SFD Report

Gaindakot Municipality
Nepal

Final Report

This SFD Report - SFD level 2 - was prepared by
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SFD Report Gaindakot Municipality, Nepal, 2025

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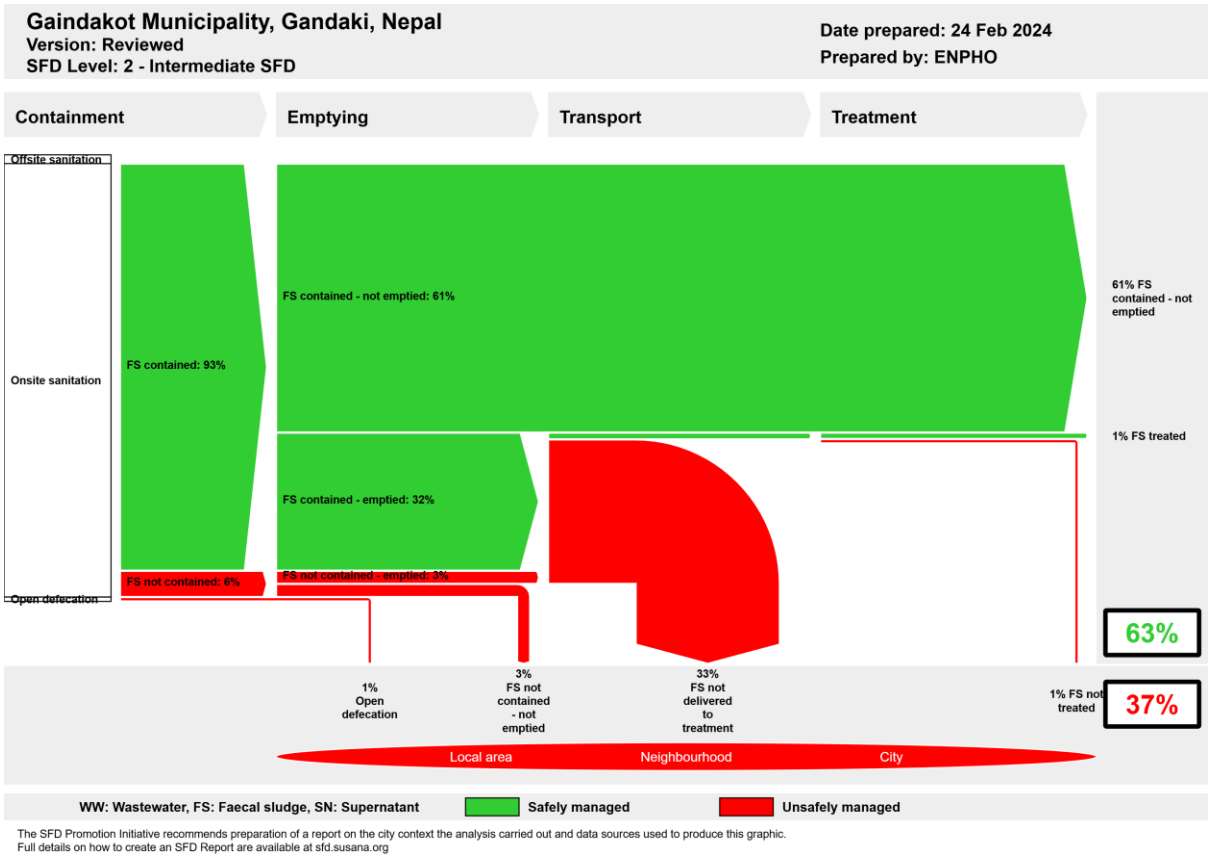
1. The SFD Graphic



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

2. Diagram information

SFD Level:

This SFD is a level 2 - Intermediate report.

Produced by:

Environment and Public Health Organization (ENPHO).

Collaborating partners:

Gaindakot Municipality

Municipal Association of Nepal (MuAN)

United Cities and Local Governments Asia-Pacific (UCLG ASPAC)

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3. General city information

Gaindakot Municipality, located in Nawalpur (Bardaghat Susta East) district, Gandaki Province, Nepal was formed in 2014 by merging Mukundapur, Amarapuri, and Gaindakot Village Development Committees VDCs, which was further expanded by incorporating Ratanpur VDC. The municipality encompasses 18 political wards across 159.93 square kilometres, with a population of 79,349 individuals residing in 20,191 households.

The annual growth rate of the municipality is 2.9%. The subtropical climate, characterized by hot summers exceeding 30°C and monsoon seasons with heavy rainfall, shapes Gaindakot's weather patterns.

The municipality's diverse topography ranges from the rugged foothills of the Mahabharat Range to the fertile plains of the Terai region. It is positioned 562 metres above sea level.

4. Service outcomes

This section provides a quick summary of the various sanitation technologies used across the municipality's sanitation value chain. All data in this section are from the household and institutional surveys conducted for this study (ENPHO, 2023). Despite municipality being declared as Open Defecation Free (ODF), still 1% of the total population are deprived from access to basic sanitation facilities and defecate in open places.

Containment:

Of the total population of municipality, 99% has access to improved sanitation relying on onsite sanitation systems. Notably, only 1% of households have well-designed septic tanks, with 8% opting for fully lined tanks, 2% biogas digesters, 14% using lined tanks with impermeable walls and open bottoms, and 73% adopting lined pits with semipermeable walls and open bottom constructed with pre-cast concrete rings, and unlined pit 1%.

All 35 surveyed institutions in the municipality have access to a safely managed sanitation system: 22% have fully lined tanks, 49% have lined tanks with impermeable walls and open bottoms, 29% have lined pits with semipermeable walls and open bottoms.

Emptying and transportation:

It's noteworthy that while 99% of households in Gaindakot have containment, nearly 38% have emptied them due to faecal sludge overflow. Single and twin pits are emptied more frequently, particularly within two years interval, leading to higher emptying rates compared to rectangular tanks. About 56.5% of the population opts for mechanical emptying, while 43.5% rely on manual methods. The municipality has four private desludging service providers with additional 2-3 desludging vehicles from Bharatpur Metropolitan City, Chitwan.

Treatment and Disposal:

A Faecal Sludge Treatment Plant (FSTP) was built by Mukundapur WSUC inside the Mukundapur community forest area, but it remains non-functional due to unresolved issues. Consequently, sludge collected from mechanical emptying is disposed of in confined land, on the land of service takers, nearby forests, and water bodies. Those practicing manual emptying dig new pits for disposal or apply it directly to farms. Some opt to dispose of it in water bodies or nearby stormwater drains, while others use it as compost.

Risk Assessment:

The survey findings indicated that 6% of households consumed groundwater, 91% had a private tap at home, and 2% depended on public taps. Additionally, 1% used spring source for drinking purpose. Key Informant Interviews (KIIs) highlighted Jaluke WSUC serves wards 1, 2, and 4 serving approximately 2010 households. Similarly, Namuna Shivanagar WSUC serves wards 6, 7, 8, and 9 covering about 2,000 households. Dhodeni WSUC operates in ward 3, while Gaindakot Pumping Scheme WSUC serves wards 4 and 5. Mukundapur WSUC covers wards 10, 11, 12, and 13 covering 4,082 households. Taranagar WSUC serves a smaller number of households, approximately 200-300 in ward 14, while Amarapuri WSUC covers wards 14, 15, 16, and 17 (KII-4 and 5, 2023).

People who used open-bottom tanks and handpumps within a horizontal distance of less than 25 feet (7.6 m) from the source of pollutants and a depth of up to 100 feet (30.4 m) are thought to be at significant risk of groundwater pollution. While households who have installed lined pits with semi permeable walls and open bottom are at high risk of ground water contamination as they pumped through handpump for water consumption.

The SFD graphic showed that FS generated by 63% of population are safely managed while 37% are unsafely managed. The safely managed Faecal Sludge (FS) generated by 61% of the population is temporary as this FS is only contained. So, once the containment gets filled and the FS from the containment is emptied, the percentage of unsafely managed FS would increase.

5. Service delivery context

Access to safe 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 need of people. Particularly, the National Sanitation and Hygiene Master Plan (NSHMP) 2011 has been 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. Currently, the municipality has solid waste management act but faecal sludge management is least prioritized.

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
Public Institutions at Provincial Government	Ministry of Energy, Water Resources and Water Supplky
Public Institutions at Local Government	Gaindakot Municipality, Jaluke WSUC, Namuna Shivanagar WSUC, Mukundapur WSUC
Non-governmental Organizations	Environment and Public Health Organization (ENPHO)
Private Sector	Public toilet operators, Private desludgers
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC

7. Credibility of data

The data were collected from proportionate stratification random sampling. Altogether, 583 households and 35 institutions were surveyed from 18 wards of the municipality. Primary data on emptying, transportation, and current sanitation practices in the municipality are validated from Key Informant Interviews (KIIs) with water service providers, public toilet caretaker and other different sanitation and environmental stakeholder. The overall data and findings were shared with the stakeholders of the municipality and validated through a sharing program on 28 February 2023.

8. Process of SFD development

Data on sanitation situation is collected through household and institutional surveys (ENPHO, 2023). 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 of municipality and private desludging service providers to understand the situation practices across the service chain. Types of sanitation technologies used in different locations were mapped using ARCGIS. To produce the SFD graphic, initially a relationship between sanitation technology used in questionnaire survey and SFD PI methodology was made. Then, data were 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:

- Gaindakot Municipality. (2023). Municipal Profile of Gaindakot Municipality.
- ENPHO. (2023). Sanitation Survey on Gaindakot Municipality. Gaindakot.
- MICS. (2020). Multiple Indicator Cluster Survey, 2019. Kathmandu, Nepal: Central Bureau of Statistics.
- NSO. (2022). National population and housing census 2021. Kathmandu: National Statisitics Office.

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Table of contents

List of tables

List of figures

Abbreviations

AEPC	Alternative Energy Promotion Centre
BMGF	Bill and Melinda Gates Foundation
DWSSM	Department of Water Supply and Sewerage Management
ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
GoN	Government of Nepal
HH	Household
IRF	Institutional and Regulatory Framework
KII	Key Informant Interview
KM	Kilometres
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
MuNASS-II	Municipalities Advocacy on Sanitation in South Asia – II
MoH	Ministry of Health
MoHP	Ministry of Health and Population
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NGO	Non-Governmental Organization
NPC	National Planning Commission
NSHMP	National Sanitation and Hygiene Master Plan
NSO	National Statistics Office
NUWSSSP	National Urban Water Supply and Sanitation Sector Policy
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
PPP	Public Private Partnership
RWSSNP	Rural Water Supply and Sanitation National Policy
SDP	Sector Development Plan
SFD	Shit Flow Diagram
SFD PI	Shit Flow Diagram Promotion Initiative
UCLG ASPAC	United Cities and Local Governments Asia Pacific
VDC	Village Development Committee
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSUC	Water Supply and User's Committee
WW	Wastewater

1 City context

Gaindakot is a municipality situated in Nawalpur (Bardaghat Susta East) district, Gandaki Province of Nepal. It was established in the year 2014 by merging existing Mukundapur, Amarapuri, and Gaindakot Village Development Committee (VDC) which was again expanded by merging Ratanpur VDC. It is situated on the shore of Narayani River in the lap of Maula Kalika temple having a great possibility of tourism development. The municipality is named Gaindakot as the municipality lies in north side of Chitwan national park and it is believed the Gainda (Rhinocerous) lived here before the human settlement. It comprises 18 political wards spread across 159.93 square kilometres of geographical area (Gaindakot Municipality, 2024).

Figure 1 shows the map of the municipality with its ward boundaries.

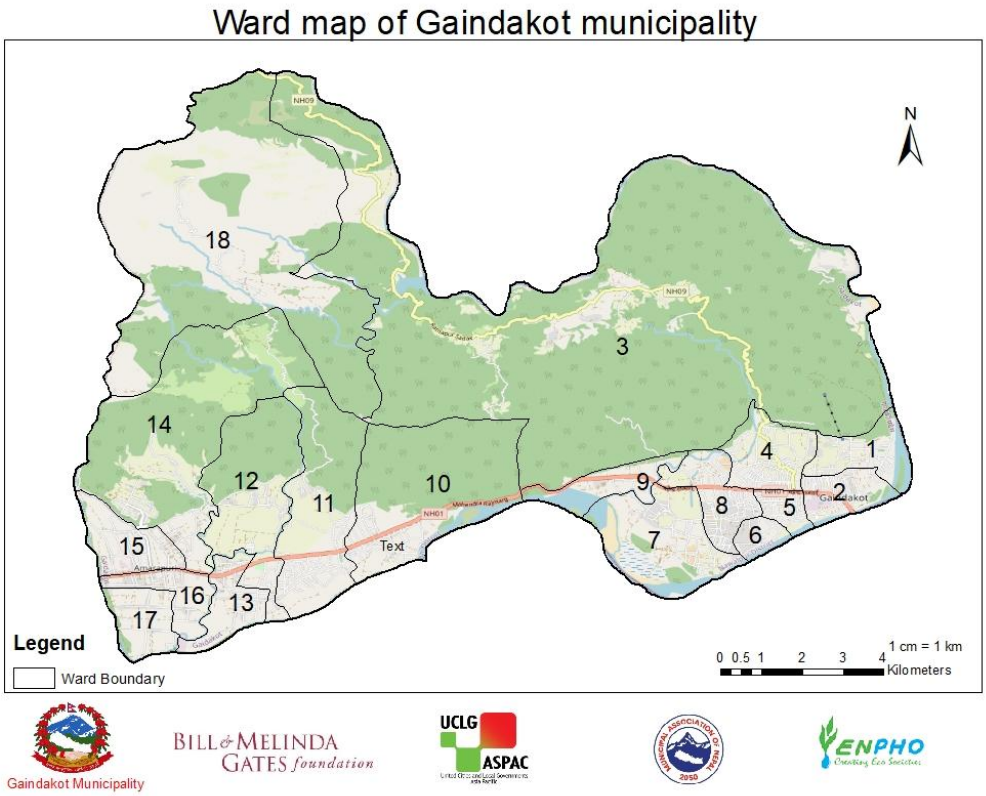

Figure 1: Map of Gaindakot Municipality with ward boundaries.

1.1 Population

The municipality's population, according to the 2021 National Population and Housing Census, stood at 79,349 individuals distributed across 20,191 households. The male and female populations were 37,929 (47.8%) and 41,420 (52.2%) respectively (NSO, 2021). The municipality has experienced an annual growth rate of 2.9% per annum, and a population density of 496/km (City Population, Gaindakot, 2021)

1.2 Climate

The municipality experiences a subtropical climate, typical of the Terai region in Nepal. As per Köppen climate type: Cwa: climate is monsoon-influenced humid subtropical climate (Koppen Climate type, 2023). Summers are characterized by hot and humid conditions, with temperatures often rising above 30 degrees celsius (86 degrees Fahrenheit). Monsoon season, spanning from June to September, brings heavy rainfall (Gaindakot Climate, 2023). August is the hottest month, with an average temperature of 25°C, while January is the coldest, averaging 11°C. July sees the highest rainfall at 476.2 mm on average, and April is the windiest month with an average speed of 14 km/h (Figure 2). The annual precipitation is 1579.0 mm (per year) (Weather time and date, 2023).

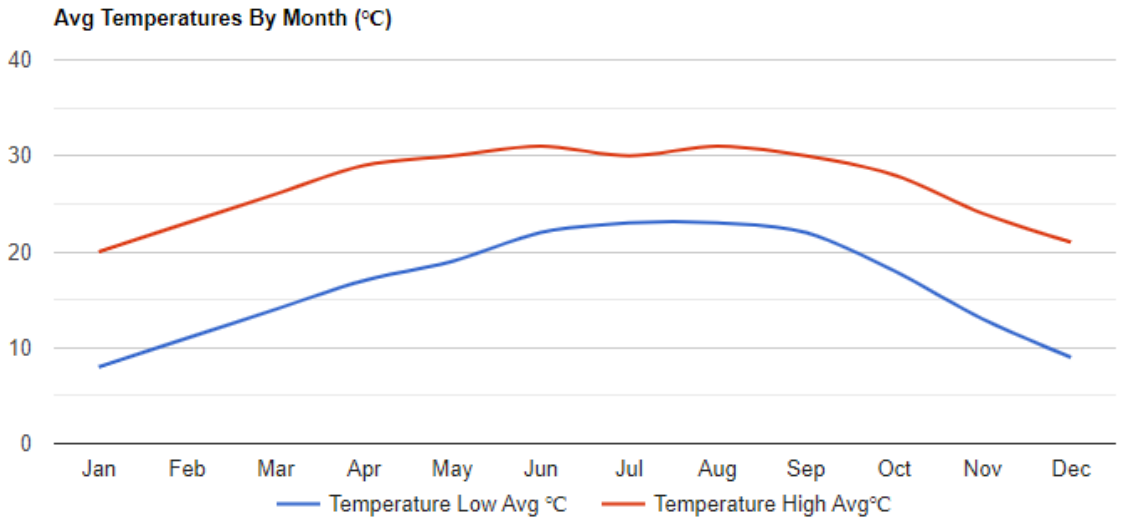

Figure 2: Average high and low temperature in Gaindakot Municipality. Source: (Weatherspark, 2023).

1.3 Topography

The topography of the municipality is diverse, encompassing both hilly terrain and fertile plains. It is situated at an elevation of 562 metres above sea level, and geographical coordinates range from 84° 24' 46" E longitude to 27° 42' 29" N latitude. It is located approximately 150 kilometres southwest of Kathmandu and 130 kilometres south of Pokhara. It shares borders with Chitwan District to the east and south, Devchuli Municipality and Bulingtar Rural Municipality to the west, and Tanahun District to the north (Gaindakot Municipality, 2024) .

2 Service Outcomes

2.1 Overview

The country has persistently worked towards achieving its current sanitation status for over three decades. On September 30, 2019, the Government of Nepal declared the nation free of open defecation, marking universal access to improved sanitation facilities nationwide (MoWS, 2019). The municipality has achieved Open Defecation Free (ODF) status and moves toward a new phase of sanitation management to address the challenges of treating fecal sludge collected from toilets (Gaindakot Municipality, 2024).

Despite the nationwide ODF declaration in 2019, the sanitation situation in many places remains unsatisfactory across the country. Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2023). To assess the sanitation status across the entire sanitation value chain, a household survey was conducted in 583 sampled households using a proportionate sampling in the 18 wards of municipality (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 reviews, Key Informant Interviews (KIIs) and a validation workshop are presented in this section.

2.1.1 Sanitation systems in household buildings

The National Population and Housing Census, 2021 indicates that 0.6% of the households in the municipality lacks access to basic sanitation facilities. Additionally, findings from this survey in 2023 revealed that 1% of the sampled households in municipality lacks access to improved sanitation facilities. An improved sanitation facility is defined as one that hygienically separates human excreta from human contact. Improved sanitation facilities include flush or pour flush to piped sewer systems, septic tanks, or pit latrines, ventilated improved pit latrines, pit latrines with slabs and composting toilets (MICS, 2019).

In the municipality, 99% of the population has access to improved sanitation facilities all relying on onsite sanitation technology. Any sanitation technology or system involving the collection and storage of excreta (referred to as faecal sludge) on the plot where it is generated is known as onsite sanitation (Susana, 2018). Only 1% of households have a well-designed septic tank for storing faecal sludge from toilets. Instead, 8% of households installed fully lined tanks with a single or double chamber, and 2% have built biogas. Twin pits are installed by 10% of households, while single offset pits are adopted by 63% of households who use pre-cast concrete rings to assemble the pits. Additionally, 14% of households have constructed lined tanks with impermeable walls and an open bottom, and 1% installed unlined pit.

Table 1 illustrates the various types of onsite sanitation technologies used in the municipality and the corresponding proportion of households utilizing each.

Table 1: Sanitation system showing open defecation, and different onsite sanitation technologies installed at households in Gaindakot municipality (ENPHO, 2023).

Types of containment	Construction material used in the wall of the containment	Construction material used in the bottom of the containment	Number of Chambers	Number of containments	%	Recategorized as SFD	%
Biogas digester	NA	NA	NA	NA	2%	Fully lined tank	10%
Fully lined tank	Cemented brick/stone walls or concrete walls	PCC or plaster	One or two	NA	8%		
Septic tank	Cemented brick/stone walls or concrete walls	PCC or plaster	Two or more than two	NA	1%	Septic tank	1%
Lined tank with impermeable walls and open bottom	Cemented brick/stone walls or concrete walls	Soiling or nothing	One or two or more than two	NA	14%	Lined tank with impermeable walls and open bottom	14%
Single pit	Concrete rings in piled up form	Soiling or nothing	NA	One	63%	Lined pit with semipermeable walls and bottom	73%
Twin pits	Concrete rings in piled up form	Soiling or nothing	NA	Two	10%		
Unlined pit	Mud mortar brick/stone wall, No lining, Dry stone wall	Soiling or nothing	NA	NA	1%	Unlined pit	1%
Open defecation	NA	NA	NA	NA	1%	Open defecation	1%
						Total	**100%**

Septic tank: A septic tank is a well-sealed and waterproof rectangular chamber with an inlet and outlet, featuring two or more chambers for better storage and stabilization of faecal sludge (FS). This properly sealed technology discharges effluent into a soak pit (Susana, 2018) . A well-maintained septic tank efficiently handles wastewater, reducing environmental pollution and safeguarding public health. In Gaindakot Municipality, only a minimal fraction of the population (1%) has installed a properly designed septic tank in their homes.

Fully lined tank: A fully lined tank is a rectangular tank with impermeable walls and a base, engineered to prevent leakage or seepage of faecal sludge into the surrounding environment. This design ensures the safe storage of faecal sludge, protecting against groundwater contamination (Linda Strande, 2014). In the municipality, 8% of households have constructed fully lined tanks. These types of containment are generally built in different households near the highway road.

Biogas: A biogas digester, an effective energy conversion technology, treats household-generated faecal sludge through anaerobic digestion. This process reduces sludge size,

eliminates harmful pathogens, and yields biogas and nutrient-rich slurry, biologically stable to use as a soil conditioner (Linda Strande, 2014). The Alternative Energy Promotion Centre (AEPC) has promoted biogas technology in 77 districts of Nepal, contributing to improved health and sanitation (AEPC, 2018). In the municipality, 2% of households have biogas digesters. When creating a SFD graphic, biogas is reclassified as SFD containment, considering it as a fully lined tank. Figure 3 is the biogas digester as seen in one of the households of Gaindakot Municipality.

Figure 3: Biogas in households of Gaindakot Municipality.

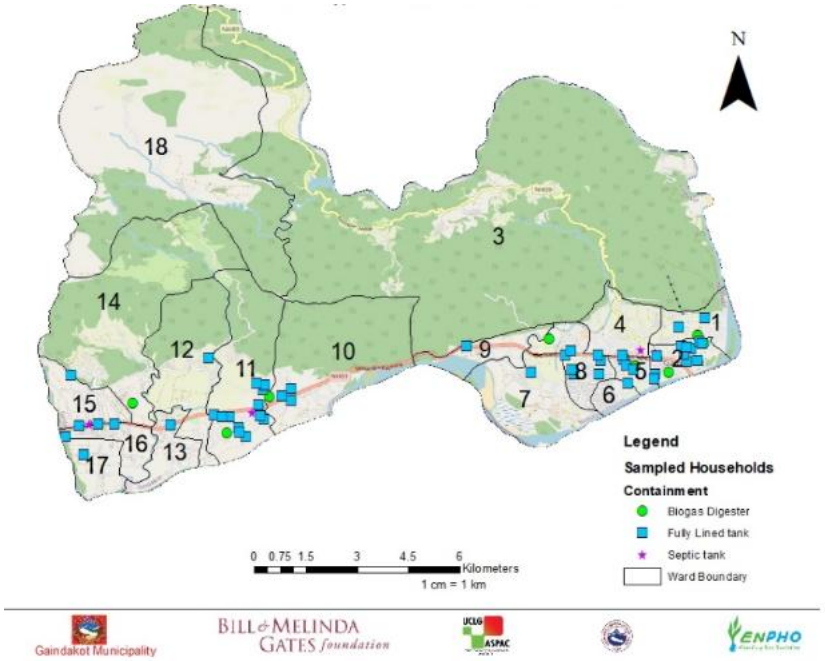

Figure 4: GIS map highlighting the location of different safe containments built within municipality.

Twin pits: Twin pits consist of two properly constructed and well-maintained pits with semi-permeable, honeycombed lined walls and an open permeable base designed for infiltration, ensuring structural integrity, and preventing contamination. These pits effectively treat faecal sludge when there is no exfiltration of water. (Saxena & Den, 2022) The two sets of pits are used alternately to store blackwater, with one pit in use while the other undergoes natural decomposition. These pits are either dug or made by assembling precast concrete rings at a minimum horizontal distance of 1.2m connected through a diversion box. However, many twin pits installed by households do not adhere to the design (Figure 5). 10% have installed twin pits in their household.

Figure 5: Twin pits installed at the household level.

Single pit: It is a properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open permeable base facilitating infiltration (Susana, 2018). Unlike fully lined tanks, single pits lack a specifically designed outlet for effluent, allowing percolation into the soil. In the municipality, 63% of households have built single pits (Figure 6). These containments were present in almost every ward, with very few in ward 18 which is the hilly region of the municipality. Figure 6 depicts a single pit, one with lid and vent pipe (left image) and another without a lid (right image). Figure 7 shows a GIS map of the lined pit with impermeable walls and open bottom built in different wards of municipality. When creating a SFD graphic, single pit and twin pit are reclassified as SFD containment, considering it as a lined pit with semipermeable walls and open bottom.

Figure 6: Pictures of a single pit in different households of the municipality.

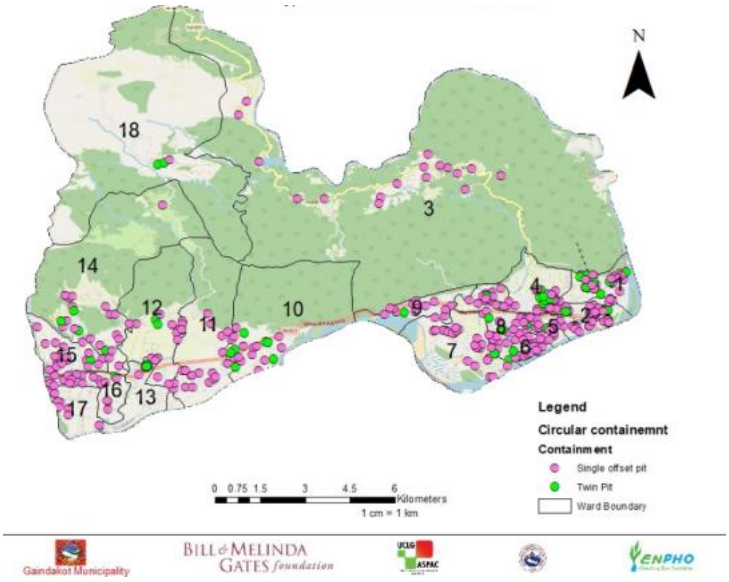

Figure 7 : GIS map highlighting the location of different lined pit built within municipality.

Lined tank with impermeable walls and open bottom: This rectangular onsite technology involves constructing tanks with impermeable walls and a permeable base, allowing the infiltration of effluents that could potentially contaminate groundwater (Peal, et al., 2020). In the municipality, 14% of households have installed this type of containment.

Unlined Pit: An unlined pit is a pit appropriately designed, constructed, and maintained, featuring permeable walls and a base for liquid infiltration. However, it poses a concern as the walls are made of materials like mud mortar stone/brick or dry stone, and the base with soiling or nothing, making it permeable. This directly increases the risk of groundwater contamination on open bottom containments. Only a small proportion of households in the municipality (1%) used unlined pits, mostly in the hilly region of the municipality. Figure 8 shows a map locating different types of containment in Gaindakot Municipality.

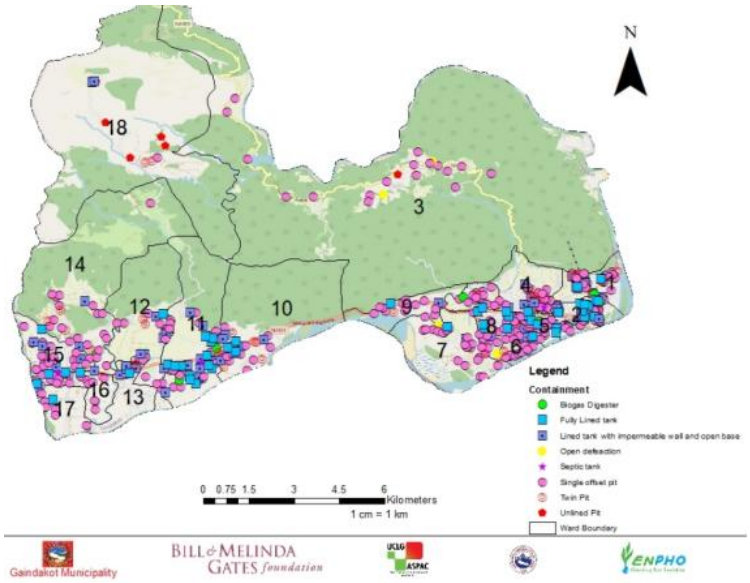

Figure 8: GIS map locating different types of containment in Gaindakot Municipality.

2.1.2 Sanitation system in Institutional Buildings

All the surveyed 37 institutions had access to a safely managed sanitation system in the municipality. Different educational institutes, government and non-government offices, health care centres and hotels with lodging facilities were surveyed.

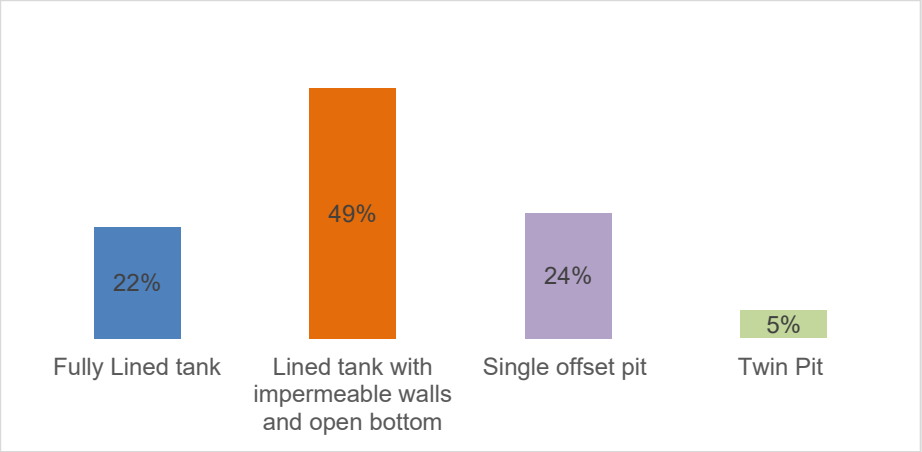

Figure 9: Containments used in institutional buildings.

The proportion of different types of sanitation technologies used in institutions are shown in Figure 9. The findings showed that 22% institutional buildings had made fully lined tanks, 49% had lined tanks with impermeable walls and open bottom, 24% had single offset pit and 5% twin pits installed.

2.1.3 Public toilets

Based on the Key Informant Interviews (KIIs), approximately 9-10 public toilets have been constructed in various areas. Some of these have been built by the municipality, while others have been funded by different organizations. These facilities are strategically placed in locations where there is an increased flow of people, and along the highway roads. During the study period, we visited six of these public toilets, and below are brief descriptions of each:

Public toilet near Maulakalika temple area

A public toilet has been constructed at the entrance gate of the Maulakalika temple by the Maulakalika Community Forest Users Committee. It has separate facilities for males and females, with a service charge taken for usage. The toilet's physical structure is simple and constructed from cement and brick, and each section contains three squatting pans. The toilet is connected to a rectangular holding tank. Primarily, it serves visitors and devotees visiting the temple. According to local sources, there is no caretaker assigned to look after the toilet sanitation (Figure 10).

Figure 10: Public toilet built infront of gate of Maulakalika temple.

Public Toilet in Thumsi

There are two public toilets in ward 9, one is constructed near to the magic park which was mainly used during Haatiya Bazaar when there is increased flow of people. The toilet was not in a fully functional state and the cleanliness was totally neglected. Although there were 2 separate sections for male and female, only one section was in use. The sanitary condition of the toilet was very poor, and no caretaker was assigned for maintaining cleanliness and hygiene. The following are some pictures demonstrating the situation of toilet (Figure 11).

Figure 11: Public toilet built in Thumsi, ward 9.

There is another public toilet constructed near to highway road in Thumsi, ward 9 (Figure 12) where there is separate compartment for male and female. The facility was well-maintained, with all necessary amenities such as soap, water, proper ventilation, and dustbins provided. The toilet was connected to two containments (twin pits, and holding tank), which are emptied using both manual and mechanical methods: manually by traditional sanitation workers when available, and mechanically when needed.

Figure 12: Public toilet built in Thumsi, ward 9.

Public toilet in Sisne Dada, ward 10

At Sisne Dada, there's a public toilet managed by an elderly couple. The toilet has separate compartments for men and women and was kept in well-maintained condition. There's a 1000-litre water tank for water supply, and the toilet was connected to a rectangular holding tank. The holding tank needs frequent emptying. Surprisingly, the elderly man who manages the toilet also works as a traditional manual laborer. He manually empties the containments and disposes of the faecal sludge, either in farmland or water bodies. Figure 13 illustrates the public toilet on the left and its connection to the containment on the right.

Figure 13: Public toilet built in sisne dada, ward 10.

Two public toilets have been built in different locations: one in front of the ward-10 office and another by the Namuna Shivnagar WSUC (Figure 14). The toilets appeared to be in good sanitary condition, but detailed information could not be gathered as there were no caretakers around.

Figure 14: Public toilet built in ward 10, Bhedabari.

2.1.4 Emptying and transportation services of containment

Emptying of containment

Emptying is one of the major components of the sanitation service chain. Regular emptying of the containment prevents sludge overflow and blockages (Strande, 2014). It ensures the proper functioning of containment basically for the septic tank which functioned well until the volume of sludge is one-third of the total volume of the tank. Interestingly, of the total 99% of households with containment, 37.7% have emptied their containment due to faecal sludge overflow.

Single offset pits and twin pits are emptied more frequently in intervals of less than 2 years. Given the easier accessibility of concrete circular rings, more households install ring pits, leading to a higher rate of its emptying compared to rectangular tanks (KII-2, 2023). The data indicated that about 56.5% of the population opts for mechanical emptying and 43.5% of the household relied on manual emptying.

Transportation services

There are four private desludging service providers operating within the municipality. Additionally, 2-3 desludging vehicles come from the neighboring municipality, Bharatpur Metropolitan City, Chitwan, to offer on-demand services. Detailed information of the service providers serving within Gaindakot municipality is provided in the following Table 2 and Figure 15 (KII-2, 2023).

Table 2: Details on private desluging services in Gaindakot Municipality.

Service Provider:	Jayadev Bhusal Sewa	Unnamed	Shree Gandaki Amrit Dhara Pasupalan Krisak Samhua	All Nepal Septic tank safai, Bhedabari-10
Service started	2-3 years	1 year	1 year	3 years
Capacity	4,000 litres	4,000 litres	3,000 litres	6,500 litres
Cost per trip	Rectangular containment: Rs. 3,500-4,000 (USD 24-28) For ring tank depends.	Rectangular containment: Rs. 3500-5,000 (USD 24-35), Ring tank: Rs. 1,500-2,000 (USD 10-14)	Rectangular containment: Rs. 2,500-3,000 (USD 17-21)	Rectangular containment: Rs. 3,500-4,000 (USD 24-28)
Average no. of trips per month	20-30	10-15	12-16	12-16
Disposal practice	On Farmland of service users on demand or land taken on lease for disposal purpose			
Number of vehicles	1	1	1	1

Figure 15: Private desludging vehicles operating in the Gaindakot Municipality.

2.1.5 Treatment and disposal/reuse of faecal sludge

During the study period it was explored that there was one Faecal Sludge Treatment Plant (FSTP) constructed by Mukundapur WSUC inside the Mukundapur community forest premises, but it remains non-functional due to unresolved issues. Consequently, the collected sludge from mechanical emptying is either applied on farmland on farmers' request or disposed of in confined land areas, or water bodies. Those who manually emptied practiced digging new pits and dumping them and some applied it directly to farms. Some disposed of it in water bodies or nearby stormwater drains, while others use it as compost, though this method cannot be considered safe. It possesses direct risks to the environment and public health (Figure 16).

Figure 16: Treatment plant constructed inside community forest.

2.1.6 Risk assessment of groundwater pollution from open bottom containment

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

a. Sources of Drinking Water

As per the findings of this survey, 6% of households consumed groundwater as their main source of drinking water, 91% had private tap in their home and 2% used public taps, and 1% depended on spring source. Key informant interviews (KII-3, 2023; KII-4, 2023) findings indicated that there are different WSUC operating in different wards of the municipality. As per KII, Jaluke WSUC has been serving ward 1, 2 and 4 serving almost 2010 households. Likewise, there is 1 Namuna Shivanagar WSUC that is serving on ward 6,7,8 and 9 serving about 2,000 households, Dhodeni WSUC serving in ward 3, Gaindakot pumping scheme WSUC covering ward 4 and 5, Mukundapur WSUC serving in ward 10, 11, 12 and 13 covering 4,082 households, Taranagar WSUC in ward 14 covering small number of households about 200-300 HH, Amarapuri WSUC covering ward 14,15,16, and 17 (KII-4 and 5, 2023).

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

The term aquifer pollution vulnerability represents 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, lined pits, and unlined 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 World Health Organization (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 (100 feet) in sandy loam soil. People using open bottom tanks and consuming water from the handpumps with the depth up to 100 feet (30.4 m) and horizontal distance of the pump within 25 feet (7.6 m) from the source of pollutants are assumed at significant risk to groundwater pollution.

Figure 17 illustrates the depth of hand pumps and their horizontal distance from lined pits with semi-permeable walls and an open bottom (twin pits and single offset pits). In total, 73% of households have installed lined pits with semi-permeable walls and an open bottom. Among these, 8% of households use groundwater as a source of drinking water, and it was found that 81% of these households are at high risk of groundwater contamination due to the water being pumped through hand pumps. Thus, the population with lined pits having semi-permeable walls and an open bottom, without outlet or overflow, and presenting a significant risk of groundwater pollution (T2A5C10) is 5% (calculated as 73% x 81% = 5%).

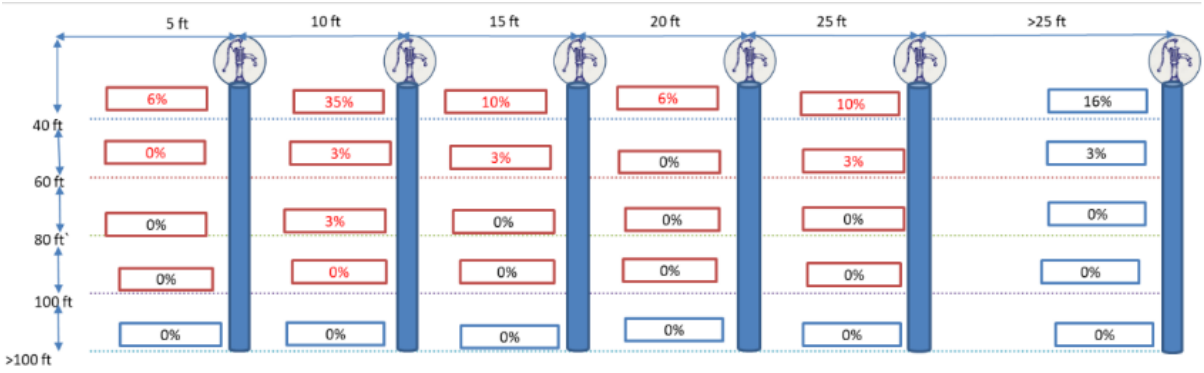

Figure 17: Depth of hand pumps and lateral spacing of it with containment types: lined pit with semi-permeable walls and open bottom.

2.2 SFD selection grid

The SFD grid consists of different containment technology used in list A and its connection in list B. Sanitation technologies selected in the SFD grid in Gaindakot Municipality are shown in Figure 18. The vertical column on the left side of the SFD selection grid has a list of technologies to which the toilet is connected to, and households without toilet resorting to open defecation. Similarly, horizontal row at the top of the selection grid shows options for connection made for the outlet or overflow of discharge from the toilet.

As per the containment definition by Shit Flow Diagram Promotive Initiative (SFD PI), various containments are categorized into different SFD categories. For example, biogas is reclassified as a fully lined tank, given that the walls and bottom of the biogas structure are water-sealed and share similar features with a fully lined tank. Similarly, single pits and twin pits, constructed by assembling pre-cast concrete rings on top of each other, are collectively referred to as lined pits with semi-permeable walls and an open bottom. However, fully lined tanks, unlined tanks, lined tanks with impermeable walls and open bottom and septic tanks do not require reclassification and remain unchanged. After the reclassification of these containments, the types of sanitation technologies and their connections are chosen in the SFD selection grid, as illustrated in Figure 18.

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 T1A2C5					
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		Significant risk of GW pollution T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A5C10
Unlined pit										T1A5C10 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 18: SFD selection grid for Gaindakot Municipality.

A brief explanation of terms used to indicate different frames selected in the SFD selection grid is explained in Table 3.

Table 3: Explanation of terms used to indicate frame selected in the SFD selection grid.

T1A2C5	This is a correctly designed, properly constructed, fully functioning septic tank with a supernatant/effluent outlet connected to a correctly designed, properly constructed, fully functioning soak pit. However, it's important to note that the supernatant/effluent flowing from the tank is only partially treated and remains hazardous, but since it is captured in the soak pit, all the excreta in this system is considered contained.
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.
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. However, 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.
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	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.
T2A5C10	A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained.
T1B11 C7 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.

2.3 SFD matrix

2.3.1 Proportion of faecal sludge from types of sanitation technologies

In the second step of developing SFD graphics, the proportion of Faecal Sludge (FS) in each type of sanitation technology is calculated. Following detailed instructions in SFD PI, a default "100%" value is applied when onsite containers are connected to soak pits, water bodies, or open ground, representing the entire contents as faecal sludge, with a portion being periodically emptied. For onsite containers connected to a sewer network or open drains, a "50%" value is used, indicating that half the contents are modelled as faecal sludge, with periodic emptying. The remaining fraction contains faecal sludge in the container and infiltrates (for open-bottomed tanks), while the other half is modelled as supernatant discharging into the sewer network or open drains. The formula for calculating FS proportions is provided below:

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

The calculated FS proportion in each type of sanitation technologies are:

i. The proportion of FS in septic tanks is 100% as the effluent is connected to soak pit.

ii. The proportion of FS in fully lined tanks is calculated as 100% as there are no connections made to an open drain; the tank maintains a 100% FS proportion.

iii. The FS proportion from lined tanks with open bottoms and all types of pits is 100%, as there are no connections of lined tanks with impermeable walls and open bottoms to open drains.

After determining the proportion of FS in each type of sanitation technology, the corresponding population proportions from the selected technologies in the SFD selection grid are set. Figure 19 illustrates the SFD matrix of the municipality.

Gaindakot, Gandaki, Nepal, 24 Feb 2024. SFD Level: 2 - Intermediate SFD
Population: 79349
Proportion of tanks: septic tanks: 100%, fully lined tanks: 100%, lined, open bottom tanks: 1

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
T1A2C5 Septic tank connected to soak pit	1.0	23.0	0.0	0.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	10.0	29.0	53.0	95.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	13.0	6.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0	15.0	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	68.0	40.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	1.0	45.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	1.0			
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	5.0	57.0	0.0	0.0

Figure 19: SFD matrix of Gaindakot Municipality.

2.3.2 Proportion of faecal sludge emptied (F3)

The column labelled "Population (Pop)" in Figure 19 displays the proportion of contents for each type of onsite container (septic tanks, fully lined tanks (sealed), lined tanks with impermeable walls and open bottom, and lined pits with impermeable walls and open bottom). The variable F3 represents the proportion of contents in each type of onsite container that undergoes emptying at least once after construction. The calculation of the proportion of faecal sludge emptied (F3) is based on the percentage of containment emptied (ENPHO, 2023) and the amount of faecal sludge (FS) emptied during the process (KII-2, 2023).

According to findings from household surveys and Key Informant Interviews (KII-2, 2023), approximately 90% of the FS in the containment is emptied. This is attributed to most containments getting filled due to groundwater intrusion, resulting in a high liquid content that can be easily pumped out by desludging vehicles. However, an average of 10% of the FS in the containment, characterized by high thickness and poor water solubility, remains un-removed during emptying, as reported from KII-2 with desludger information. The calculation of the emptied proportion of FS is adjusted accordingly as follows (Table 4).

$$Actual\ Proportion\ of\ FS\ emptied\ (F3) = percentage\ of\ containment\ emptied \times proportion\ of\ FS\ removed\ during\ emptying$$

Table 4: Sanitation technologies and proportion of emptied faecal sludge (ENPHO, 2023[(1)]; KII_2, 2023[(2)]).

SN	Sanitation Technologies	SFD Reference Variable	Percentage of Emptied Containment (1)	Emptied Proportion of FS during emptying (2)	Actual Proportion of Emptied FS (F3)
1	Septic tank connected to soakpit (Low Risk)	T1A2C5	25%	90%	23%
2	Fully lined tank (sealed), no outlet or overflow	T1A3C10	32%	90%	29%
3	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	7%	90%	6%
4	Lined tank with impermeable walls and open bottom, connected to an open ground	T1A4C8	17%	90%	15%
5	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	45%	90%	40%
6	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (High Risk)	T2A5C10	63%	90%	57%
7	Unlined Pit, no outlet or overflow	T1A6C10	50%	90%	45%

2.3.3 Proportion of FS emptied which is delivered to Treatment Plant and treated (F4 and F5)

The municipality has a treatment plant, but it is not functional till date. Operational biogas classified under fully lined tank are considered treated (F5). In the provided SFD matrix, 18% of fully lined tanks, including 10% with functioning household biogas digesters, are considered delivered to treatment (F4=53%) with 95% efficiency (F5=95%). Since the treatment plant is not functional, none of the sludge is delivered to treatment plant or treated, F4=0%, F5=0% for other emptied containments.

2.4 Summary of assumptions

Onsite Sanitation Systems:

- ✓ The proportion of FS in septic tanks was set to 100%, 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, as per the guidance provided by SuSanA.
- ✓ Variables F3, F4 and F5 for all onsite sanitation systems were derived from the household survey and cross-checked with KIIs conducted.
- ✓ 29% of the emptied FS from fully lined tanks connected to no outlet or overflow (system T1A3C10) is delivered to treatment and treated in the FSTP (F4 = 53% and F5 = 95%).
- ✓ None of the emptied FS were delivered to treatment and treated in the FSTP (F4 = 0% and F5 = 0%) for other containments except biogas system.

2.5 SFD Graphic

Figure 20 presents diagrammatic representations of the excreta flow within Gaindakot Municipality. The color scheme signifies the nature of sanitation systems, with green indicating safely managed systems and red denoting unsafely managed ones. The SFD graphic reveals that FS generated from 63% of the population is safely managed, represented by "Green" arrowheads, indicating FS stored in containment without significant risk to groundwater. Conversely, FS from 37% of the population is unmanaged, represented by "Red" arrowheads. This signifies FS not contained and openly dumped FS emptied from the containments, both considered unsafe. The SFD graphic illustrates four varied factors across the sanitation value chain, arranged from left to right.

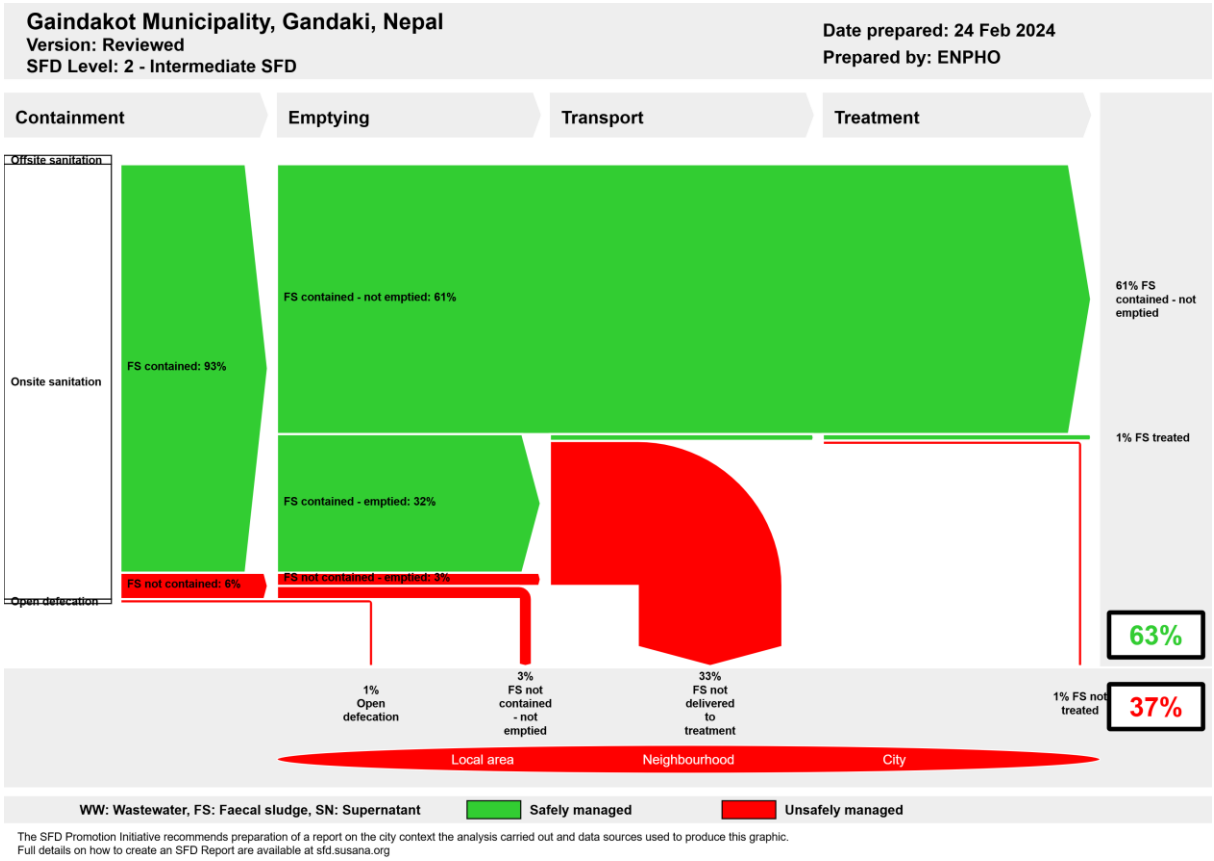

Figure 20: SFD graphics of Gaindakot Municipality.

2.5.1 Onsite sanitation

All 100% of the population in Gaindakot Municipality utilizes onsite sanitation technologies. Among them, FS generated by 93% of the population is appropriately stored in technically effective containment, as depicted by "FS contained" in the SFD graphic. FS from the remaining 6% of the population is stored in unsafe containment, represented as "FS not contained."

FS contained

The term 'FS contained' refers to faecal sludge within an onsite sanitation technology that ensures a safe level of protection from excreta, limiting pathogen transmission to the user or the public. These containment systems, such as tanks or pits, are correctly designed, properly constructed, fully functioning, and pose little to no risk of polluting groundwater used for drinking (Susana, 2018). FS is generated by 93% of the population.

The value of FS contained (93%) is derived from the summation of the percentage of the population using the following containment systems: septic tank connected to soak pit with 'low risk' to groundwater pollution (T1A2C5), fully lined tank without outlet or overflow (T1A3C10), lined tank with impermeable walls and open bottom without outlet or overflow (T1A4C10), and lined pit with semi-permeable walls and open bottom without outlet or overflow (T1A5C10), unlined pit, no outlet or overflow (T1A6C10).

FS not Contained

The term 'FS not contained' refers to faecal sludge within an onsite sanitation technology that does not ensure a safe level of protection from excreta, with a likely risk of pathogen transmission. These containment systems, such as tanks or pits, are incorrectly designed, poorly constructed, poorly functioning, and/or pose a 'significant' risk of polluting groundwater used for drinking (Susana, 2018). FS generated by 6% of the population is not contained.

The value of FS not contained (6%) is obtained from the summation of the percentage of the population using the following containment systems: lined tank with impermeable walls and open bottom connected to open ground (T1A4C8). Additionally, the FS collected in lined pits with semi-permeable walls and open bottoms, without outlet or overflow, poses a 'significant risk' to groundwater pollution (T2A5C10).

FS contained - not Emptied

It is faecal sludge that is contained within an onsite sanitation technology but not removed may persist within the container or infiltrate into the ground, depending on the type of sanitation technology in use (Susana, 2018).The value of 61% is obtained from the proportion of the population using sanitation systems where the FS is contained and has not emptied their containment. However, this 61% 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 as they fill up. The emptied FS remains safe depending upon the emptying mechanism and available treatment options/facilities.

FS contained - Emptied

It is faecal sludge which is removed from an onsite sanitation technology where it is safely contained and can be emptied, utilizing either mechanical or manual emptying equipment. The value of 32% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

FS not contained - Emptied

In this faecal sludge is removed from an onsite sanitation technology where it is not contained and can be emptied, utilizing either mechanical or manual emptying equipment. The value of 3% is obtained from the proportion of the population using sanitation systems where the FS is not contained and have emptied their containment.

FS not contained - not Emptied

It is faecal sludge that is not contained within onsite sanitation technology and not removed. It may persist within the container or infiltrate into the ground, depending on the type of sanitation technology in use. The value of 3% is obtained from the proportion of the population using sanitation systems where the FS is not contained and not emptied.

FS not delivered to treatment

The proportion of FS not delivered to treatment, i.e. 33%, is the summation of FS contained - emptied and FS not contained - emptied. Although there is a FSTP, there is still practice of manual emptying and those who manually emptied their containment, such FS are not

delivered to treatment plants. The emptied FS is disposed of untreated to farmlands. Therefore, this proportion of disposed FS possesses risk to local area and neighbourhood.

FS treated

The proportion of FS delivered to treatment is 1% which comes from the FS contained – emptied that mainly comes from biogas digester which is considered treated.

2.5.2 Open defecation

It refers to the practice where people defecate in the open spaces, mainly outdoors rather than using a toilet or latrine. It is a significant public health concern as it can lead to contamination of water sources, and spread diseases such as diarrheal illnesses, cholera, typhoid, and parasitic infections. Despite municipality having ODF status, 1% of population still defecate openly.

3 Service delivery context description

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 the 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 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 sewage and wastewater. It defines sewage and wastewater management as construction of sewer networks and treatment plants to preserve sources of water. It is 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 septic tanks 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 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 authority. 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 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. Policy

Historically, the National Sanitation Policy (1994) was the guideline for the planning and implementation of sanitation programs. The policy had promoted sanitation issues together with issues on water supply in rural communities. Also, Rural Water Supply and Sanitation National Policy (RWSSNP) 2004, has set a new target to provide safe, reliable, and affordable water supply with basic sanitation facilities. The policy focused on delivering quality services on water and sanitation to the marginalized and vulnerable groups. Participatory approach, community leadership project development, optimization of local resources and installation of locally appropriate technologies were major principles in the policy. (DWSSM, 2004) However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery. (DWSSM, 2009) Thus, the National Urban Water Supply and Sanitation Sector Policy (NUWSSSP) was formulated and enforced in 2009. It focused on achieving coherent, consistent, and uniform approaches of development in urban areas with the involvement of different agencies and institutions. Both these policies were limited to addressing emerging issues and challenges in the rural and urban areas. 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 innovative 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 the 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 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 the 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. Nepal was declared ODF nation on September 23, 2019, (MoWS, 2019) however, the target of 90% households with toilets connected to sewer system or proper FSM is yet to be achieved. The municipality hasn't made a specific policy on faecal sludge management. However, the environment and waste management section are actively working on activities related to waste management.

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 Government

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 policies, plans and programs. It supports, facilitates, and coordinates with federal, provincial, and local government for developing policy plans and Figure 21.

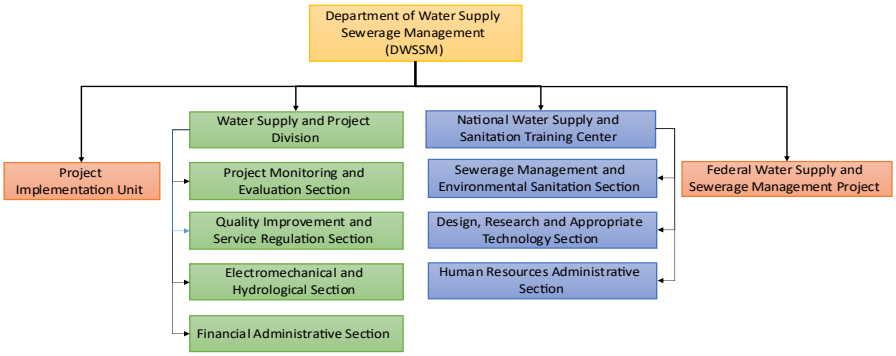

Figure 21: Organizational structure of Department of Water Supply and Sewerage Management (DWSSM).

At Provincial Government

Ministry of Energy, Water Resources and Water supply: Ministry of Energy, Water Resources and Water supply of provincial government in Gandaki 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 Drinking Water, Irrigation and Energy Development Office (DWIEDO). DWIEDO 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 500 to 1,000 in Himalayan region.

At Local Government

Municipal council: Figure 22 illustrates the organizational structure of the municipality. Within this structure, there is an environment and waste management section responsible for sanitation-related work. However, the focus is primarily on waste management, with less attention given to faecal sludge management. Although there is a waste management act in place, there are no specific policies or regulations regarding faecal sludge management. Out of the total budget of USD7,928,439.60 (1 arba 6 crore) only USD59,837 (80 lakhs) has been allocated for waste management (KII-5, 2023). Following is the organogram taken from Gaindakot municipality (Gaindakot Municipality, 2023).

Figure 22: Organogram of Gaindakot Municipality.

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 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).

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 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 grey water	✓	✓	✓
6	Small-bore sewer collection for toilet and septic tank effluent, low-cost treatment, and disposal		✓	
7	Sanitary sewers for wastewater collection, transmission, non-conventional treatment, and disposal	✓		
8	Sanitary sewers for wastewater collection, the transmission of conventional treatment and disposal	✓		
9	Limited solid waste collection and safe disposal	✓	✓	✓

4 Stakeholder Engagement

4.1 Key Informant Interviews (KIIs)

During the study, Key Informant Interviews (KIIs) were conducted to gather insights from key stakeholders working in the sanitation sector of Gaindakot Municipality. The objective was to obtain a comprehensive understanding of current sanitation service practices. Mr. Madan Bhakta Adhikari, Mayor of Gaindakot municipality, was interviewed specifically regarding sanitation service practices, covering technical, institutional, and financial aspects. Additional interviews were conducted with Mr. Shankar Prasad Poudel, focal person from environment and waste management section, different members of Water Sanitation Users Committee (WSUC), and relevant stakeholders.

Furthermore, different private desludgers were interviewed to gain insights into FS emptying and disposal practices. The discussion covered topics such as types of containments, containment volumes, and the frequency of emptying. Similarly, caretakers from public toilets were interviewed to understand the status of public toilets in the municipality (Table 6).

Table 6: List of Key informant interviewed personnel.

S.N.	Name	Designation	Organization/ Company	Purpose of KII	Date
1.	Madan Bhakta Adhikari	Mayor	Gaindakot Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development	13 October, 2023
2.	Rajkumar Pariyar, Khem Raj Sapkota, Ramkanta Rijal, Mahendra Bhakta Adhikari, Kiran Bhusal (KII-2)	Private Desludgers	Gaindakot Municipality	Emptying practices, finances, requirement, disposal and treatment	15 October, 2023
3.	Jagannath Poudel (KII-4)	Chairperson	Jaluke WSUC	Water Supply Services	13 October, 2023
4.	Jhalak Raj Sharma (KII-3)	Staff	Namuna Shivanagar WSUC	Water supply services	14 October, 2023
5.	Shankar Kandel (KII-5)	Environment and waste management Section	Gaindakot Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development	12 October, 2023
6.	Belmaya Pariyar, Birbahadur Pandey, Narayan Pathak (KII-6)	Caretaker	Public toilet, Gaindakot	Sanitation status of toilet	15 October, 2023

4.2 Household survey

A household survey was carried out in all 18 wards of the municipality, with local enumerators selected and mobilized by the municipality. These enumerators received a two-day orientation on sanitation and survey methods. Using the mobile application "KOBOCOLLECT," the household survey was conducted after this orientation. During field visits, a member of the SFD team accompanied enumerators to households. Mr. Madan Bhakta Adhikari, the mayor of the municipality, provided encouragement and motivation to the enumerators before the survey. The pictures below depict the formal orientation session attended by the Mayor, Deputy Mayor, and a facilitator from the municipality (Figure 23).


Figure 23: Glimpses of SFD orientation to enumerators in municipal hall.

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 $n_0 = \frac{z^2pq}{e^2}$ and its finite population correction for the proportion $n = n_o / (1 + (n_o - 1)/N)$.

Z	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 583 households were sampled from 20,191 households distributed in 18 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 24.

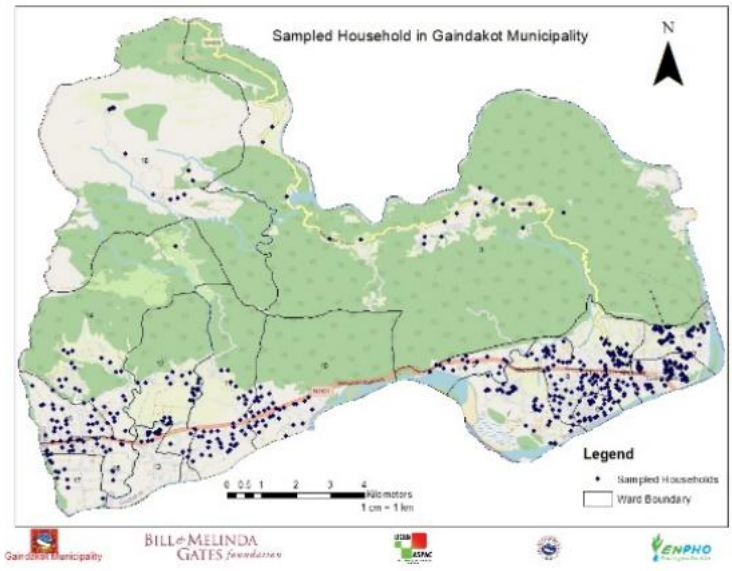

Figure 24: Distribution of sampling points in different wards of Gaindakot Municipality.

4.3 Direct observation

Various sanitation technologies in the households in all the wards were observed and visual references were kept. Additionally, private desludging vehicles for the transportation of faecal sludge were observed. Visits were conducted to different public toilets, and various Water and Sanitation User Committees (WSUCs) situated within the municipality and visual references were recorded during these visits.

4.4 Sharing and validation of data

The Shit Flow Diagram Sharing and Validation workshop was conducted in the municipality to share the findings of the sanitation situation survey and receive the suggestion from municipal stakeholders. Altogether, 46 participants including the mayor, deputy mayor, CAO, ward chairpersons, and other members from municipal executive council, sectoral staffs, chairperson of different WSUC actively participated in the workshop and provided valuable suggestions (Figure 25). The list of participants with their designation is attached in Appendix 3.

Figure 25: Discussion on SFD by stakeholder of the municipality in validation sharing program.

5 Acknowledgements

We would like to acknowledge the organizations involved in the Municipalities Advocacy on Sanitation in South Asia – II (MuNASS-II) project for their collaboration and coordination, namely the United Cities and Local Governments Asia-Pacific (UCLG ASPAC) as the executing agency and the Municipal Association of Nepal (MuAN) as the implementing agency, for their coordination with the municipality.

We extend our sincere appreciation to the individuals who provided invaluable support and guidance during the study: Mr. Madan Bhakta Adhikari-Mayor, Ms. Shanti Koirala- Deputy Mayor of Gaindakot Municipality for continuous support in the study. We would also like to thank Mr. Liladhar Sharma, the planning section of the municipality and Mr. Shankar Kandel, from the environment and waste management section for facilitating the enumerators and continuous support throughout the study.

We would like to appreciate Dr. Roshan Raj Shrestha, Deputy Director of Bill and Melinda Gates Foundation (BMGF), Dr. Bernadia Irawati Tjandradewi, Secretary General of UCLG ASPAC. Similarly, we are very much obliged to Mr. Bhim Prasad Dhungana, President of MuAN and Co. President of UCLG ASPAC, and Mr. Kalanidhi Devkota, Executive Director of MuAN, Mr. Muskan Shrestha, Sanitation Advocacy Specialist, MuAN for their gracious support during the study.

Our heartfelt appreciation also goes to Ms. Bhawana Sharma, Executive Director, and Mr. Rajendra Shrestha, Program Director of Environment and Public Health Organization (ENPHO) for their tremendous support and guidance throughout the study. We are grateful to the entire ENPHO team for their gracious support, as well as the MuNASS-II team, without whom this study would not have been possible.

Finally, we extend our thanks to the enumerators: Balkumari Pulami, Santosh Bhattarai, Madhav Sapkota, Bhagwan Bhandari, Sarita Gaudel, Babita Hamal, Khem Prasad Magar, Rita Chalise, Sujan Kandel, Pujan Ghimire, Ashish Poudel, Balkrishna B.K, Mukti Kandel, Unish Thapa, Ambika Kharel, Hommaya Pariyar for their support during the survey.

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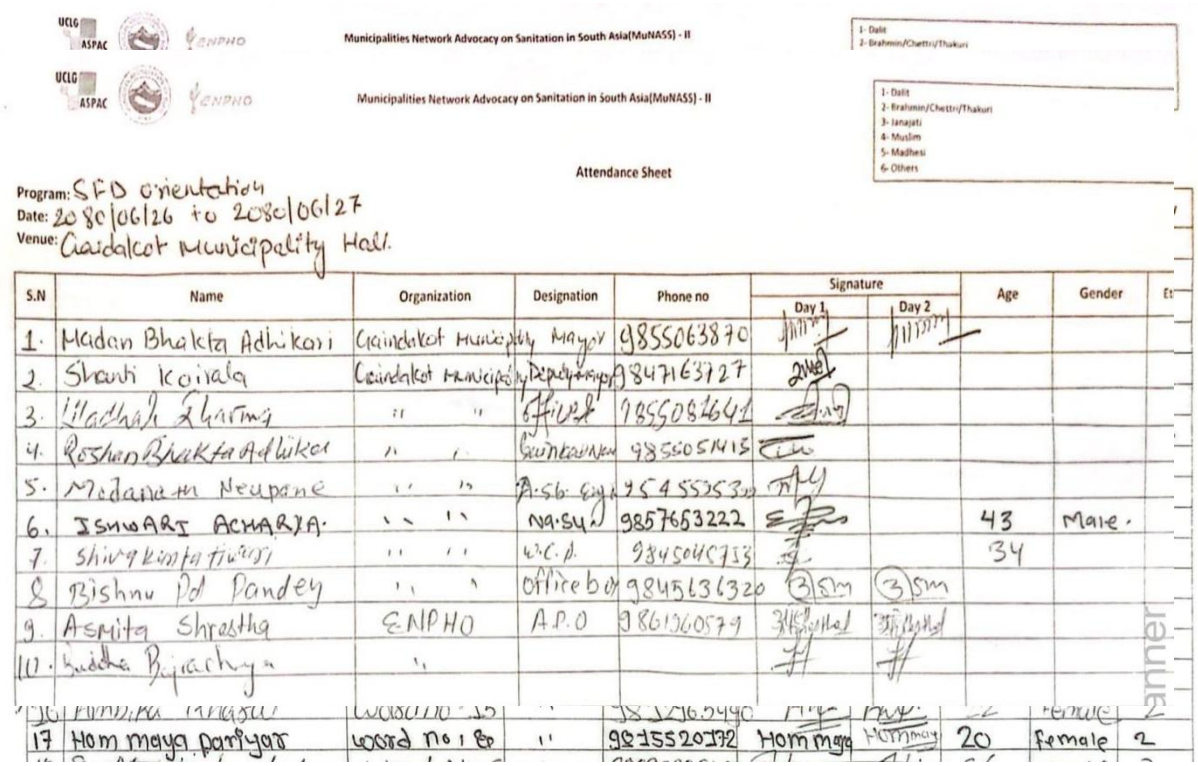
7 Appendix

Appendix 1: Roles and responsibility of various tiers of governments delineated in drafted SDP 2016 – 2030

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

Appendix 2: List of enumerators in SFD orientation



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

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: SFD orientation
Date: 2080/06/26 to 2080/06/27
Venue: Gaidakot Municipality Hall

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Et
1.	Madan Bhakta Adhikari	Gaindakot Municipality	Mayor	9855063870					
2.	Shanti Koirala	Gaindakot Municipality	Deputy Mayor	9847163727					
3.	Madhab Kharung	" "	Official	9855084641					
4.	Roshan Bhakta Adhikari	" "	Councillor	9855054115					
5.	Medani Neupane	" "	A.S.O.	9745535300					
6.	ISHWARI ACHARYA	" "	N.S.U.	9857053222			43	Male	
7.	Shivakanta Tiwari	" "	W.C.D.	9845045733			34		
8.	Bishnu Pd Pandey	" "	Office boy	9845636320	3/5/25	3/5/25			
9.	Asmita Shrestha	ENPHO	A.P.O	9861960579					
10.	Sudha Bijaychya	"							
17	Hom maya pariyar	ward no: 8	"	9815520172	Hom maya	Hom maya	20	female	2

Appendix 3: List of participants present in sharing and validation meeting of SFD

आज मिति २०२० साल फागुन १६ गतेका दिन गैंडाकोट नगरपालिकामा नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एसको) को प्राविधिक सहयोग, The United cities - Local Government Asia Pacific (UCLG-ASPAC) को सहकार्यमा र Bill and Mellanda Gates Foundation (BMGF) को आर्थिक सहयोगमा मानव मलमूत्र सेवा प्रवाह चित्र (Shit flow Diagram- SFD) सम्बन्धि छलफल तथा प्रमाणीकरण कार्यक्रममा निम्न अनुसारको सरोकारवाला हरुको उपस्थिती रहेको थ।

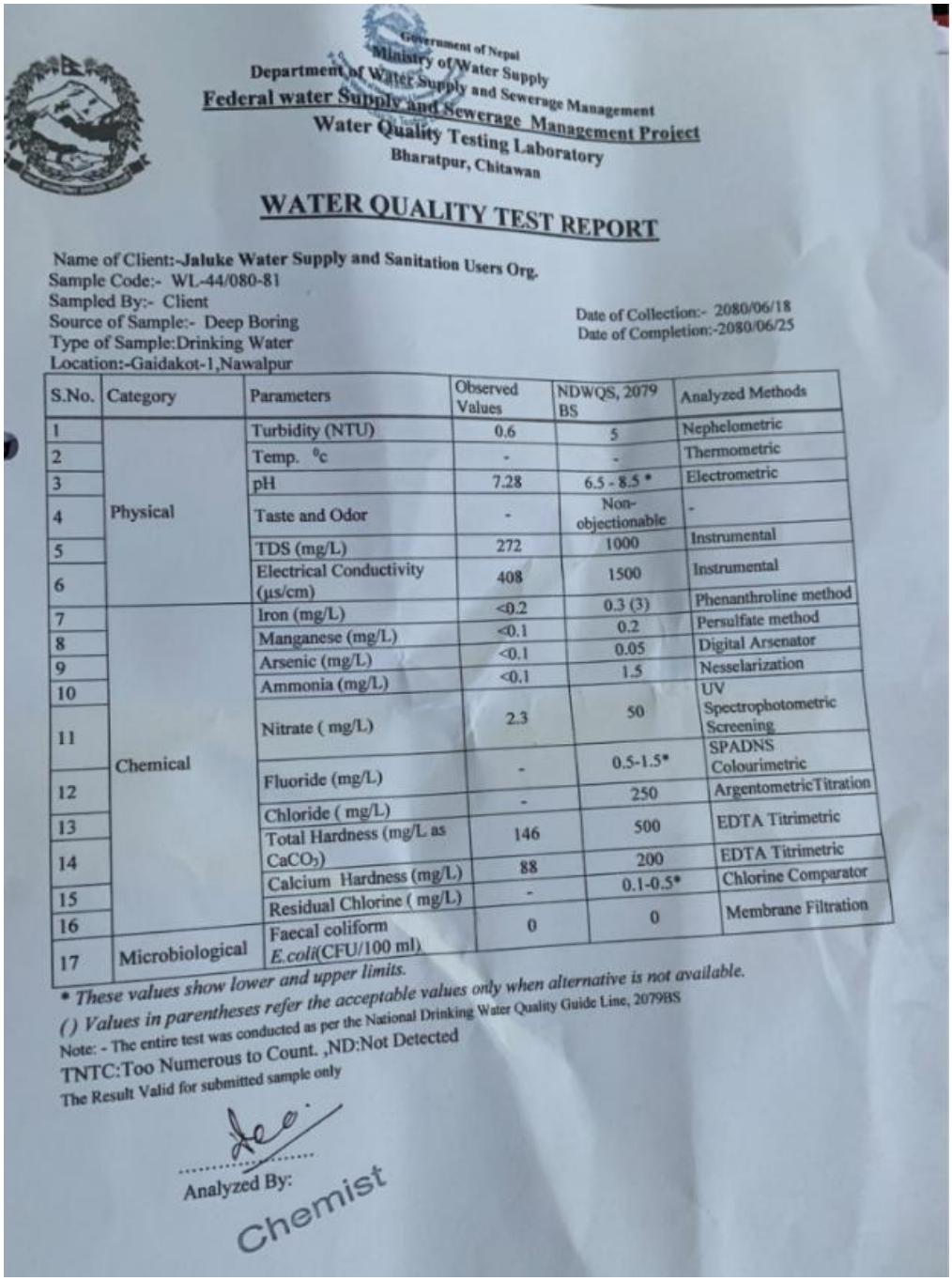
उपस्थिती :

स.नं	नाम	पद	कार्यालय	फोन नं.	हस्ताक्षर
१.	मदन भक्त अधिकारी	नगर प्रमुख	गैंडाकोट नगरपालिका	९८४५०६२८००	
२.	शान्ती कोइराला	नगर उप-प्रमुख	गैंडाकोट नगरपालिका	९८४७१६२७२७	
३.	फनिन्द्र खनाल	प्र. प्र. अ.	गैंडाकोट नगरपालिका	९८४७६३६९९९	
४.	कृष्ण प्र. पौडाले	अध्यक्ष - गैंडाकोट	वार्ड नं. ४	९८४५०५९४६९	
५.	हिरा लाल सापकोटा	सम्पर्क - अमरपुरी	गैंडाकोट ५	९८४६९०१६२८	
६	विष्णु प्रसाद कण्डेल	डिलं. अमरपुरी	गैंडाकोट ४	९८४६०९६४८०	
७	शेषकान्त देवकोटा	अध्यक्ष	गुरुदुङ्गा खानेपानी	९८४५०९१०३०	
८	पुष्टि प्रसाद निरौला	सदस्य - गुरुदङ्गा	"	९८०४२८५१५६	
९	जयराम कंडेल	अध्यक्ष - दोलगा	खानेपानी तथा सरसफाई समु०	९८६१०५१३५५	
१०	शालिकराम आचार्य	सचिव - अलुके	खा.पा.गो-१	९८४५०५५१७२	
११	मदन गौतम	लेखा आपेरेटर	गैंडाकोट न.पा.	९८४८०३८६३०	
१२	विष्णु प्रसाद पौडेल	वरिष्ठ कनिरा	गैंडाकोट न.पा.	९८४४५९८३७१	
१३	केशव राज शर्मा पौडेल	सचिव	गैंडाकोट खा.पा.	९८४८६५२०३८	
१४	टेक बहादुर थापा मगर	अध्यक्ष	आँपखोला खानेपानी	९८६५०८५५९६	
१५	जगन्नाथ पौडेल	अध्यक्ष	अलुके खानेपानी	९८४५०९९२४०	
१६.	राजप्रसाद अधिकारी	प्रशा.अधिकृत	गैंडाकोट न.पा.	९८४१९९८५	
१७	केशव गौतम	कनि.प्रा.वा.प्रे.	- " -	९८४८०४८६५५	
१८	विनोद पौडेल	कनि.प्र.अधिकृत	"	९८४१०६६५९६	
१९	प्रकाश पोखरेल	अ.इ.नि.	डिमोर न.पा.	९८४५६५५१४०	

क्र.सं	नाम	पद	कार्यालय	फोन नं	हस्ताक्षर
१८	मन्जिल थपलिया	इन्जिनियर	गौडाकोट न.पा.	9843121679	
१९	शान्ती न्यौपाने	कार्यपालिका	म.गौ.नं. ५	9865004514	
२०	कमला आचार्य	कार्यपालिका स	गौ.न.पा.८	९८५४१३९०६४	
२१	इश्वरी जी.सी.	का.पा.स	गौडाकोट-६	9845140197	
२२	ज्ञान प्रसाद खनाल	सूचना अधिकारी	"	—	
२५	रामु प्रसाद शर्मा	फाम ओवरसियर	गौ.न.पा	9857629849	
२४	सुरेन्द्र प्रसाद रेग्मी	वडा अध्यक्ष	गौडाकोट ९	९८५५०६३४२२	
२६	होम नाथ आले (टिमल)	न.पा.कार्यालय	ओडेनी-२	९८८५०९२२२५	
२५	विष्णु प्र. भुसाल	हेल्थ	गौ.न.पा	9858063088	
२३	शंकर डुंगेल	विषय शाखा	"	—	
३०	लक्ष्मी आचार्य	[illegible]	"	—	
३१	रोशन ... अधिकारी	[illegible]		—	
३२	इन्द्र प्रसाद काफ्ले	अधिकृत	गौडाकोट न.पा	९८६५३४३३८२	
३३	आशिष भण्डारी	प्राविधिक सहायक	"	९८६७५५१०३९	
३४	गीता पौडेल	अधिकृत	"	९८५७६५६२५८	
३५	प्रमोदा शर्मा पौडेल	आन्तरिक अधिकृत	"	९८४६२०१२३२	
३६	नविना गिरी	प्रशिक्षार्थी अधिकृत		९८६३२२२८९८	
३६	रविना ढकाल	प्रशिक्षार्थी अधिकृत		९८६८३९६६५५	
३८	प्रदीप राज पौडेल	सम्पर्क	गौ.न.पा	९८६०३२६७९८	
३९	(नि.त) थापा	को.स.	को.स (गौडाकोट न.पा)	९८४५२०९९	
40.	शान्ता घर्ती	का.पालक		९८४३४८०७८८	
41.	तिलक ...	[illegible]	गौडाकोट	[illegible]	
42.	उर्मिला वि.क.	वडा -११	गौडाकोट	9868337180	
43.	चक्र पाणी कडेल	वडा अध्यक्ष ११	गौडाकोट	९८५५०७६१८८	
44.	गोविन्द प्रसाद ...	वडा स.-११	गौडाकोट	६८४४०४३६००	
45.	तेज प्रसाद घिमिरे	वडा अध्यक्ष वा.नं ४	गौडाकोट	९८५५०६४७९६	
46.	रतन ब. वाईबा	वडा सदस्य	१६ गौडाकोट	९८६३०६६५५६	
47.	गंगाराम पौडेल	[illegible]	गौडाकोट-१	९८४५३३०९३०	
48.	अमृता कार्की	सा.प्रा	गौडाकोट-५	९८६०६१३३९८	
49.	Asmita Shrestha	Sr.A.P.O	ENPHO	986060571	
50.	Anita Tohgju	A.P.O.	"		

Appendix 4: Glimpses of KIIs

Appendix 5: Water quality test report



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
Bharatpur, Chitawan

WATER QUALITY TEST REPORT

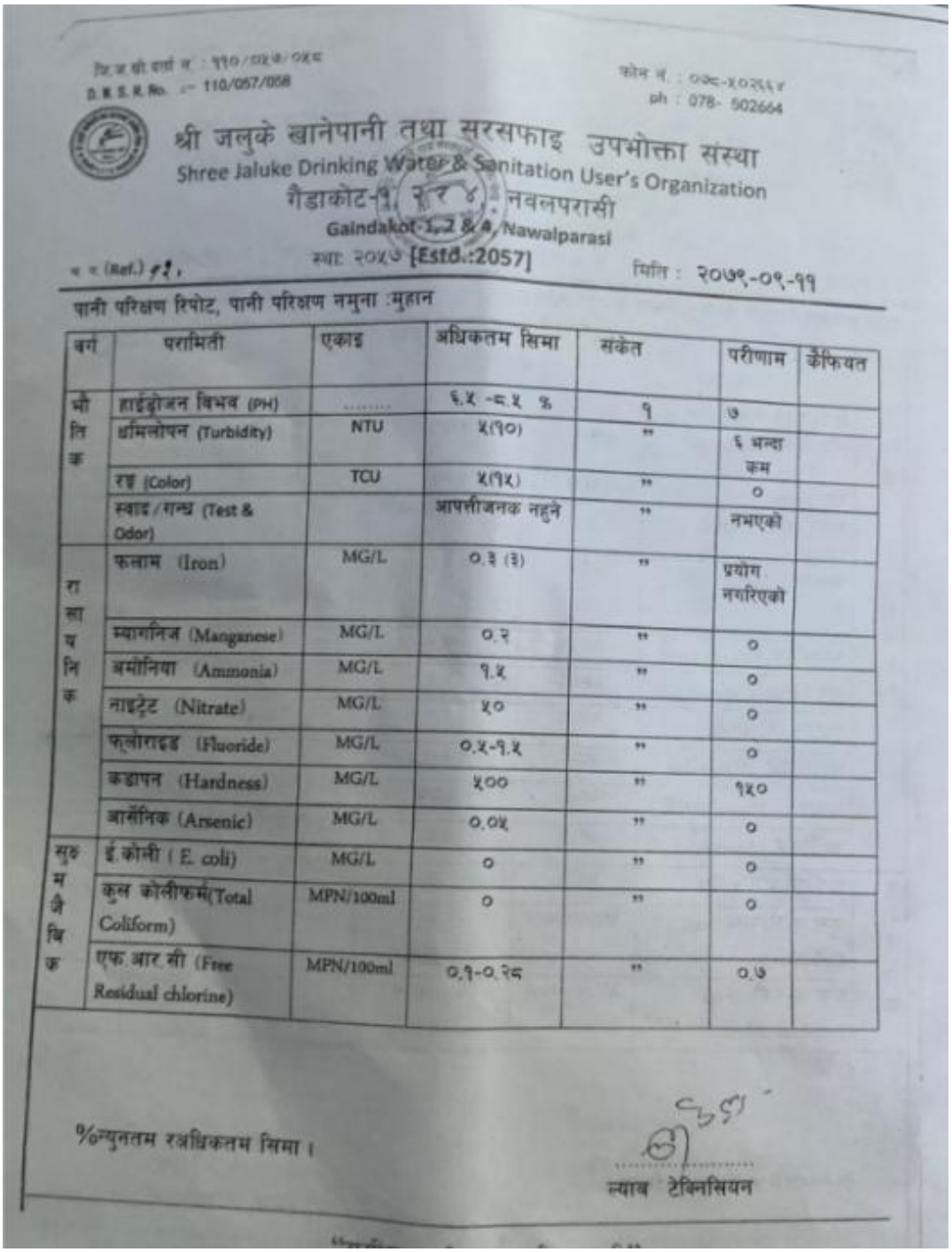
Name of Client:-**Jaluke Water Supply and Sanitation Users Org.**
Sample Code:- WL-44/080-81
Sampled By:- Client
Source of Sample:- Deep Boring
Type of Sample:Drinking Water
Location:-Gaidakot-1,Nawalpur

Date of Collection:- 2080/06/18
Date of Completion:-2080/06/25

S.No.	Category	Parameters	Observed Values	NDWQS, 2079 BS	Analyzed Methods
1	Physical	Turbidity (NTU)	0.6	5	Nephelometric
2		Temp. °c	-	-	Thermometric
3		pH	7.28	6.5 - 8.5 *	Electrometric
4		Taste and Odor	-	Non-objectionable	-
5		TDS (mg/L)	272	1000	Instrumental
6		Electrical Conductivity (µs/cm)	408	1500	Instrumental
7	Chemical	Iron (mg/L)	<0.2	0.3 (3)	Phenanthroline method
8		Manganese (mg/L)	<0.1	0.2	Persulfate method
9		Arsenic (mg/L)	<0.1	0.05	Digital Arsenator
10		Ammonia (mg/L)	<0.1	1.5	Nesselarization
11		Nitrate (mg/L)	2.3	50	UV Spectrophotometric Screening
12		Fluoride (mg/L)	-	0.5-1.5*	SPADNS Colourimetric
13		Chloride (mg/L)	-	250	ArgentometricTitration
14		Total Hardness (mg/L as $CaCO_3$)	146	500	EDTA Titrimetric
15		Calcium Hardness (mg/L)	88	200	EDTA Titrimetric
16		Residual Chlorine (mg/L)	-	0.1-0.5*	Chlorine Comparator
17	Microbiological	Faecal coliform *E.coli*(CFU/100 ml)	0	0	Membrane Filtration

** These values show lower and upper limits.*
( ) Values in parentheses refer the acceptable values only when alternative is not available.
Note: - The entire test was conducted as per the National Drinking Water Quality Guide Line, 2079BS
TNTC:Too Numerous to Count. ,ND:Not Detected
The Result Valid for submitted sample only

Analyzed By:
Chemist



D.W.S.S.R.No. :- 110/057/058

फोन नं. : ०७८-५०२६६४
ph : 078- 502664

श्री जलुके खानेपानी तथा सरसफाइ उपभोक्ता संस्था
Shree Jaluke Drinking Water & Sanitation User's Organization
गैडाकोट-१, २ र ४, नवलपरासी
Gaindakot-1, 2 & 4, Nawalparasi
स्थाः २०५७ [Estd.:2057]

च.नं (Ref.) १२,

मिति : २०७९-०९-११

पानी परिक्षण रिपोट, पानी परिक्षण नमुना :मुहान

वर्ग	परामिती	एकाइ	अधिकतम सिमा	सकेत	परीणाम	कैफियत
भौतिक	हाईड्रोजन विभव (PH)	.....	६.५ -८.५ %	१	७	
	धमिलोपन (Turbidity)	NTU	५(१०)	"	६ भन्दा कम	
	रङ्ग (Color)	TCU	५(१५)	"	०	
	स्वाद/गन्ध (Test & Odor)		आपत्तीजनक नहुने	"	नभएको	
रासायनिक	फलाम (Iron)	MG/L	०.३ (३)	"	प्रयोग नगरिएको	
	म्यागनिज (Manganese)	MG/L	०.२	"	०	
	अमोनिया (Ammonia)	MG/L	१.५	"	०	
	नाइट्रेट (Nitrate)	MG/L	५०	"	०	
	फ्लोराइड (Fluoride)	MG/L	०.५-१.५	"	०	
	कडापन (Hardness)	MG/L	५००	"	१५०	
	आर्सेनिक (Arsenic)	MG/L	०.०५	"	०	
सुक्ष्मजैविक	ई.कोली (E. coli)	MG/L	०	"	०	
	कुल कोलीफर्म(Total Coliform)	MPN/100ml	०	"	०	
	एफ आर सी (Free Residual chlorine)	MPN/100ml	०.१-०.२८	"	०.७	

%न्युनतम र्अधिकतम सिमा ।

न्याब टेक्निसियन

SFD Gaindakot Municipality, Nepal, 2025

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This Executive Summary and the SFD Report are available from:

www.sfd.susana.org

SFD Promotion Initiative