities that are not shared and designed to hygienically separate excreta from human contact are considered improved sanitation facilities. In context of Mahakali Municipality, 97.61% of households have improved sanitation facility. The remaining 2.39% of households either opt for open defecation, use neighbour's toilet, or use community toilet/shared toilets. The households having a sanitation facility are either connected to an onsite or offsite sanitation system.

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) whereas 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 generated (SuSanA, 2018). Among the households with sanitation facility, only 0.27% of households have an offsite sanitation system and 99.73% of households have an onsite sanitation system. Figure 2 shows the percentage of households using onsite and offsite sanitation systems.

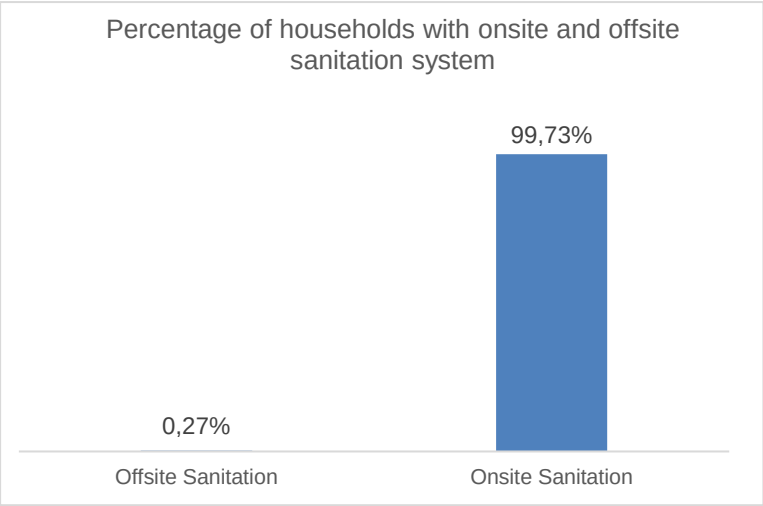

Figure 2: Household sanitation status of Mahakali Municipality.

Types of Offsite Sanitation Systems

0.27% of households with sanitation facility in the municipality have an offsite sanitation system. As the municipality does not have a defined sewerage network, here, households with their toilet having direct outlets to water bodies are considered as an offsite sanitation system. The disposal of excreta, directly to an open environment or water body without any treatment is one of the causes of disease transmission (WHO, 1958). Thus, the practice is unhygienic and possess threats to public health. Figure 3 shows the outlet of an offsite sanitation system showing a toilet discharging to a water body.

Figure 3: Toilet discharges directly to a water body.

Types of Onsite Sanitation Systems

99.73% of households with sanitation facilities in the municipality have an onsite sanitation system. All the sanitation facilities having containments are considered as onsite sanitation systems. Here, only 1.07% of households have a fully lined tank and most households i.e., 62.20% have a lined tank with impermeable walls and open bottom while 0.27% have a single pit and 36.46% have an unlined pit. Figure 4 shows pictures of diverse types of containments found in Mahakali Municipality.

Figure 4: Fully lined tank (on left) and lined tank with impermeable walls and open bottom (on right) found in Mahakali Municipality.

2.1.1 Containment

The type of containments in the municipality has different types of outlets (Figure 5). Following is the description of them.

Fully lined tank is a rectangular onsite sanitation technology which is used to safely store faecal sludge. There is no outlet or overflow to discharge effluent. The walls and bottom of tank are totally lined and sealed (Strande, et al., 2014). Only 1.07% of households located in urban areas, particularly Khalanga, have installed such containment.

Lined tank with impermeable walls and open bottom is a rectangular onsite technology where the walls of the tank are lined and the bottom of tank is not lined. The facility allows infiltration of leachates which could contaminate groundwater (Peal, et al., 2020). The containment is installed in 62.20% of households.

Single pit is made from pre-cast concrete rings one above another. There is no lining between rings, and it allows infiltration of effluents from walls and as well as bottom of the pit. No outlet or overflow for effluent is observed in this type of containment. This type of containment is installed in 0.27% of households.

Unlined pit is a pit without proper mason works however a dry stone are piled internally to prevent from collapsing. These containments are not sealed and thus water infiltrates into the ground (SuSanA, 2018). 36.46% of the households mostly located in the rural area and standalone buildings in the municipalities without access to road connection have installed this containment.

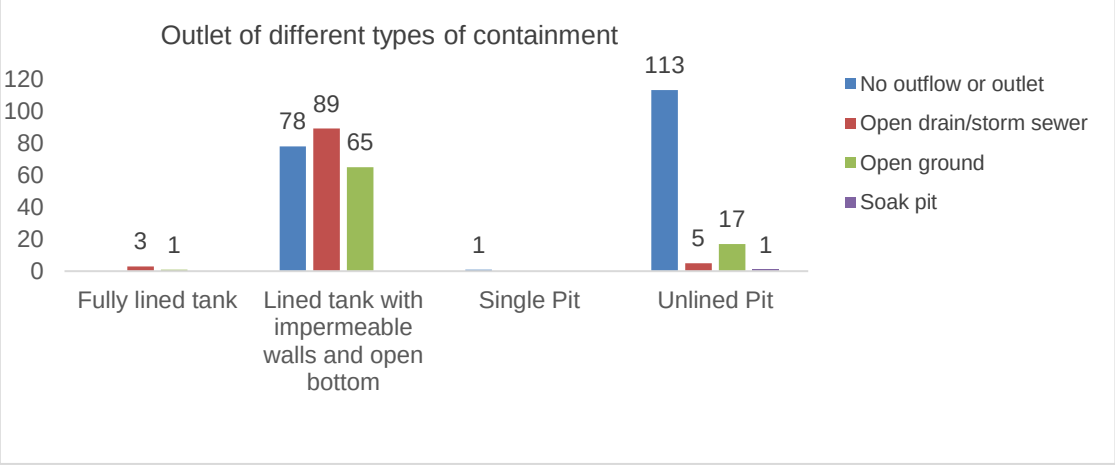

Figure 5: Different types of containments with their outlet.

Different types of containments are found in specific wards of the municipality. Fully lined tanks and lined tanks with impermeable walls and open bottoms are mostly found in urban areas such as local bazaar and households nearby highway, whereas single pits and unlined pits are mostly seen in rural areas of the municipality. Figure 6 shows the ward map of Mahakali Municipality with different types of containments at household level.

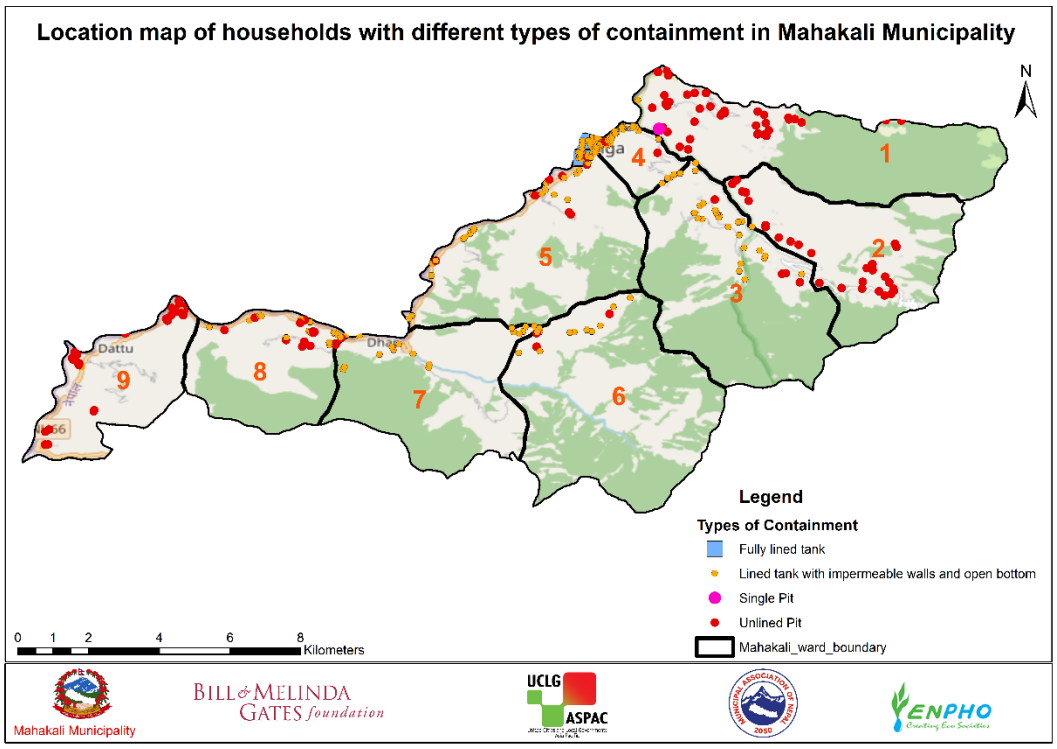

Figure 6: Ward map of Mahakali Municipality with different types of containment in households.

2.1.2 Emptying and Transport

Only 1.34% of households have emptied the containment at least once since installation whereas 98.66% have not emptied their containments. Here, the emptied containments are lined tanks with impermeable walls and open bottom, and unlined pits. Since the remaining containments were constructed in less than 5 years, the containments have not been filled and thus are not emptied. The containments were emptied manually despite the availability of a desludging truck in the municipality. The municipality lacks a motorable road connection due to challenging geography, so the desludging vehicle has not been used so far. In addition, the containments in areas with motorable road connections have not been filled yet. Figure 7 shows the percentage of households that emptied containment at least once and Figure 8 shows a picture of the desludging vehicle at Mahakali Municipality.

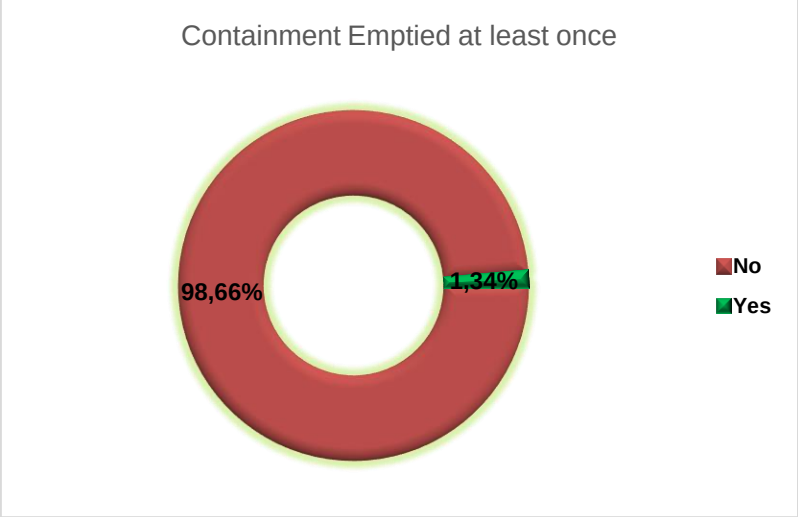

Figure 7: Percentage of households that emptied containment at least once.

Figure 8: Desludging suction truck at Mahakali Municipality.

2.1.3 Treatment and Disposal/Reuse

The emptied Faecal Sludge (FS) has been managed by composting, dig and dumped or applied to farmlands as of traditional practice. As the municipality does not have a Faecal Sludge Treatment Plant (FSTP), all the emptied FS is disposed unsafely in the environment.

b Sanitation System in Institutional buildings

The data on the status of sanitation situation in institutional buildings were obtained from educational buildings, government/non-government organizations and health care centres. Table 1 shows the type and percentage of the institutions surveyed.

Table 1: Type and percentage of surveyed institutions.

Type of institution	Number of Surveyed Institutions
Educational	12
Government /Non-government Organization	11
Health care centre	6
Grand Total	**29**

Two types of onsite sanitation systems were found on institutional buildings of Mahakali municipality. Figure 9 shows the ward map of Mahakali Municipality with different types of onsite sanitation systems.

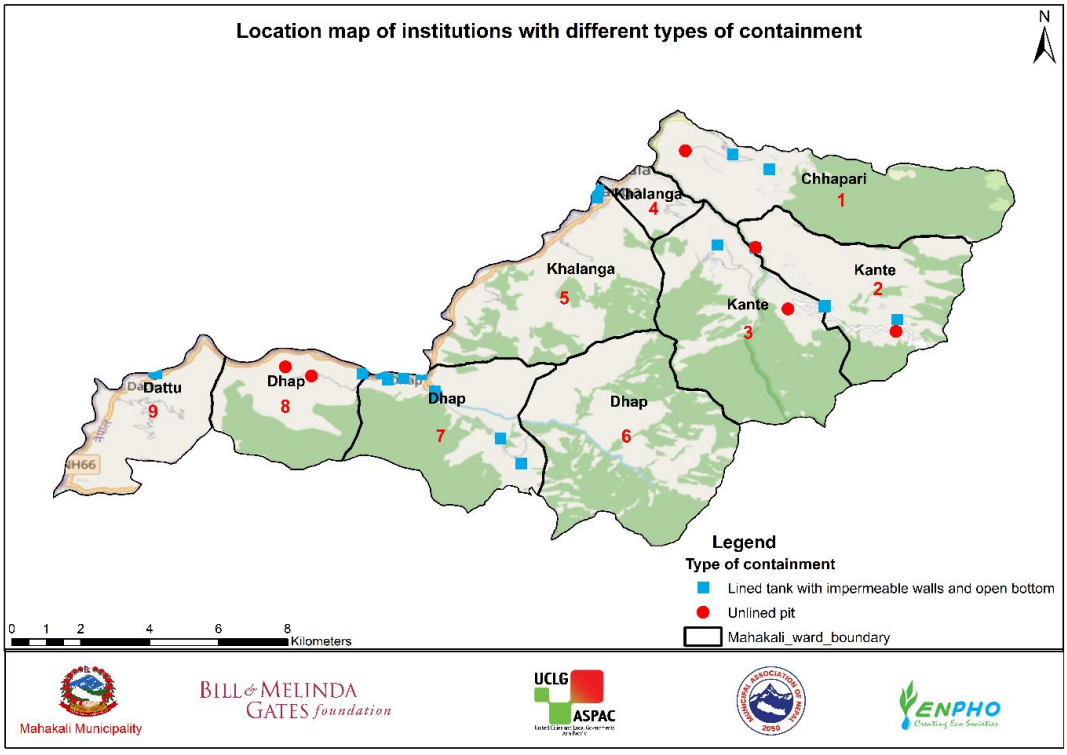

Figure 9: Ward map of Mahakali Municipality with different types of containment in institutions.

c Public Toilets

Mahakali Municipality has five public toilets among which three are at ward 4, one each are at ward 8 and ward 9. Public toilets were installed at the points where there is higher flow of people. All public toilets were constructed by municipality. Table 2 provides the description of observed public toilets at Mahakali Municipality.

Table 2: Description of public toilets at Mahakali Municipality.

Public Toilet at Mahakali Municipality						
S.N.	No. of Urinal	No. of Toilet Seat/Pan in		No. of users per day	Size of containment (m^3)	Location
		Male	Female			
Public Toilet A	1	1	1	100-200	15	Local Bazar
Public Toilet B	0	2	1	200-400	10	Bindraban bus park
Public Toilet C	0	1	1	8-10	8	Bus stop at Dhap

The public toilets A and B are located at the local bazar and the Bindraban bus park of ward 4, respectively. Public toilet C is located at the bus stop at Dhap of ward 8. The public toilets B and C serve public transport passengers, while public toilet A serves the general public, passengers and local people operating their business in the bazar area. Water used for toilet flushing and cleaning comes from rivers. Public toilets A and C have fully lined tanks, while public toilet B is connected to a lined tank with impermeable walls and an open bottom. Only the emptying of public toilet A has been recorded whereas public toilet C was constructed on 2021 and yet not emptied. Using the urinal and defecating costs Rs. 5 (USD 0.04) and Rs. 10 (USD 0.08), respectively. Table 3 shows the infrastructure, inner structure and containment of public toilets.

Table 3: Infrastructure, inner structure, and containment of public toilets.

Identity	Infrastructure	Inner structure	Containment
Public Toilet A			
Public Toilet B			

Public Toilet C			

2.2 SFD Matrix

2.2.1 SFD Selection Grid

Figure 11 shows the types of sanitation technologies present in the Mahakali Municipality selected in the Shit Flow Diagram (SFD) selection grid. The vertical column on the left side of grid represents sanitation technologies to which toilet is connected to, and horizontal row at top is connection of the technologies. The households with single pits are selected as lined pits with semi-permeable walls and open bottom. Similarly for the households using neighbour's toilet and community/shared toilet, containment types are selected as available in respective toilets. Here, households defecating openly are selected as open defecation.

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		T1A1C7			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	T1A3C6		T1A3C8		
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	T1A4C6		T1A4C8		Significant risk of GW pollution T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution T1A5C10
Unlined pit										Significant risk of GW pollution 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 10: SFD selection grid for Mahakali Municipality.

The detail description of selected terms in the selection grid in Figure 10 is provided in Table 4.

Table 4: Explanation of terms used to indicate the frames selected in the SFD selection grid.

T1A1C7	A fully functioning toilet discharges directly to a water body. The excreta are raw, untreated and hazardous and since it discharges directly to a water body, all the excreta in this system are considered not contained.
T1A3C6	A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults (consequently the excreta is potentially more toxic than the excreta in a septic tank). 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.
T1A3C8	A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults (consequently the excreta is potentially more toxic than the excreta in a septic tank). Since the tank is fitted with a supernatant/effluent overflow connected to open ground the excreta in this system is considered NOT contained.
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. It includes wall-lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. 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.
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. It includes wall-lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. Since the tank is fitted with a supernatant/effluent overflow connected to open ground, the excreta in this system is considered NOT contained.
T1A4C10	A correctly designed, properly constructed and well maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes all lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks (e.g. cubluks in Indonesia). However, since the tank is NOT fitted with a supernatant/effluent overflow this system is considered contained.
T1A5C10	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.
T1A6C10	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.
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.

2.2.2 SFD Matrix

The second step in the process of developing the SFD graphic is the calculation of the proportion of Faecal Sludge (FS) contained in each type of sanitation technologies. 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 the proportion of the contents of each type of onsite container which is faecal sludge.

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 fully lined tanks (sealed) or lined tanks with impermeable walls and open bottom and all types of pits), is shown in column population. F3 is the proportion of FS from each type of onsite container which is emptied at least once after its construction. The value of FS emptied is derived from the household survey data and applies only from systems T1A4C8 and T1A6C10, the only ones that have ever been emptied.

Variable F4 is the proportion of emptied FS delivered to treatment and F5 is the proportion of FS delivered to treatment and treated. All the emptied FS from the municipality has been applied directly to farmland, dig and dumped and composted not following the World Health Organization (WHO) recommendations. Since the emptied FS has not been treated, the value for variables F4 and F5 was set to 0% in both cases.

Variable S4e is the proportion of supernatant in open drain or storm sewer that is delivered to treatment plant and S5e is the proportion of supernatant that is delivered to treatment plant that is treated. The municipality does not have a defined sewer network thus, the proportion of supernatant is not calculated. Therefore, the value for S4e and S5e remained zero for systems T1A3C6 and T1A4C6. Figure 12 shows the SFD matrix of Mahakali Municipality.

Mahakali Municipality, Sudurpaschim, Nepal, 30 Nov 2022. SFD Level: 2 - Intermediate SFD
Population: 24572
Proportion of tanks: septic tanks: 0%, fully lined tanks: 63%, lined, open bottom tanks: 87%

Containment						
System type	Population	FS emptying	FS transport	FS treatment	SN transport	SN treatment
	Pop	F3	F4	F5	S4e	S5e
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	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
T1A1C7 Toilet discharges directly to water body	0.3					
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	0.8	0.0	0.0	0.0	0.0	0.0
T1A3C8 Fully lined tank (sealed) connected to open ground	0.3	0.0	0.0	0.0		
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	20.7	0.0	0.0	0.0		
T1A4C6 Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	23.7	0.0	0.0	0.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	17.3	1.5	0.0	0.0		
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	0.3	0.0	0.0	0.0		
T1A6C10 Unlined pit, no outlet or overflow	36.2	3.0	0.0	0.0		
T1B11 C7 TO C9 Open defecation	0.5					

Figure 11: SFD Matrix of Mahakali Municipality.

2.2.3 Risk of Groundwater Pollution

In the municipality, most households i.e., 50.8% have access to drinking water directly through spring source such as river and borehole. Similarly, 48.7% have access of drinking water through piped drinking water supply service. There are four existing Water Supply Systems in the municipality that were constructed by Water Supply and Sanitation Divisional Office (WSSDO) which were handed over to Water Service Users' Committee (WSUC). The service covers a portion of the Khalanga region i.e., fewer than 70% of ward 4 and 5. The supply system provides water via private connections and community faucets. The distribution system is disorganised, and distribution pipelines are visible everywhere on streets. In addition, water leaking from the pipes is a regular issue. Considering the perception of beneficiaries regarding the quality of the given water, 48.4% of the respondents felt that it was good (very satisfactory), 45.8% felt that it was satisfactory, and 5.8% claimed that it was unsatisfactory (MoWS, 2020).

The remaining 0.3% of households use jar water and other 0.3% use tanker water for drinking purpose. Here, maximum i.e., 99.5% of households use spring source for drinking water.

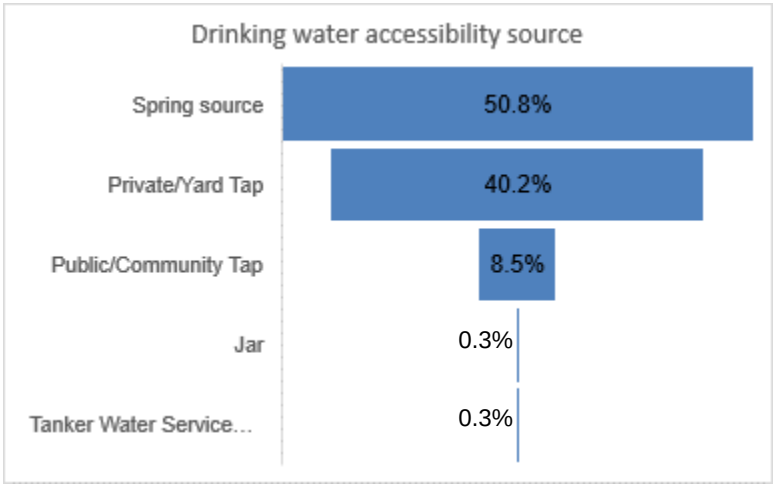

Figure 12: Drinking water accessibility source at Mahakali Municipality.

Figure 13: Water intake and piped drinking water supply.

In the municipality, sources for piped water supply are located at least 30 metres upstream from sanitation facilities and pipelines are at least 10 metres away from latrines, septic tanks

and main drains (MoWS, 2020). Moreover, these services use filtration and chlorination for water purification prior to water supply. The water quality test report (test report can be reviewed in Annex 4 and 5) shows zero presence of *E. coli* contamination in piped supply water. Households using drinking water directly from spring source have their source located 200-300 metres, upstream or in a horizontal distance, from the locality. A study suggests that *E. coli* can travel up to 1.5 metres vertically and 10.7 metres horizontally in sandy or sandy clay geology (INREM, 2011). As the geology of Mahakali Municipality consists of slate, limestone and sandstone (Upreti, 1999), *E. coli* contamination is very low in this region. Thus, the risk analysis for spring water source contamination is significantly low in Mahakali Municipality. Therefore, in the SFD matrix, lined tanks, lined and unlined pits were selected as systems T1A4C10, T1A5C10 and T1A6C10, respectively.

2.3 Summary of assumptions

Sanitation Accessibility:

- ✓ 2.39% of households in Mahakali Municipality do not have accessibility to improved sanitation facility where 0.53% of households opt for open defecation, 1.33% of households use neighbour's toilet and 0.53% of households use community/shared toilets.

Offsite sanitation systems:

- ✓ 0.3% of the toilets discharge directly to a water body (T1A1C7). Since there is no Wastewater Treatment Plant (WWTP), all wastewater is disposed of untreated into the environment.

Onsite sanitation systems:

- ✓ The proportion of FS in septic tanks were set to 0% (no septic tanks were recorded in the municipality), the proportion of FS in fully lined tanks was set to 63% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 87% according to the relative proportions of the systems in the municipality, as per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website.
- ✓ Variables F3, F4, F5, S4e and S5e for all onsite sanitation systems were derived from the HH survey and cross-checked with the KIIs conducted. The FS from (T1A4C8) and (T1A6C10) emptied are composted conventionally, applied into fields and dug up and dumped without any treatment. Thus, the value for both variables F4 and F5 are set to 0% since emptied FS is not handled securely and the municipality does not have a designated treatment plant.
- ✓ Since the municipality lacks a treatment plant, the supernatant produced from systems T1A3C6 and T1A4C6 is dumped straight into water bodies without any treatment. So, values for variables S4e and S5e are both set to 0%.

2.4 SFD Graphic

Figure 14 shows the SFD graphic for Mahakali Municipality. In the graphic, FS and wastewater (WW) from the percentage of population coloured in green indicates that they are being

handled, stored, and managed safely whereas the percentage that is coloured red indicates that they are being handled, managed, or stored unsafely. It also represents the fate of the faecal sludge along the sanitation value chain going from left to right.

The SFD graphic shows that FS from 56% of population is safely managed and, FS and WW from 44% population is unsafely managed.

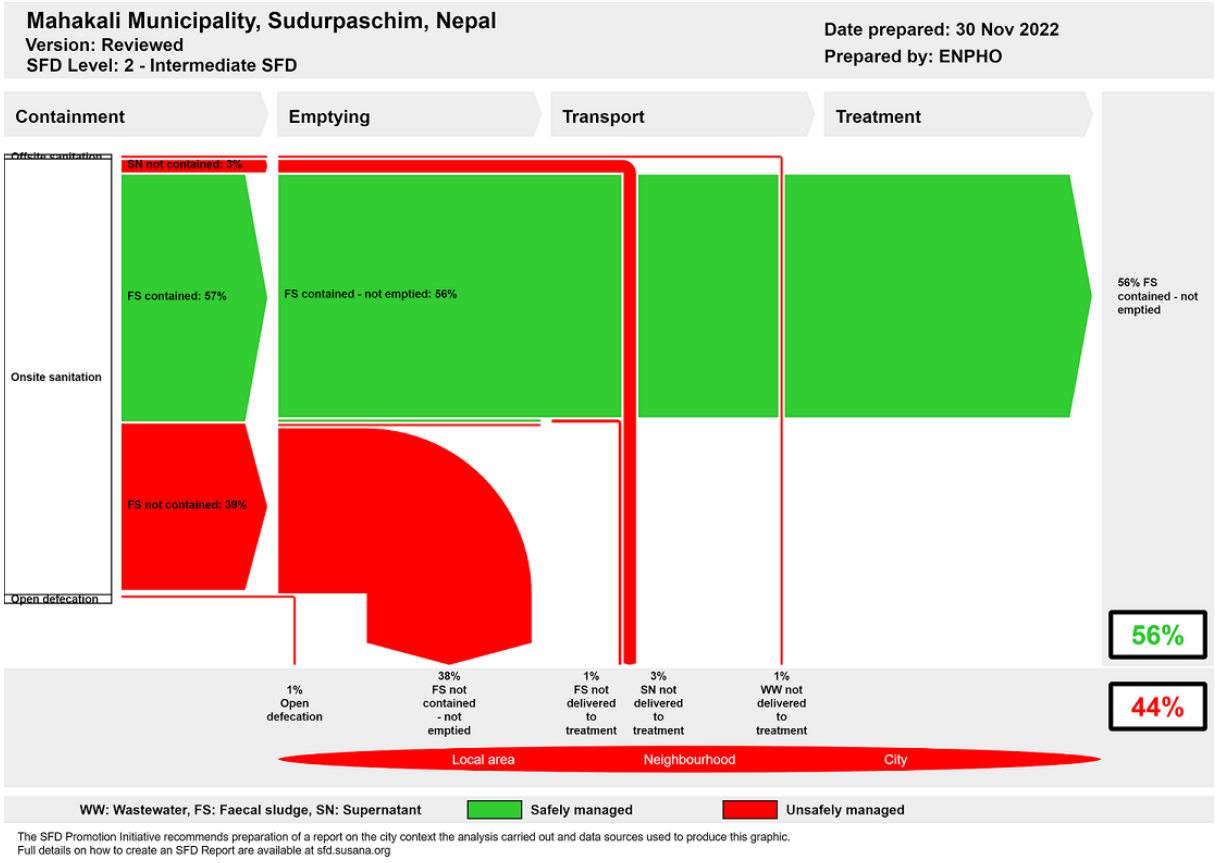

Figure 14: SFD Graphic of Mahakali Municipality.

Offsite Sanitation

WW produced from 1% of population is not delivered to treatment and thus, it is not managed safely. The outlet of toilets is connected directly to water bodies so, produced WW is delivered directly to water bodies.

Onsite Sanitation

The 99% of population with access to sanitation facilities (including neighbor's toilet and community/shared toilet) relies on the onsite sanitation systems. The FS from 57% of the population is contained, FS from 38% of the population is not contained and 3% is generated as supernatant (SN) not contained.

However, the 56% 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'. When these pits and tanks are full, the FS will require emptying and transporting to a treatment plant. If the current practice of Faecal Sludge Management (FSM) continues (i.e. disposal to fields),

this proportion of safely managed FS will become unsafely managed as the FS will end up untreated in the environment.

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 general 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 percentage of the population that uses lined tanks with impermeable walls and an impermeable bottom (T1A4C10), lined pits (T1A5C10) and unlined pits with no outflow or overflow (T1A6C10) without posing a significant risk of groundwater contamination, is the value of FS 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 general 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 percentage of population that uses fully lined tanks connected to an open drain or storm sewer (T1A3C6) and to open ground (T1A3C8) and lined tanks with impermeable walls and open bottom connected to an open drain or storm sewer (T1A4C6) and to open ground (T1A4C8) makes up for the value of FS not contained.

FS contained not Emptied

The FS generated from 1% population is emptied whereas the remaining FS contained has not been emptied. Thus, the graphic shows that FS generated from 56% of population is contained and not emptied.

FS not delivered to treatment

The municipality does not have a treatment facility to treat faecal sludge. So, all the FS emptied from contained and not contained sanitation systems is disposed of into farmlands, composted, or dug and dumped. The proportion of FS not delivered to treatment is 1%, is the summation of FS contained - emptied and FS not contained- emptied.

Supernatant (SN) not delivered to treatment

The proportion of supernatant is obtained from containments connected to open drain or storm water sewer calculated as 50% of FS contained in each containment. The total proportion of supernatant (SN) is 3% of FS generated by the total population. Since the municipality lacks a proper sewer network and a treatment plant, the supernatant is disposed of directly into water bodies. Hence the proportion of SN not delivered to treatment is 3%.

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, electromagnetic 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 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 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.

3.2 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. 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. Thus, the National Water Supply and Sanitation Policy (NWSSP) was formulated in 2014 by the Government of Nepal (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. Nepal committed to Millennium Development Goals (MDGs) for 2000 - 2015. One 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 set-up 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.

3.3 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 Government

National Planning Commission: At the federal government, the National Planning Commission (NPC) 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 (MoWS) 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 15.

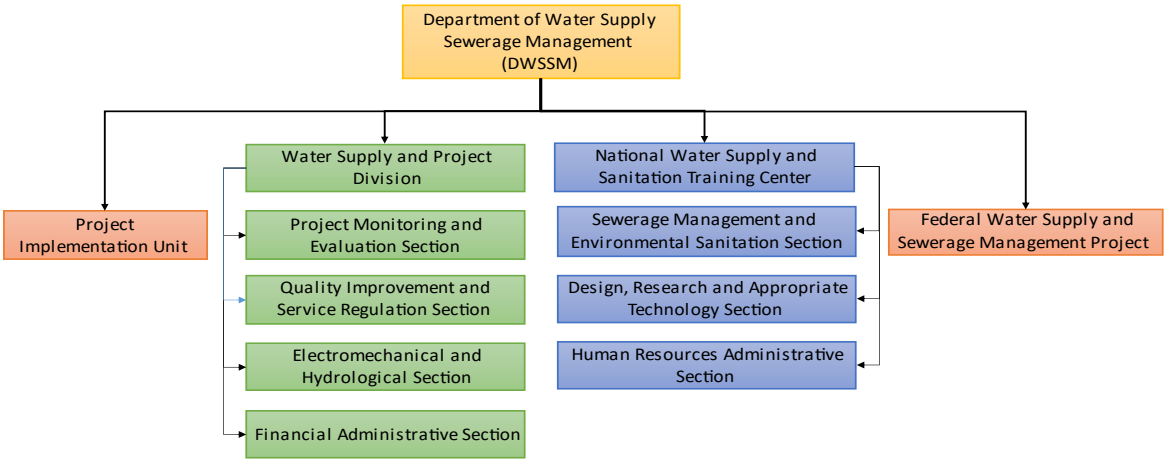

Figure 15: Organizational structure of Department of Water Supply and Sewerage Management (DWSSM).

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

At Provincial Government

Ministry of Physical Infrastructure and Transport: Ministry of Physical Infrastructure and Transport development of provincial government in Sudurpaschim province is major executing body for planning, developing, and implementing water supply and sanitation programs. 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:

i. Inter local government projects.

ii. Beneficiaries between 5,000 to 15,000 in terai region, 3,000 to 5,000 in hilly region and 5,00 to 1,000 in Himalayan region.

At Local Government

Municipal council: The municipality consists of 7 divisions including a sanitation related section. The Sanitation sub-section lies under the Infrastructure Development and Environmental management section. The sub-section has been providing door to door solid waste collection service in the municipality. The municipality has allocated the land and budget for developing a sanitary landfill site in the municipality.

3.4 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 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). The municipality does not have a sewer network. The toilet system is either directly connected to the river or they are connected to containments which are emptied manually by traditional desludgers.

3.5 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 5. However, FSM specific standards have yet to be developed and implemented.

Table 5: 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 Interview

The Key Informant Interviews (KIIs) and objective sharing of the study were conducted with major stakeholders of the sanitation sector in the municipality. Acting Chief Administrative Officer and Assistant at the municipality were interviewed on current sanitation services with respect to technical, institutional, and financial aspects. The KIIs were performed with Chairperson of Khalanga Water Supply, Sewerage and Sanitation Users' Committee and Engineer of ITECO Consultancy-UNEC to understand supply and demand of water, water sources, quality water and availability of water. Also, an interview was performed with the caretaker of public toilet to understand faecal sludge generation from the public toilets of the municipality as well as to understand public toilet management practice.

Table 6: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organization/Company	Purpose of KII	Date
1.	Yubraj Joshi (KII-1)	Planning and Monitoring Office	Mahakali Municipality	Sanitation status, municipality representatives	8 June 2022
2.	Tikendra Awasthi (KII-2)	Assistant	Mahakali Municipality	Sanitation status, municipality representatives	8 June 2022
3.	Jayadev Joshi (KII-3)	Chairperson	Khalanga Water Supply, Sewerage and Sanitation Users' Committee	Supply and demand of water, water sources, quality water, availability of water	8 June 2022
4.	Kuber Bahadur Singh (KII-4)	Engineer	ITECO Consultancy-UNEC	Supply and demand of water, water sources, quality water, availability of water	9 June 2022
5.	KII-5	Public Toilet caretaker	Local Bazar, Mahakali Municipality-Ward4	Quantitative and management data on public toilet and public toilet operation	9 June 2022
6.	Krishna Singh Dhami (KII-6)	Public Toilet caretaker	Bindraban Bus Park, Mahakali Municipality-Ward 4	Quantitative and management data on public toilet and public toilet operation	9 June 2022
7.	KII-7	Chairperson	Public Toilet Management Committee- Ward 8	Quantitative and management data on public toilet and public toilet operation	10 June 2022

4.2 Household Survey

A random household survey was conducted in all wards of the municipality. The municipality selected local enumerators who were oriented prior to the survey and were mobilized for data collection. A mobile application "KOBOCOLLECT" was used for the household survey. In the orientation, enumerators were clarified on survey objectives, technical terms concerning sanitation, use of the mobile application and procedure of random sampling survey based on the provided map.

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 $n= n_o/(1+ (n_o-1)/N)$.

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

$n_h= (N_h/N)*n$, where N_h is a total population in each stratum.

Thus, a total of 376 households were sampled from 4,526 households distributed in 9 wards with proportionate stratification random sampling. The total number of households was calculated by dividing population acquired from municipality website by household size acquired from census 2021. Figure 16 shows the ward map of Mahakali Municipality with location of surveyed households.

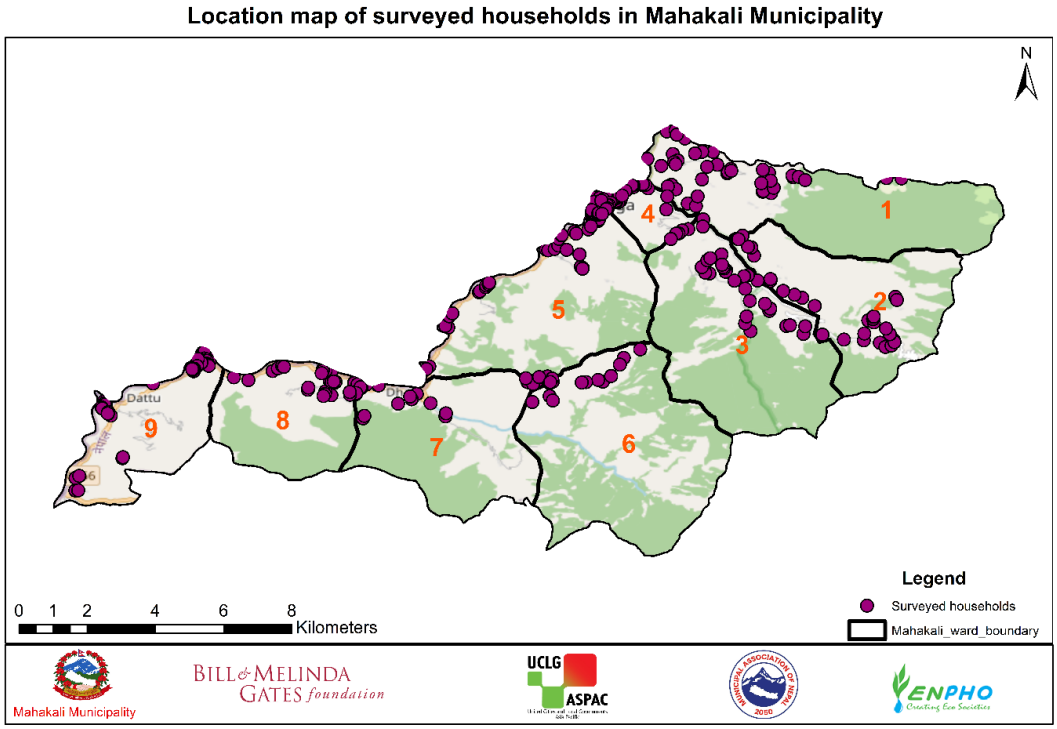

Figure 16: Location map of surveyed households.

4.3 Direct Observation

The sanitation facilities and drinking water sources at households, public toilets and waste collection centre of municipality were observed. Similarly, monitoring visits during survey were carried out. Figures 17 and 18 are the visual references of the mentioned activities.

Figure 17: Toilet at household and public toilet at Mahakali Municipality.


Figure 18: Household survey monitoring and observation at waste collection centre.

4.4 Sharing and Validation of Data

The sharing and validation of SFD findings were conducted in the municipality hall in participation of the mayor, ward chairpersons, general members of municipal council and other relevant stakeholders shown in Figure 19. The participants agreed upon the findings of this study that showed current SFD of the municipality. The mayor focused on the need to improve knowledge on faecal sludge of general members of municipal council, key stakeholders, and general public as well. As the municipality is shifting towards urbanization, the mayor also mentioned the necessities of proper sanitation system for safe and beautiful city and added that findings of this study support in further planning of sanitation in the municipality.

Figure 19: Sharing and validation workshop for SFD findings at Mahakali municipality.

5 Acknowledgements

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

We offer sincere acknowledgement to Mr. Narsingh Chairshir, Mayor of the municipality, Mr. Nar Bahadur Thagunna, Chief Administrative Officer, Mr. Yubraj Joshi, Planning and Monitoring Officer, Mr. Tikendra Awasthi, Assistant for providing valuable time and information during study. Similarly, we would like to thank all the respective staffs of the municipality, key stakeholders and enumerators involved during the study, without whose help this study would not have been completed.

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7 Appendix Annexes

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

Table 7: Roles and responsibilities of various tiers of government 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

7.2 Appendix 2: Total Number of Households and Surveyed Households

Table 8: Total number of households in each ward and surveyed households.

Ward	Households	Surveyed Number of Households
1	529	44
2	381	32
3	404	34
4	1,172	98
5	686	57
6	258	21
7	254	21
8	384	32
9	458	37
	Total	**376**

7.3 Appendix 3: Number of Surveyed Institutions

Table 9: Number of the surveyed institutions.

Ward	Educational	Government /Non-government Office	Health care centre	Total institution-ward wise
1	3	1	1	5
2	2	1	2	5
3	1	-	-	1
4	1	1	-	2
6	2	-	-	2
7		6	1	7
8	2	1	1	4
9	1	1	1	3
Grand Total	**12**	**11**	**6**	**29**

7.4 Appendix 4: Water Quality Test Report of Garaku Khola

Government of Nepal
Ministry of Water Supply
Department of Water Supply and Sewerage Management
Federal Water Supply and Sewerage Management Project
Water Quality Testing Laboratory
Dhangadhi, Kailali

Water Quality Test Report

Sample Entry No:	**150**	**Sampled By**	**Sender**
Sender/Client :	**Ashish C.A.B Gwallek Joint Venture**	**Sampling Date**	**2078/12/01**
Source:	**Surface Water**	**Reported Date**	**2078/12/02**
Sampling Point:	**Garaku Khola**		
Address:	**Mahakali-3, Darchula**	**Sample Condition:**	**OK**

S.N.	Parameters	Unit	Observed Values	NDWQS, 2062 BS	Analyzed Methods
1.	Taste &Odor	-	Non-Objectionable	Non-Objectionable	Sense Observation
2.	Color	TCU	<5 @ pH 8.5	5(15)	2120 B, APHA 22nd Edition
3.	pH	-	8.5@ 25°C	6.5 - 8.5*	4500-H^+, APHA 22nd Edition
4.	Turbidity	NTU	<0.01	5(10)	2130 B, APHA 22nd Edition
5.	Total Dissolved Solid	mg/l	231	1000	TDS Meter
6.	Electrical Conductivity	µS/cm	345@ 25°C	1500	2510 B, APHA 22nd Edition
7.	Calcium	mg/l	32	200	3500 Ca- B, APHA 22nd Edition
8.	Total Hardness as $CaCO_3$	mg/l	160	500	2340 C, APHA 22nd Edition
9.	Total Iron	mg/l	<0.1	0.3(3)	Iron Test Kit
10.	Ammonia	mg/l	0.1	1.5	Ammonia Test Kit
11.	Nitrate	mg/l	0.94	50	4500-NO_3^-B, APHA 22nd Edition
12.	Manganese	mg/l	<0.1	0.2	Manganese Test Kit
13.	E.Coli	CFU/100ml	0	0	9222 D, APHA 22nd Edition

Note: The entire test was conducted as per the National Drinking Water Quality Guideline, 2062BS (MPPW/GoN).
Remarks: '()'indicates if no any alternatives are available, '*'indicates minimum & maximum limits, '<'indicates less than, 'µg/l' indicates microgram per litre etc.

Analyzed By

Verified by

Appendix 5: Water Quality Test Report of Dhauligad Khola

Government of Nepal
Ministry of Water Supply
Department of Water Supply and Sewerage Management
Federal Water Supply and Sewerage Management Project
Water Quality Testing Laboratory
Dhangadhi, Kailali

Water Quality Test Report

Sample Entry No:	**151**	**Sampled By**	**Sender**
Sender/Client :	**Ashish C.A.B Gwallek Joint Venture**	**Sampling Date**	**2078/12/01**
Source:	**Surface Water**	**Reported Date**	**2078/12/02**
Sampling Point:	**Dhauligad Khola**		
Address:	**Mahakali-5, Darchula**	**Sample Condition:**	**OK**

S.N.	Parameters	Unit	Observed Values	NDWQS, 2062 BS	Analyzed Methods
1.	Taste &Odor	-	Non-Objectionable	Non-Objectionable	Sense Observation
2.	Color	TCU	<5 @ pH 8.2	5(15)	2120 B, APHA 22nd Edition
3.	pH	-	8.2@ 25^{0}C	6.5 - 8.5*	4500-H^+, APHA 22nd Edition
4.	Turbidity	NTU	<0.01	5(10)	2130 B, APHA 22nd Edition
5.	Total Dissolved Solid	mg/l	224	1000	TDS Meter
6.	Electrical Conductivity	µS/cm	334@ 25^{0}C	1500	2510 B, APHA 22nd Edition
7.	Calcium	mg/l	34	200	3500 Ca- B, APHA 22nd Edition
8.	Total Hardness as $CaCO_3$	mg/l	160	500	2340 C, APHA 22nd Edition
9.	Total Iron	mg/l	<0.1	0.3(3)	Iron Test Kit
10.	Ammonia	mg/l	0.1	1.5	Ammonia Test Kit
11.	Nitrate	mg/l	0	50	4500-NO_3^-B, APHA 22nd Edition
12.	Manganese	mg/l	<0.1	0.2	Manganese Test Kit
13.	E.Coli	CFU/100ml	0	0	9222 D, APHA 22nd Edition

Note: The entire test was conducted as per the National Drinking Water Quality Guideline, 2062BS (MPPW/GoN).
Remarks: '( )'indicates if no any alternatives are available, '*'indicates minimum & maximum limits, '<'indicates less than, 'µg/l' indicates microgram per litre etc.

Analyzed By

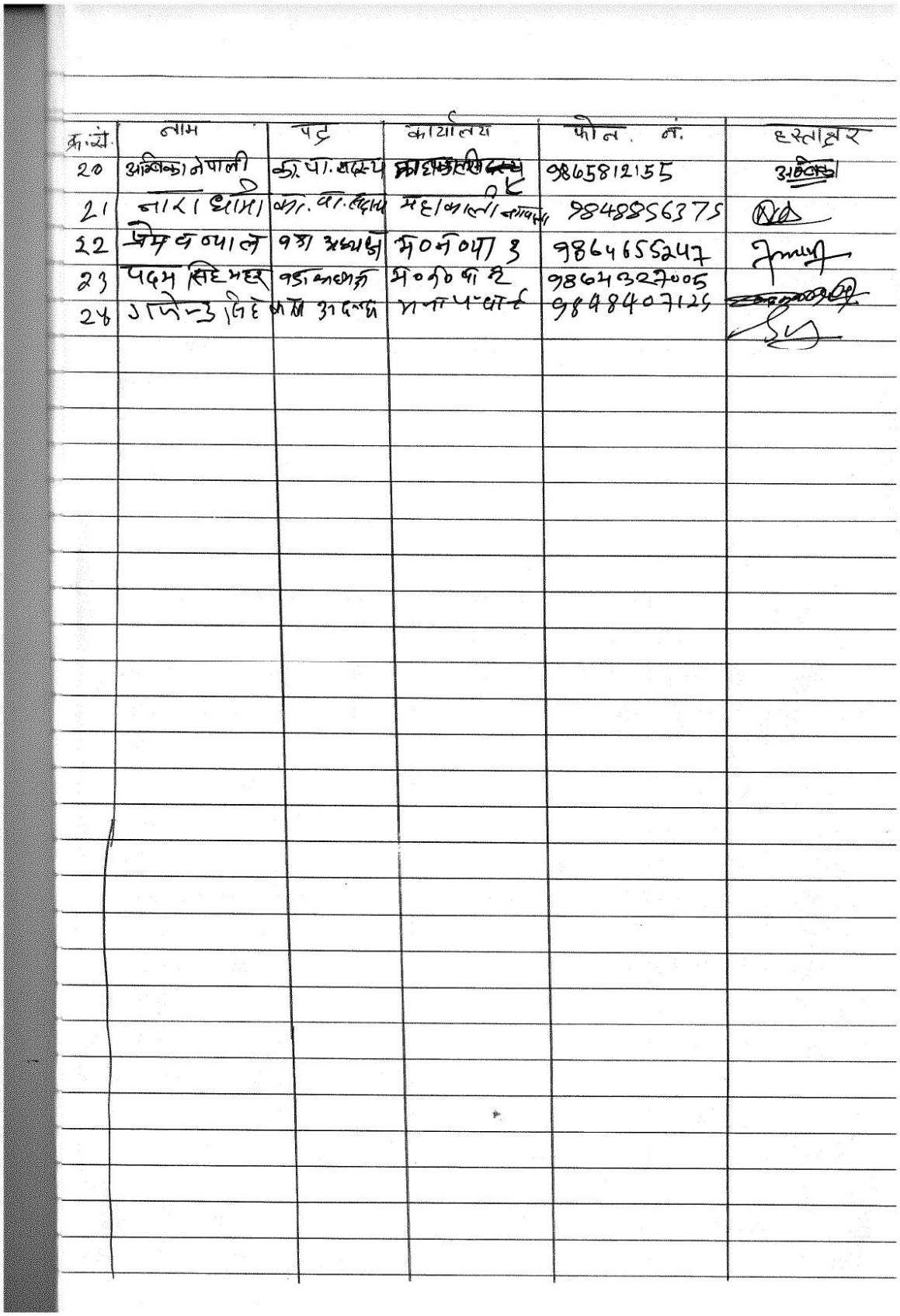
Verified by

7.5 Appendix 6: List of Participants in Sharing and Validation Workshop

आज मिति २०७६ भाद्र १३ गतेका दिन नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एन्फो) को प्राविधिक सहयोग र The United Cities and Local Governments Asia Pacific (UCLG ASPAC) को सहकार्यमा Municipalities Network Advocacy on Sanitation in South Asia (MuNASS II) कार्यक्रम अन्तर्गत महाकाली नगरपालिकामा Shit Flow Diagram (SFD) सम्बन्धी अन्तरक्रिया कार्यक्रममा निम्न अनुसारका व्यक्तिहरूको उपस्थिति रहेको छ ।

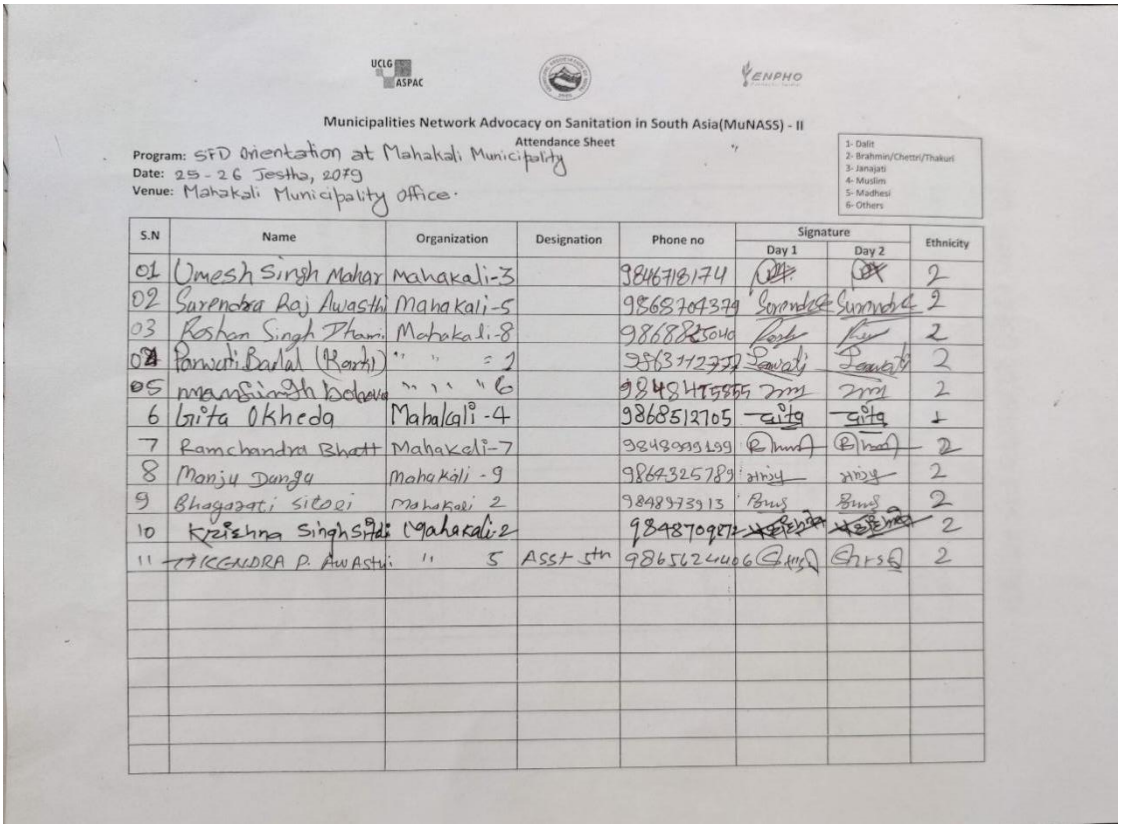
उपस्थिति

क्र.स.	नाम	पद	कार्यालय	फोन नं.	हस्ताक्षर
१.	नर सिंह चौसिर	नगर प्रमुख	महाकाली नगरपालिका	९८४८८६६२०७	[illegible]
२.	दुर्गा कुमारी खत्री (बिष्ट)	नगर उप प्रमुख	महाकाली नगरपालिका	९८४८७७५२३५	[illegible]
३.	नर बहादुर ठगुन्ना	प्र.प्र.अ.	महाकाली न.पा.	[illegible]	[illegible]
४.	जगत बहादुर कुमाल	व.४ अध्यक्ष	महाकाली नगरपालिका	९८४१५७०४३२	[illegible]
५	जगत सिंह धुनार	कार्यपालिका सदस्या		9749802313	[illegible]
६.	रोशन सिंह धामी	गणक	म.न.पा. 8	986882[illegible]	[illegible]
७	गीता ओलेडा	का.स.	म.न.पा. ४	९८६८४९३७०४	Gita
८	मंगल सिंह ठकुल्ला	[illegible] अध्यक्ष	[illegible] ४	९८८८६८९४४	[illegible]
९.	जय ब. फर्त्याल	जे.स्वा.नि.	महाकाली न.पा.	९८४८८९३२२५	[illegible]
१०	सोनादित्य बोहरा	अध्यक्ष	म.न.पा ६	[illegible]	९८६०६१८२२९
११	केशव सिंह बिष्ट	वा.उ. तथा विपद व्यवस्थापन आयोग	म.के.पा.	९८६८८०३६६६	[illegible]
१२	जमुना दमाई	कार्यपालिका सदस्य	म-न-पा-3	98687178[illegible]	[illegible]
१३	मदन सिंह धामी	अध्यक्ष	म.न.पा. ८.	98647635[illegible]	[illegible]
१४	अंकुर सिंह डोकाल	अध्यक्ष	[illegible]-2	9806790074	[illegible]
१५	दिलीप राज अवस्थी	अध्यक्ष	महाकाली न.पा. २	९८४८६८९८६	[illegible]
१६	पुरन सिंह कुठारी	का.पा. सदस्य	महाकाली न.पा. ४	९८४८६६२९८०	[illegible]
१७	पार्वती ऐरी	का.पा. सदस्य	महाकाली न.पा. ५	९६८९८२१६१	पार्वती
१८	हेमा चन्द	का.पा. सदस्य	महाकाली न.पा. 6	9842231419	[illegible]
१९	भुवनेश्वरी रखौला	का.पा. सदस्य	महाकाली न.पा. 8	9865969181	भुवनेश्वरी



क्र.सं.	नाम	पद	कार्यालय	फोन नं.	हस्ताक्षर
20	अम्बिका नेपाली	क.प्रा.अधिकृत	[illegible]	9865812155	[illegible]
21	नारा [illegible]	[illegible]	महाकाली नगरपा	9848856375	[illegible]
22	[illegible]	[illegible]	[illegible]	9864655247	[illegible]
23	पदम सिंह महर	वडा अध्यक्ष	[illegible]	9864327005	[illegible]
24	[illegible]	[illegible]	[illegible]	9848407125	[illegible]

7.6 Appendix 7: List of Participants in SFD Orientation Program



UCLG ASPAC | ENPHO

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

Attendance Sheet

Program: SFD Orientation at Mahakali Municipality
Date: 25-26 Jestha, 2079
Venue: Mahakali Municipality Office.

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

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Ethnicity
01	Umesh Singh Mahar	Mahakali-3		9846718174			2
02	Surendra Raj Awasthi	Mahakali-5		9868704379			2
03	Roshan Singh Dhami	Mahakali-8		9868835040			2
04	Parwati Bailal (Karki)	" " 1		9863742777			2
05	mansingh Bohara	" " 6		9848475855			2
6	Gita Okheda	Mahakali -4		9868512705			2
7	Ramchandra Bhatt	Mahakali-7		9848999199			2
8	Manju Danga	Mahakali - 9		9864325789			2
9	Bhagawati Sitoqi	Mahakali 2		9849973913			2
10	Krishna Singh Sha	Mahakali-2		9848709872			2
11	YOGENDRA P. AWASTHI	" 5	ASST 5th	9865624406			2

SFD Mahakali Municipality, Nepal, 2023

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This Executive Summary and the SFD Report are available from:

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SFD Promotion Initiative