SFD Report

Gorkha 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 Gorkha Municipality, Nepal, 2026

Produced by:

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

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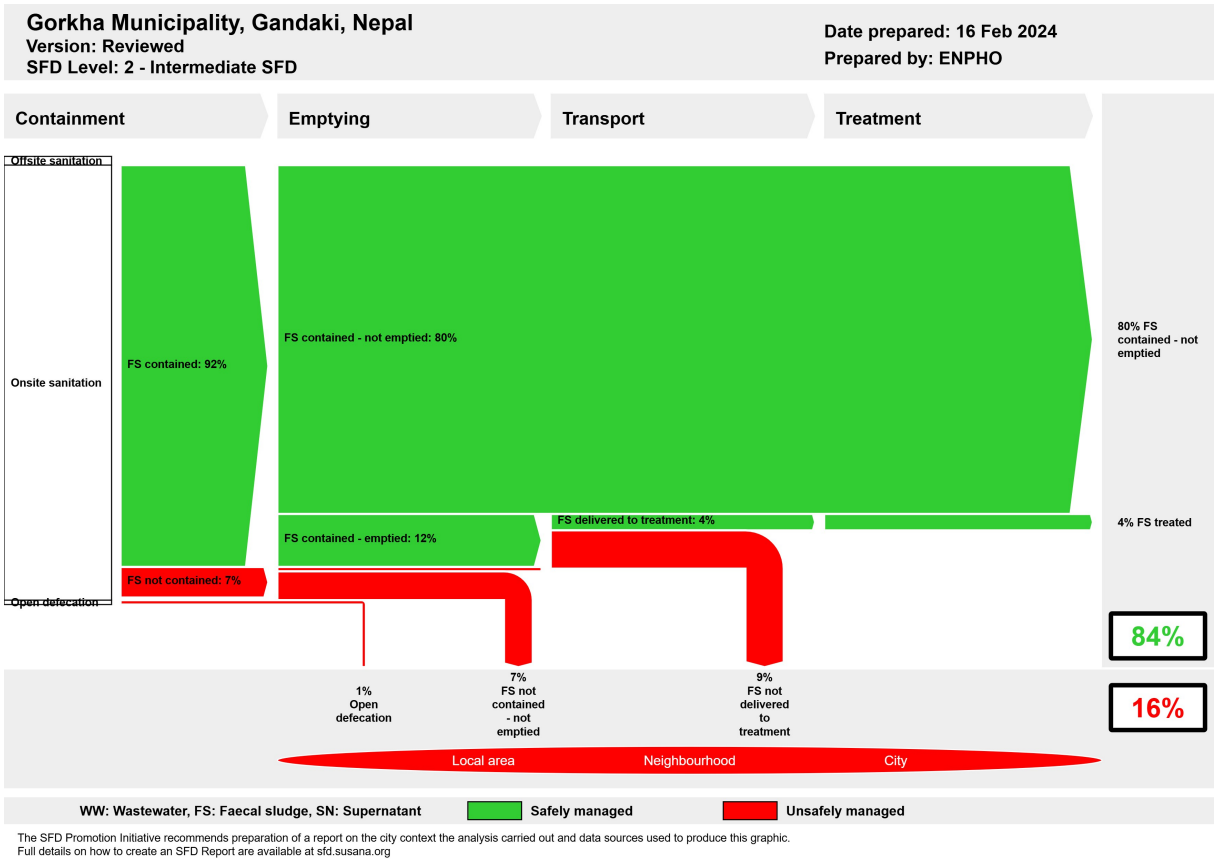
1. The SFD Graphic



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:

Gorkha 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

Gorkha Municipality is situated in Gorkha District of Gandaki Province in the western region of Nepal. It is divided into 14 wards and covers an area of 131.86 sq. km.

It was established on January 28, 2014 by merging 3 Village Development Committees (VDCs) namely, Gorakhkali, Raniswara and Taranagar. It lies at 27°56'03" to 28°13'07" N latitude and 84°23' to 84°38' E longitude and at the altitude from 328 meters above sea level (masl) to 1522 masl (Gorkha Municipality, 2024).

A population of 52,468 is residing on 14,988 households in the municipality (National Statistics Office, 2023). The annual population growth rate of the municipality is 0.63%. The municipality has a temperate climate (Cwa) with hot summers and dry winters. The annual average temperature of the municipality is 20.1°C and receives 1,492 mm rainfall per year (Climate-Data, 2021).

4. Service outcomes

The overview of different sanitation technologies across the sanitation value chain in the municipality is briefly explained in this section. All data in this section is from the household and institutional surveys conducted for this survey (ENPHO, 2023). Gorkha district was declared Open Defecation Free (ODF) on December 31, 2014. Still 1% of households do not have toilets, while 99% of households have the coverage of improved sanitation facility. The households without improved sanitation facility opt for open defecation.

Containment:

All the households with sanitation facilities rely on onsite sanitation systems. About 37% of households have fully lined tanks, 30% have lined tanks with impermeable walls and open bottom, 3% have lined pits with semi-permeable walls and open bottom and 29% have unlined pits.

All the institutional buildings have toilets with 100% onsite sanitation system. Among which, 32% of institutional buildings have fully lined tanks, 42% have lined tanks with semi-permeable walls and open bottom, 2% have lined pit with semi-permeable walls and open bottom and 24% have unlined pits.

Four public toilets in the municipality were observed for the study. Among these, the toilets located near *Gorkha Museum* and at *Laxmibazar* were non-functional during the time of study. The toilet located at *Harimatari* was constructed by multi-stakeholders including Gorkha Municipality while the one located near *Gorakhkali temple* was constructed by Gorkhkali Youth Club. About 50 people use these toilets per day. The restrooms at *Harimatari* are mostly used by city dwellers and one located near *Gorakhkali temple* is used by visitors at temple. The users are charged NRs. 10 (USD 0.08) for urination and Rs. 20 (USD 0.12) for defecation in Harimatari while no charge is taken in the toilet near temple.

Emptying and Transport:

Among the buildings with onsite sanitation system, only 11% of households and 5% of institutional buildings have emptied their containment. Both manual and mechanical emptying is practiced in the municipality while mechanical emptying is prevalent. Moreover, some households also practice open emptying.

The municipality has only one private desludging service provider. The service provider has a desludging vehicle with a tank capacity of 4,500 litres. The service charge for each trip is NRs. 7,000 (USD 52.6) to empty a containment.

Treatment and Disposal/Reuse:

Mechanically emptied faecal sludge (FS) is disposed in an open space of Beldanda as well as farmlands as per demand, since there is no faecal sludge treatment plant (FSTP). The manually emptied FS is mostly dug and dumped, while the practice of composting and disposing in farmlands is also found. Therefore, all the emptied FS is disposed unsafely into an open environment.

Approximately 56% of households have piped drinking water supply services in the municipality. Among others, Prithivi Narayan Small Town Water Supply Users' Committee is one of the major drinking water services providers in the municipality. It serves in wards 6, 7 and 8. It has distributed 1,348 taps at households and institutions. Among the remaining households, 12% of households access to drinking water from community taps and 32% still relies on spring sources.

Spring sources are vulnerable of contamination. The vulnerability of sources depends on lateral spacing between sanitation systems and the sources. The water quality test report from a study showed that sources, reservoir tanks, taps and drinking water in the municipality are contaminated with *E. coli* while a test report from Prithivi Narayan Small Town WSUC showed zero presence of *E. coli*. This shows that drinking water accessed directly from spring sources has the possibility of contamination.

The SFD graphic shows that excreta generated from 84% of the population are safely managed, while 16% of the population are unsafely managed. The safely managed FS generated from 80% of population is temporary as the FS has not been emptied. The FS generated from 4% of population is only treated from biogas digester at households. With the current practice of faecal sludge management (FSM), the proportion of safely managed FS will soon become unsafely managed once the containments start filling up.

5. Service delivery context

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

Several policies have been in place to accomplish the sanitation needs of people. Particularly, NSHMP 2011 has proved to be an important strategic document for all stakeholders to develop uniform programs and implementation mechanisms at all levels. It strengthened institutional set up with the formation of Water and Sanitation Coordination Committee (WASH-CC) to actively engage in sanitation campaigns. The sanitation campaign was implemented throughout the country mainly focusing on achieving universal access to improved sanitation.

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).

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 / Organisations
Public Institutions at Federal Government	Ministry of Water Supply
Public Institutions at Provincial Government	Ministry of Energy, Water Resources and Water Supply
Public Institutions at Local Government	Gorkha Municipality
Non-governmental Organisations	Environment and Public Health Organization (ENPHO)
Private Sector	Water Supply Users Committee Private Desludging Service Provider
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC

7. Process of SFD development

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2023) . Enumerators of the municipality were mobilised after orientating on sanitation technologies and proper use of mobile application (KOBOCOLLECT) to collect data for survey. The Key Informant Interviews (KIIs) were conducted with WASH focal person of the municipality, Water and Sanitation Users' Committee and caretakers of public toilets. Types of sanitation technologies used in various locations have been mapped using ARCGIS. For the Shit Flow Diagram (SFD) graphic production, initially, a relationship between sanitation technology used in questionnaire survey and Shit Flow Diagram Promotive Initiatives (SFD PI) methodology was made. Then, data were fed into SFD graphic generator to produce the SFD graphic.

8. Credibility of data

The major data were collected from random household sampling. Altogether, 375 households and 41 institutions were surveyed from 14 wards of Gorkha Municipality. Primary data on emptying, transportation and current sanitation practices in the municipality were validated from KII with public toilet management, municipal representatives, and water service providers. 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:

- Climate-Data, 2021. Climate-Data. [Online].
- ENPHO, 2023. Sanitation Situation Assessment of Gorkha Municipality. Unpublished, s.l.: s.n.
- Gorkha Municipality, 2024. Grokha Municipality. [Online] Available at: https://gorkhamun.gov.np/en [Accessed 20 May 2024].
- ENPHO, 2023. Sanitation Situation Assessment of Gorkha Municipality. Unpublished, s.l.: s.n.
- MoWS, 2020. Open Defecation Free Nepal: Narration of the Journey, Kathmandu: Secretariat of National Sanitation and Hygiene Coordination Committee, Nepal.
- National Statistics Office, 2023. National Population and Housing Census 2021 National Report, Kathmandu: National Statistics Office.

SFD Gorkha Municipality, Nepal, 2026

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Abbreviations

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
KII	Key Informant Interview
KM	Kilometre
masl	metres above sea level
mm	Millimetre
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NPC	National Planning Commission
NSHMP	National Sanitation and Hygiene Master Plan
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
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
SuSanA	Sustainable Sanitation Alliance
UCLG ASPAC	United Cities and Local Governments Asia Pacific
VDC	Village Development Committees
WASH	Water, Sanitation and Hygiene
WSUC	Water and Sanitation Users Committee

1 City context

Gorkha Municipality, the historic place, is situated in Gorkha District of Gandaki Province in the western region of Nepal. It was established on January 28, 1997 by merging Gorakhkali, Raniswara and Taranagar Village Development Committees (VDCs). After a decision of Nepal government, four additional VDCs, Finam and Nareswor on December 2, 2014 and Taple and Deurali on December 5, 2016 were unified to reform the municipality. It is divided into 14 wards. It shares its boundary with Sahid Lakhan and Bhimsen Rural Municipalities on the east, Palungtar Rural Municipality on the west, Siranchowk Rural Municipality on the north and Sahid Lakhan and Aanbu-Khaireni Rural Municipalities on the south (Gorkha Municipality, 2024). Figure 1 shows the ward boundary map of Gorkha Municipality.

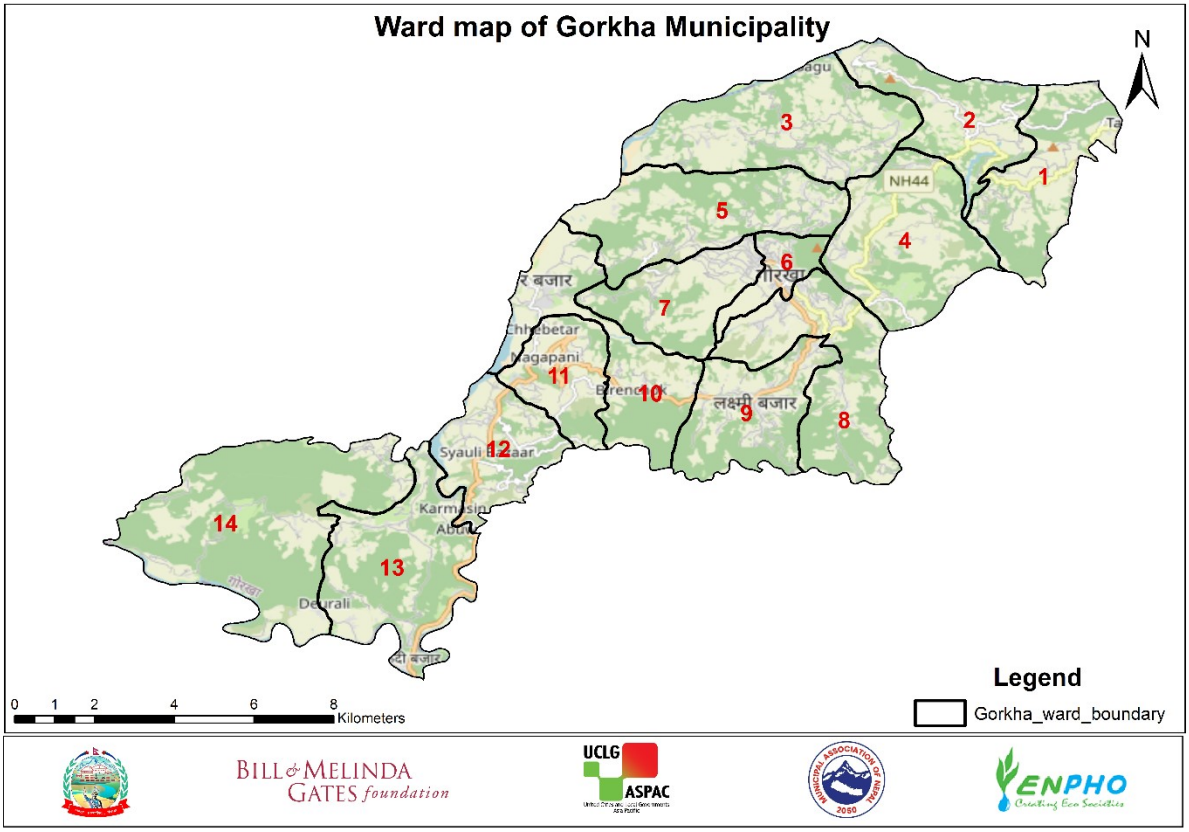


Figure 1: Ward boundary map of Gorkha Municipality.

1.1 Population

As per the national population and housing census conducted in 2021, Gorkha Municipality has a total population of 52,468 with 24,257 male and 28,211 female population residing on 14,988 households. The average household size is 3.5 and population density is 397.91/km^2. The annual population growth rate of the municipality is 0.63% (National Statistics Office, 2023).

1.2 Topography and Geography

Gorkha Municipality lies at 27°56'03" to 28°13'07" N latitude and 84°23' to 84°38' E longitude. The altitude of the municipality ranges from 328 metres above sea level (masl) to 1522 masl. It covers a total area of 131.86 sq. km. (Gorkha Municipality, 2024). The municipality lies in

the Midlands and Siwalik (Churia) range based on the physiographic division of Nepal. Thus, it has the topography based on the range. The region majorly has a composition of Phyllites, Schist, gneiss, quartzite, granite and Limestone while sandstone, mudstone, shale and conglomerate are found in the range of Churia (Upreti, 1999).

1.3 Climate

Köppen–Geiger classification is one of the most used systems for climatic categorisation. This classification is a widely used method for portraying climates worldwide, based on monthly air temperature and precipitation. The climatic condition of Gorkha Municipality falls on temperate climate (Cwa) based on Köppen–Geiger classification. This climatic condition has hot summers and dry winters (Karki, et al., 2015). The warmest month of the year is June with an average temperature of 25°C and coldest month is January with average temperature of 14°C (Gorkha Municipality, 2024). The annual average temperature, based on data of meteorological station at Finam, of the municipality is 20.1°C. Here, most amount of rainfall occurs in July and the least in December (Climate-Data, 2021). It receives 1492 mm rainfall on average annually. Figure 2 shows the graph of the monthly average for precipitation and temperature of Gorkha Municipality based on data from hydrological and meteorological station at Finam.

Figure 2: A graph showing the monthly average for precipitation and temperature of Gorkha Municipality.

2 Service Outcomes

2.1 Overview

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2023) . A total of 375 households were sampled from 14,988 households distributed in 14 wards (further details are presented in section 4). The results obtained after the triangulation and validation of the data with all the data sources including secondary data, Key Informant Interviews (KIIs) and a validation workshop is presented in this section.

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).

2.1.1 Sanitation System in Household Buildings

Gorkha district was declared Open Defecation Free (ODF) on December 31, 2014 (MoWS, 2020). The status of ODF indicates accessibility to basic sanitation in each household (HH). However, in Gorkha Municipality, still 1% of the households do not have toilets and practice open defecation. The households practising open defecation goes to an open ground. Figure 3 shows sanitation technologies present at households in Gorkha Municipality.

Figure 3: Sanitation technologies at households of Gorkha Municipality.

The remaining 99% of the households have improved sanitation facilities with onsite sanitation systems. 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). Figure 4 presents the location map of sample households with status of access to improved sanitation at Gorkha Municipality.

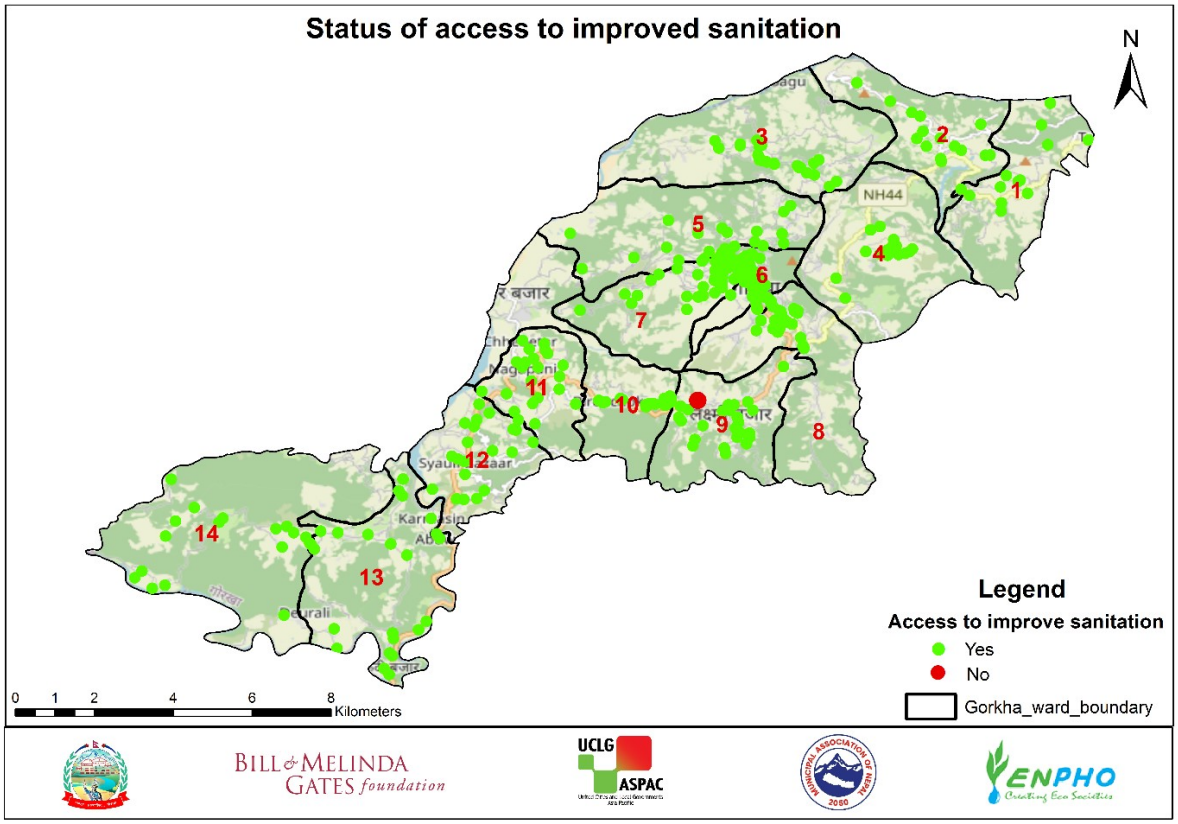


Figure 4: Location map of sample households with status of access to improved sanitation.

Types of Onsite Sanitation Systems

In the municipality, 99% of the households have onsite sanitation systems. Table 1 shows the types of onsite sanitation technologies and percentage of households using it at Gorkha Municipality.

Table 1: Types of onsite sanitation technologies at households of Gorkha Municipality.

Containment	Wall construction materials	Bottom of containment	Chamber	Number	Connected to	%
Biogas digester	NA	NA	NA	NA	No outlet/overflow	5%
Fully Lined Tank	Concrete walls OR Cemented brick/stone walls	PCC or plastered	One or Two	NA	Soak pit Sewer Open drain/open ground No outlet/overflow	32%
Lined tank with impermeable walls and open bottom	Concrete walls OR Cemented brick/stone walls	Soiling or Nothing	One or two More than two	NA	Soak pit Sewer Open drain/open ground No outlet/overflow	30%
Single pit	Concrete rings piled one after other	Soiling or Nothing	NA	One	NA	3%
Unlined pit	Mud mortar brick wall/Mud mortar cement wall/No lining/Dry stone wall	Nothing	NA	NA	NA	29%

Biogas Digester is a waste to energy conversion technology designed to treat household organic waste and faecal sludge (FS) to generate biogas. About 5% of households have built biogas digester in their houses. Alternative Energy Promotion Centre (AEPC) have promoted biogas technology at households in 77 districts of Nepal. The installation of biogas at households have supported in improving situation of health status and sanitation status in Nepal (AEPC, 2018). Figure 5 shows a type of biogas digesters in Gorkha Municipality.

Figure 5: Biogas digester at household of Gorkha Municipality.

Fully lined tank is a rectangular tank with impermeable walls and base to safely store FS. It does not have outlet for the discharge of effluent (Strande, et al., 2014) . Around 32% of households have fully lined tanks.

Lined tank with impermeable walls and open bottom is a rectangular onsite technology where the walls of the tank are lined and sealed, and a permeable base. The facility allows infiltration of effluents which could contaminate groundwater (Peal, et al., 2020). Around 30% of households have these types of containments in the municipality.

Single Pit is a circular onsite technology made from concrete rings. 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 (SuSanA, 2018) . About 3% of households have single pits in the municipality. Figure 6 shows pictures of single pits found in the municipality.

Figure 6: Single pit found in the Gorkha Municipality.

Unlined Pit is a dug pit in the ground. It has no lining in the walls and a permeable base. It allows infiltration of effluents from walls and as well as bottom of the pit (SuSanA, 2018). Circa 29% of households have unlined pits.

Table 2 shows the types of sanitation technologies recategorised according to SFD PI.

Table 2: Types of sanitation technologies recategorised according to Shit Flow Diagram Promotion Initiative (SFD PI).

Sanitation System	Percentage
No toilet/Open defecation (T1B11 C7 TO C9)	1%
Onsite Sanitation System	
Fully lined tank (T1A3C5 and T1A3C10)	37%
Lined tank with impermeable walls and open bottom (T1A4C5, T1A4C10 and T2A4C10)	30%
Lined pit with semi-permeable walls and open bottom (T1A5C10)	3%
Unlined pit (T1A6C10 and T2A6C10)	29%
Grand Total	**100%**

According to Shit Flow Diagram (SFD) Promotion Initiatives (PI), biogas digester and fully lined tanks are recategorised as fully lined tanks and single pits are recategorised as lined pits with semi-permeable walls and open bottom. Thus, 37% of households have fully lined tanks and 3% of the households have lined pits with semi-permeable walls and open bottom.

Figure 7 shows location map of sample households with different types of containment at Gorkha Municipality.

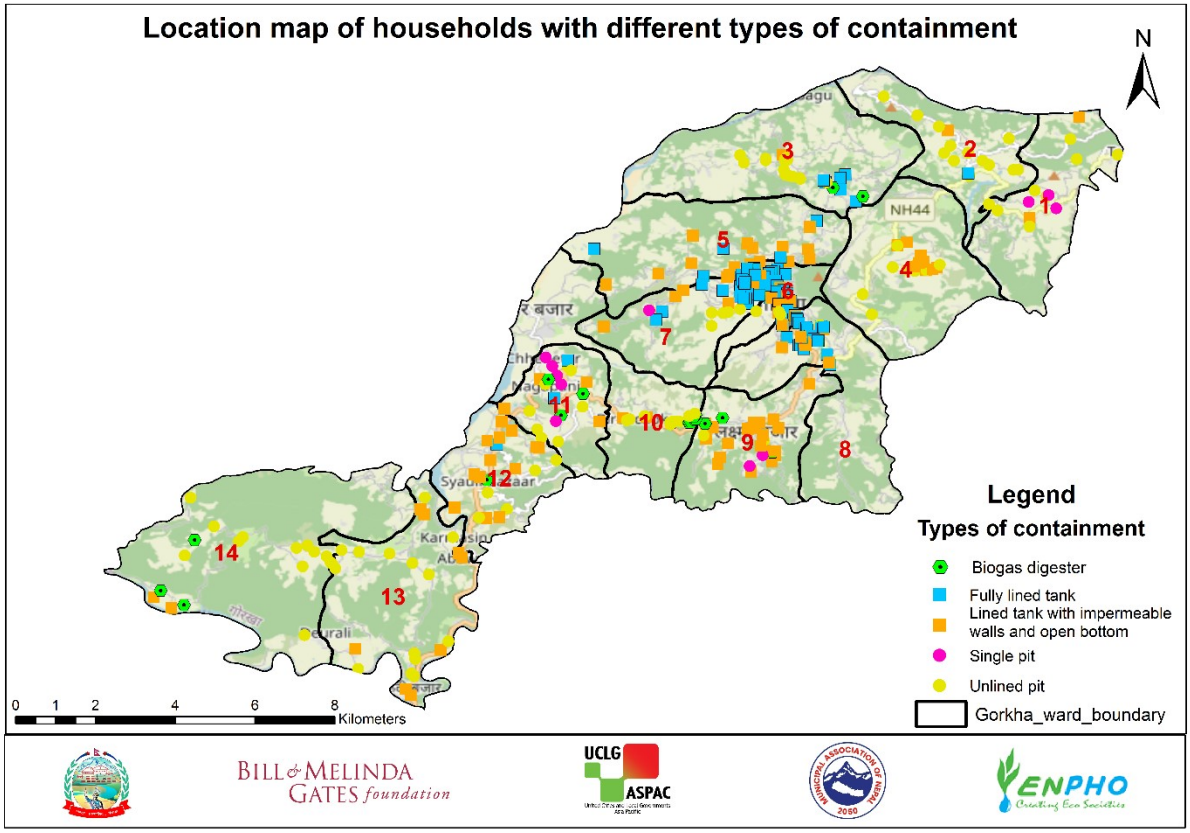


Figure 7: Location map of sample households with different types of containment.

2.1.2 Sanitation Systems in Institutional Buildings

Altogether 54 institutional buildings were surveyed. The sanitation data of institutional buildings was obtained from different types of institutions. Table 3 shows the types and number of surveyed institutions.

Table 3: Type and number of surveyed institutions

Type of Institution	Number of Surveyed Institutions
Educational Institution	13
Government /Non-government Office	17
Health care centre	10
Commercial Buildings	1
Grand Total	**54**

All the institutional buildings in the municipality have toilets with 100% onsite sanitation systems. About 32% of the buildings have fully lined tanks, 42% have lined tanks with impermeable walls and open bottom, 2% have lined pit with semi-permeable walls and open bottom and 24% have unlined pits. The data shows that almost 74% of the institutional buildings have safer FS collecting containments, whereas still 26% of the institutional buildings have improperly built containments that possesses risk to groundwater contamination. Figure 8 shows the location map of institutional buildings with different types of containments in Gorkha Municipality.

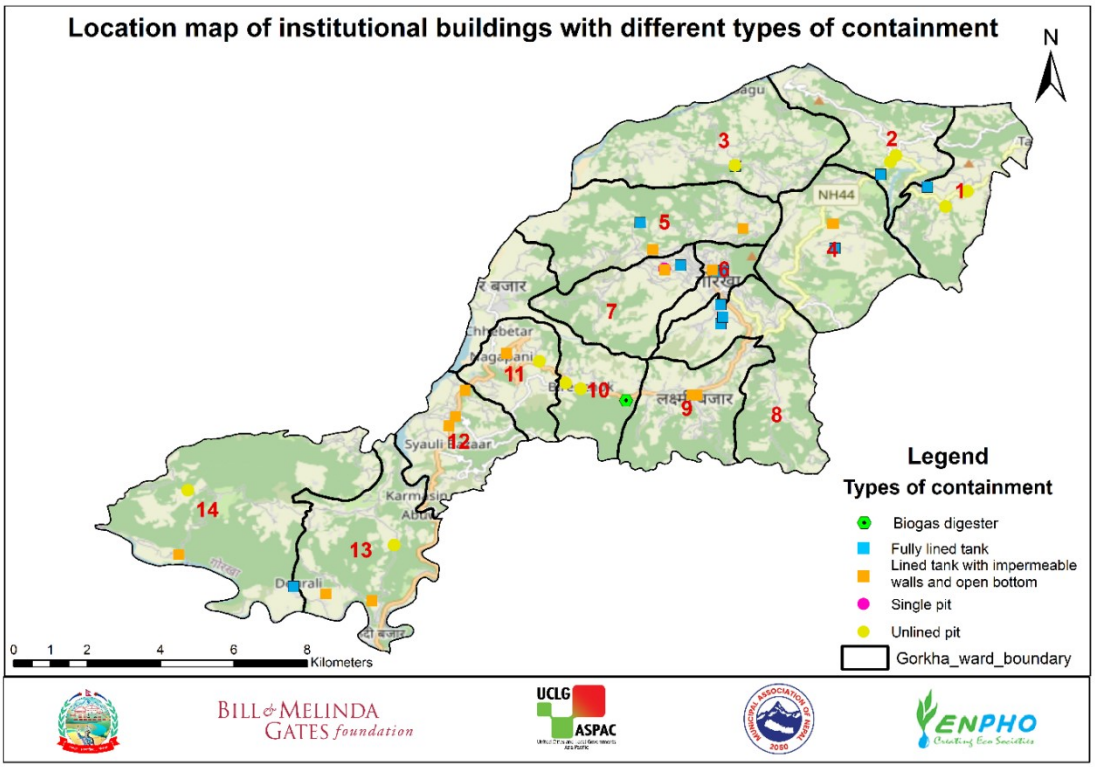


Figure 8: Map different types of containments at institutional buildings in Gorkha Municipality.

2.1.3 Public Toilets

There are four public toilets in Gorkha Municipality of which were observed for the study. During the time of study, public toilets near *Gorkha Museum* of ward 6 and at *Laxmibazar* ward 9 were not functional. The information about public toilets obtained during KII and observation is fed in this report.

Public toilet at *Harmatari*

The toilet located at *Harmatari* in ward 3 was jointly constructed by Water supply and Sanitation Division of Gorkha, Gorkha Municipality and Nepal Water for Health (NEWAH). It has a separate male and female compartment. It serves 6 users at a time with 3 urinals and 1 pan in male compartment and 2 pans in female compartment. The city dwellers are the service recipients of this toilet. About 20 users use the toilet per day. The users are charged NRs. 10 (USD 0.08) for urination and NRs. 20 (USD 0.15) for defecation.

The outlet of the toilet is connected to a rectangular containment which further opens to an open drain. Thus, the containment has not filled yet. The toilet is cleaned regularly. Water required for the toilet is supplied from a 500 litres overhead tank. The toilet compartments have ventilation. A handwashing basin is placed inside both compartments for handwashing facility (KII-4, 2023). A caretaker has been overseeing this toilet from past 3 years.

Public toilet at *Gorakhkali temple*

The toilet located at *Gorakhkali temple* in ward 6 was constructed in 2013, but was reconstructed by Gorakhkali Youth Club in 2019. It does not have separate male and female

compartments. There are 3 pans and serves 3 users at a time. People visiting the temples are the service recipients of the toilet. Usually, 25 users use the toilet per day.

The outlet of the toilet is connected to a rectangular containment. The toilet is regularly cleaned. Water required for the toilet is supplied from a 1,000 litres tank. A handwashing facility is outside the toilet. The toilet compartments have proper ventilation (KII-4, 2023).

Figure 9 shows the public toilets located in different places of Gorkha Municipality and their status.

Figure 9: Public toilets and their status in Gorkha Municipality.

2.1.4 Emptying and Transport

Emptying is one of the key elements of sanitation service chain. It basically assures the proper operation of containment. Regular emptying of the containment prevents sludge overflow and blockages (Strande, et al., 2014) . Moreover, emptying of containment is determined by the number of users, duration of years and types and size of containment.

Among the households with onsite sanitation systems, only 11% of the households have emptied their containment whereas 89% have not emptied yet. Similarly, only 5% of the institutional buildings have emptied their containment whereas 95% have not emptied yet. The emptying ratio of containment types; lined tanks with open bottom and unlined pits, are less. Most households in the municipality have constructed containments with open bottom to allow moisture to infiltrate, preventing them from filling up quickly (KII-1, 2023). Thus, this has reduced the frequency of emptying of these containments. Figure 10 shows emptying status of different types of containment at households.

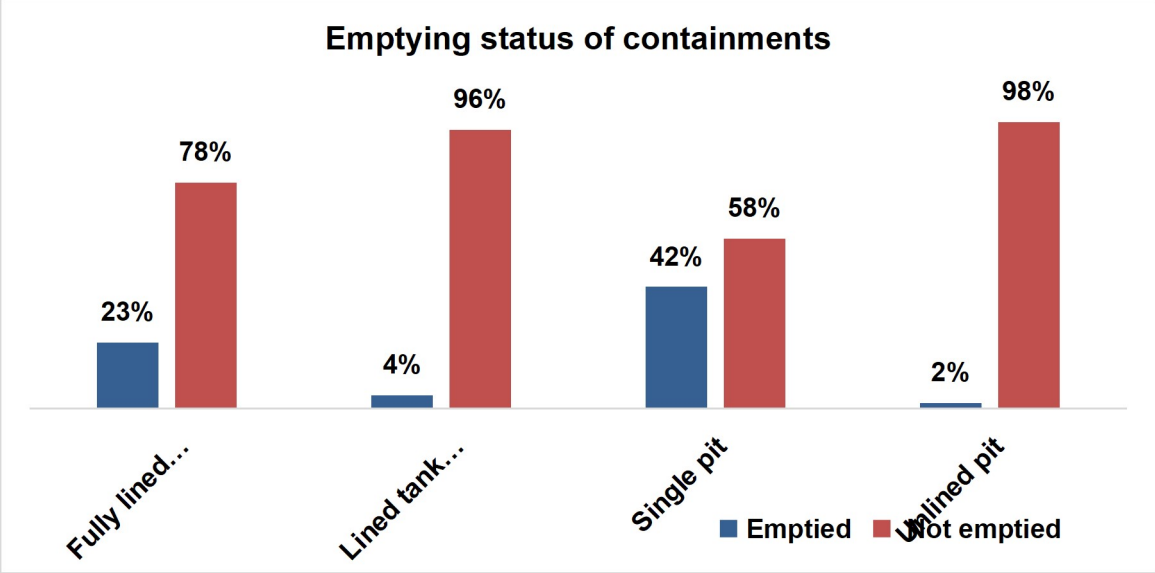


Figure 10: Status of emptying of different types of containment.

The municipality does not have regular containment emptying practice as most containment gets filled over a span of 10 years. Thus, on-demand emptying practice is found in the municipality. Manual, mechanical and open emptying is practiced at households. Moreover, mechanical emptying is more prevalent in the municipality. Among the households that have emptied their containments, 23% of households emptied manually, 64% of households have emptied mechanically and 13% have practiced open emptying. Open emptying method is the practice of discharging effluent into an open/stormwater drain, open environment or water bodies during rainy season. Moreover, all the institutional buildings that have emptied containments practice mechanical emptying. The inadequate desludging vehicle, high service charge and lack of motorable road networks are the reasons for practicing manual emptying at households. The frequent manual or mechanical emptying is challenging due to topography of the municipality. Thus, open emptying is also widely practiced in the municipality as containments are not easily accessible (KII-1, 2023).

The municipality does not have its own desludging vehicle but has a private desludging service provider. The private desludging service provider started the service since 2019,

however, it is not yet registered in the municipality. The service provider has a desludging vehicle with a tank capacity of 4,500 litres. The service charge for each trip is NRs. 7,000 (USD 52.6). Usually, there are 12-15 trips per month. A driver and a helper are assigned for the desludging service. These workers are paid NRs. 500 (USD 3.75) each per trip. The workers are also provided with gloves and masks as protective equipment (KII-2, 2023) . Figure 11 shows the desludging vehicle of the Gorkha Municipality.

Figure 11: The desludging vehicle.

2.1.5 Treatment and Disposal/Reuse

Gorkha Municipality does not have a Faecal Sludge Treatment Plant (FSTP). Mechanically emptied FS is disposed mostly in an open space at Beldanda as well as in farmlands as per demand (KII-2, 2023) , while manually emptied FS is mostly dig and dumped as well as disposed into farmlands and composted. Moreover, it can be concluded that the emptied FS is disposed of unsafely and untreated in an open environment in the municipality.

2.1.6 Risk Assessment of Water Source Pollution

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

a. Sources of drinking water and water production

Approximately 56% of households in the Gorkha Municipality have piped drinking water supply services, while 12% get drinking water from community taps and 32% rely on spring sources. Almost 25 Water and Sanitation Users' Committees (WSUCs) are recorded in the municipality (KII-1, 2023) that has been providing drinking water service at households and institutions in the municipality (ENPHO, 2023). Figure 12 showing different types of drinking water sources in the municipality.

Figure 12: Pictures showing private tap and community tap in Gorkha Municipality

Prithivi Narayan Small Town WSUC is one of the major water service providers in the municipality. It was established in 1999, and has been providing a drinking water service since then. It supplies drinking water to 1,348 households in wards 6, 7 and 8. The scheme lifts water from 3 stations installed in Dhakre khola. The lifted water is collected in 3 reservoir tanks of capacities 100 m^3, 150 m^3 and 450 m^3 which are further processed for treatment. Water is supplied to taps of households and institutions after the treatment process, which includes sedimentation, slow sand filter and chlorine dosing. Water quality is tested regularly at intervals of 3 months. Water samples are taken before and after the treatment (KII-3, 2023).

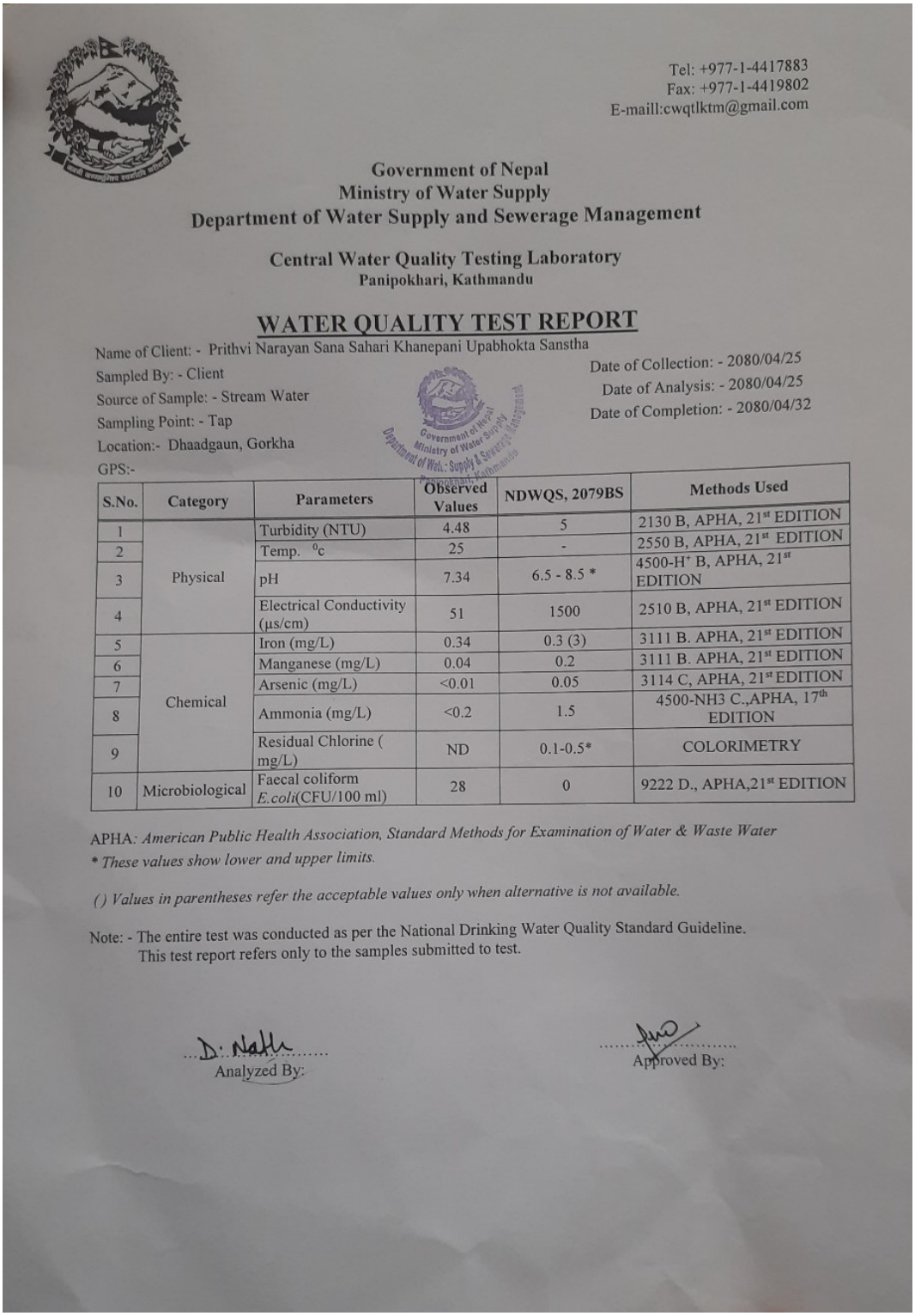
Apart from Prithivi Narayan Small Town WSUC, Tindhara, Karne Khole, Hatiyathok, Daraudi, Tinchape and Pokharithok are some of the major water supply service providers in the miunicipality (KII-3, 2023) . The water supply service is not uniformly distributed in the municipality, locals are obliged to rely on spring sources for drinking water supply.

b. The vulnerability of spring source and water pollution

The households using drinking water directly from spring source have their source located in less than 5 meters to more than 25 meters horizontally from their containment. A study suggests that *E. coli* can travel up to hundreds of meters horizontally in fractured rocks and gravels (Krishnan, 2011). As, the geology of Gorkha Municipality mostly consists of bedrocks (Upreti, 1999) , there is a possibility of *E. coli* contamination in groundwater and spring sources. The water quality test report showed presence of *E. coli* on sample water tested from source, reservoir tanks, taps and drinking water in Gorkha (ENPHO, 2023). But spring water contamination is low in Gorkha Municipality. Many study suggests that humic matter such as microorganisms in water can be removed naturally, in a period of time and in continuous flow of water (Balke & Zhu, 2008) (Odling, et al., 2020). Furthermore, the test report of drinking water quality of Prithivi Narayan Small Town WSUC showed the absence of *E. coli* (Figure 13). Thus, it can be said that population consuming water from private taps are at insignificant risk of *E. coli* consumption, while population accessing water directly from spring sources can be at possible risk of it.

Therefore, 4% of the population relies on fully lined tanks (sealed) connected to a soak pit (T1A3C5, low risk), 1% of the population relies on lined tanks with impermeable walls and an open bottom connected to a soak pit (T1A4C5, low risk); 29% depends on lined tanks with impermeable walls and an open bottom, with no outlet or overflow (25%, T1A4C10, low risk

Ans 4%, T2A4C10, high risk); 3% uses lined pits with semi-permeable walls and an open bottom, with no outlet or overflow (T1A5C10, low risk) and 29% relies on unlined pits (26%, T1A6C10, low risk and 4%,T2A6C10, high risk).



Tel: +977-1-4417883
Fax: +977-1-4419802
E-maill:cwqtlktm@gmail.com

Government of Nepal
Ministry of Water Supply
Department of Water Supply and Sewerage Management

Central Water Quality Testing Laboratory
Panipokhari, Kathmandu

WATER QUALITY TEST REPORT

Name of Client: - Prithvi Narayan Sana Sahari Khanepani Upabhokta Sanstha
Sampled By: - Client
Source of Sample: - Stream Water
Sampling Point: - Tap
Location:- Dhaadgaun, Gorkha
GPS:-

Date of Collection: - 2080/04/25
Date of Analysis: - 2080/04/25
Date of Completion: - 2080/04/32

S.No.	Category	Parameters	Observed Values	NDWQS, 2079BS	Methods Used
1	Physical	Turbidity (NTU)	4.48	5	2130 B, APHA, 21st EDITION
2		Temp. °c	25	-	2550 B, APHA, 21st EDITION
3		pH	7.34	6.5 - 8.5 *	4500-H+ B, APHA, 21st EDITION
4		Electrical Conductivity (µs/cm)	51	1500	2510 B, APHA, 21st EDITION
5	Chemical	Iron (mg/L)	0.34	0.3 (3)	3111 B. APHA, 21st EDITION
6		Manganese (mg/L)	0.04	0.2	3111 B. APHA, 21st EDITION
7		Arsenic (mg/L)	<0.01	0.05	3114 C, APHA, 21st EDITION
8		Ammonia (mg/L)	<0.2	1.5	4500-NH3 C.,APHA, 17th EDITION
9		Residual Chlorine (mg/L)	ND	0.1-0.5*	COLORIMETRY
10	Microbiological	Faecal coliform *E.coli*(CFU/100 ml)	28	0	9222 D., APHA,21st EDITION

APHA: *American Public Health Association, Standard Methods for Examination of Water & Waste Water*
** 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 Standard Guideline.
This test report refers only to the samples submitted to test.

D. Nath
Analyzed By:

Approved By:

Figure 13: Report of drinking water quality test of Prithivi Narayan Small Town WSUC.

2.2 SFD Selection Grid

Figure 14 shows the types of sanitation technologies present in the Gorkha 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 pit and twin pits are selected as lined pit with semipermeable walls and open bottom in this selection grid.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B					Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution					
Fully lined tank (sealed)					Significant risk of GW pollution T1A3C5					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 T1A4C5					T2A4C10 T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution T1A5C10
Unlined pit										T2A6C10 T1A6C10
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable							T1B11 C7 TO C9		Not Applicable

Figure 14: SFD selection grid for Gorkha Municipality.

The detail description of selected terms in the selection grid is provided in Table 4:

Table 4: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 14.

T1A3C5	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. Since the tank is fitted with a supernatant/effluent overflow connected to a correctly designed, properly constructed and fully functioning soak pit, 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. 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. However, since the tank is NOT fitted with a supernatant/effluent overflow, this system is considered contained.
T1A4C5	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 an effluent overflow connected to a correctly designed, properly constructed and fully functioning soak pit, the excreta in 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. 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.
T2A4C10	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur - the excreta is therefore likely to be partially treated. It includes all lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks (e.g. cubluks in Indonesia). 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.
T2A6C10	A correctly designed, properly constructed and well-maintained unlined pit with permeable walls and base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered NOT contained.

2.3 SFD Matrix

2.3.1 Proportion of Faecal Sludge from types of sanitation technologies

The second step in the process of developing the SFD graphic is the calculation of the proportion of contents of each type of onsite container which is faecal sludge. SFD matrix calculates the proportion of people using each type of system and the proportion of each system, from which FS and supernatant is emptied, transported and treated. A detailed instruction on how to calculate SFD proportion in SFD PI was used as guide to calculate SFD proportion. As stated on SFD PI, the default "100%" value is used for onsite containers which are connected to soak pits, water bodies or to open ground. This will model the contents as 100% faecal sludge and a proportion of this may be emptied periodically. The remaining not emptied fraction is made up of one or more of the following: faecal sludge which remains in the container, supernatant (when discharging to water bodies or to open ground), and infiltrate. The value for onsite containers that are connected to a sewer network or to open drains is used as "50%" which means half of the contents are modelled FS and a proportion of this may be emptied periodically. The remaining not emptied fraction will comprise faecal sludge which remains in the container and, in the case of open-bottomed tanks, infiltrate. The other half of the contents is modelled as supernatant discharging into the sewer network or to open drains. The formula obtained from SFD PI used for FS proportion calculation is shown below:

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

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

i. The proportion of FS in septic tank is 0%, since there are no septic tanks in the municipality.

ii. The proportion of FS in fully lined tank is 100%, as of the fully lined tanks are not connected to an open/stormwater drain.

iii. The proportion of FS from lined tanks with open bottom and all types of pit is 100%, as the lined tanks with impermeable walls and open bottom and any pits are not connected to an open/stormwater drain.

Upon calculation of proportion of FS in each type of sanitation technologies, the population using the system selected in the SFD selection grid are fed in. The column Population (Pop) gives the proportion of population using type of sanitation system.

Figure 15 shows the SFD matrix of Gorkha Municipality.

Gorkha Municipality, Gandaki, Nepal, 16 Feb 2024. SFD Level: 2 - Intermediate SFD
Population: 52468
Proportion of tanks: septic tanks: 0%, fully lined tanks: 100%, lined, open bottom tanks: 10(

Containment				
System type	Population	FS emptying	FS transport	FS treatment
	Pop	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated
T1A3C10 Fully lined tank (sealed), no outlet or overflow	33.0	30.0	38.0	100.0
T1A3C5 Fully lined tank (sealed) connected to a soak pit	4.0	5.0	0.0	0.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	25.0	2.0	0.0	0.0
T1A4C5 Lined tank with impermeable walls and open bottom, connected to a soak pit	1.0	0.0	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	3.0	34.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	26.0	2.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	1.0			
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	4.0	10.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	3.0	0.0	0.0	0.0

Figure 15: SFD Matrix of Gorkha Municipality.

2.3.2 *Proportion of Faecal Sludge Emptied (F3)*

The proportion of faecal sludge emptied (F3) is calculated based on percentage of containment emptied (ENPHO, 2023) and amount of FS emptied during the process (KII-2, 2023) . The information on FS emptied from containment is obtained from the survey and sanitation workers of the municipality designated for the desludging service. In an average 20% of the FS in the containment which is very thick and does not dissolve in water, is not removed during emptying (KII-2, 2023) . Hence, actual proportion of FS emptied from each containment is calculated as:

$$\begin{aligned} &Actual\ Proportion\ of\ FS\ emptied\ (F3) \\ &\quad = percentage\ of\ containment\ emptied \\ &\quad \times proportion\ of\ FS\ removed\ during\ emptying \end{aligned}$$

Table 5 shows the actual proportion of FS emptied from each containment.

Table 5: Sanitation technologies and proportion of emptied faecal sludge (ENPHO[1], 2023; KII-2, 2023[2]).

Sanitation Technologies	SFD Reference Variable	Percentage of Population using	Empited Proportion of FS[1]	FS Empited from Containment[2]	Actual Proportion of Empited FS (F3)
Fully lined tank (sealed), connected to a soak pit	T1A3C5	4%	6%	80%	5%
Fully lined tank (sealed), no outlet or overflow	T1A3C10	33%	37%	80%	30%
Lined tank with impermeable walls and open bottom, connected to a soak pit	T1A4C5	1%	0%	0%	0%
Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	25%	3%	80%	2%
Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	3%	42%	80%	34%
Unlined pit, no outlet or overflow	T1A6C10	26%	2%	80%	2%
Open defecation	T1B11 C7 TO C9	1%	0%	0%	0%
Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A4C10	4%	13%	80%	10%
Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A6C10	3%	0%	0%	0%

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

The municipality does not have a Faecal Sludge Treatment Plant (FSTP), but FS from 1% of population is treated. The value for FS treated is obtained from the biogas digesters which is reclassified as fully lined tanks with no outlet or overflow (T1A3C10). The emptying proportion of FS for the system is 22% (F4 = 22%), and the capacity of fully functioning biogas digester is taken to 99% (F5 = 99%). Apart from biogas digester, FS emptied from other sanitation technologies are disposed in an open environment. Hence, the portion of FS delivered to treatment plant for the remaining technologies (F4) and treated (F5) is 0%.

2.4 SFD Graphic

Figure 16 shows the SFD graphic of Gorkha Municipality. The graphic shows that excreta generated from the proportion of the population that are safely managed is shown in green coloured arrowhead, whereas unsafely managed excreta are shown in red coloured arrowhead. It shows that excreta from 84% of the population are safely managed and excreta from 16% of the population are unsafely managed. It also represents the sanitation value chain going from left to right.

Onsite Sanitation

In the municipality, 99% of households rely on onsite sanitation systems. Of the total households having an onsite sanitation system, 92% of the population uses containment where FS is contained and 7% of the population uses containment where FS is not contained.

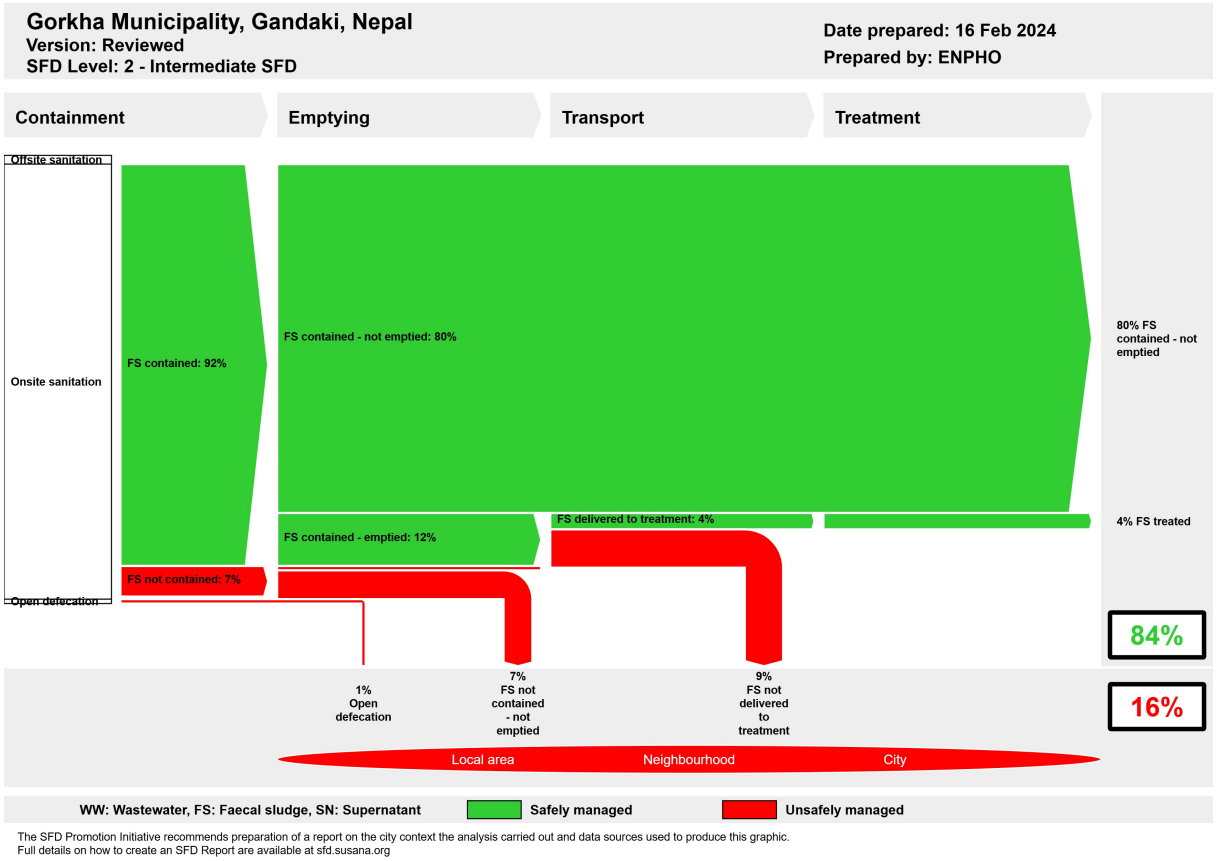


Figure 16: SFD Graphic of Gorkha Municipality.

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 value of FS contained i.e. 92% is obtained from the summation of population using fully lined tanks connected to soak pits and with no outlet or overflow (T1A3C5 and T1A3C10), lined tanks with impermeable walls and open bottom connected to soak pit and with no outlet or overflow (T1A4C5 and T1A4C10), lined pits with semi-permeable walls and open bottom with no outlet or overflow (T1A5C10) and unlined pit with no outlet or overflow (T1A6C10) without posing a significant risk to groundwater.

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 value of FS not contained i.e. 7% is obtained from the summation of population using lined tanks with impermeable walls and open bottom with no outlet or overflow (T2A4C10) and unlined pits with no outlet or overflow with 'significant risk' to groundwater (T2A6C10).

FS contained not Emptied

The value of 80% is obtained from the proportion of the population using sanitation systems where the FS is contained and have not emptied their containment.

FS contained Emptied

The value of 12% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

FS not contained Emptied

The value of FS not contained emptied is insignificant thus was round up to 1%, which 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

The value of 7% is obtained from the proportion of the population using sanitation systems where the FS is not contained and have not emptied their containment.

FS not delivered to treatment

The proportion of FS not delivered to treatment, i.e. 9%, is the summation of FS contained emptied and FS not contained emptied. Since Gorkha Municipality does not have FSTP, emptied FS is disposed of untreated to farmlands and forest. Therefore, this proportion of disposed FS possesses risk to local area and neighbourhood.

FS treated

About 5% of households in the municipality have biogas digester. The biogas digester here is considered as fully lined tank with no outlet or overflow. Despite the lack of treatment plant, the amount of FS delivered to biogas digester are treated at households. Thus, the proportion of FS treated i.e. 4% is obtained from the containment type fully lined tank with no outlet or overflow (T1A3C10).

Open Defecation

Despite Open Defecation Free (ODF) status, people residing in 1% of households still go for open defecation. Mostly, people living in poverty and who do not own land, do not have toilets in the municipality.

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

Local Government Operation Act, 2017

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

Environment Protection Act, 2019

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

Water Supply and Sanitation Act, 2022

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

Environment Friendly Local Governance Framework 2013

The environment-friendly local governance framework 2013 has been issued to add value to environment-friendly local development concept encouraging environmental protection through local bodies. The framework has set basic and advanced indicators for households, settlement, ward, village, municipality, and district levels for declaration of environment friendly. The use of water sealed toilets in households as basic indicators for sanitation and health. Provision of toilet with safety tank and use as advanced indicators for sanitation. Provision of gender, children and disabled friendly public toilets in parks, petrol pumps and main market as basic indicator for municipal level. Advance indicators such as drainage

discharged only after being processed through biological or engineering technique. While it has failed to identify the necessity of faecal sludge treatment plants as it has assumed safety tank in the households is sufficient for treating faecal sludge.

Institutional and Regulatory Framework for Faecal Sludge Management, 2017

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

Total Sanitation Guideline, 2017

Total Sanitation Guideline was promulgated by the Ministry of Water Supply in April 2017 after the successful implementation of 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 marginalised 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 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 recognised 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. After the MDGs, United Nations General Assembly set 17 global goals as Sustainable Development Goals (SDGs). Sanitation is prioritised on SDG 6. The target 6.2 of SDG 6 majorly focuses on sanitation. It mentioned to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations by 2030. In line with SDG 6.2, Nepal has targeted to provide improved sanitation to 95% households that are not shared and urban households with toilets connected to sewer system or proper FSM to 90% by 2030 (NPC, 2017). National Sanitation and Hygiene Master Plan, 2011 was developed for coordinated planning and implementation of National Sanitation Campaign. The campaign strengthened institutional setup tier of government in a participatory approach. In an alignment total sanitation campaign was initiated formally to sustain ODF. The guideline set various indicators to assess the sustainability of sanitation services. Remarkably, it extended sanitation definition as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish the hygienic environment and promote public health (NPC, 2017).

Similarly, Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (SDP 2016-2030) was formulated in 2016 for sector convergence, institutional and legal reforms, capacity development and establishing coordination and harmonisation in the sector. The SDP classified service system and delineated roles and responsibilities for effective and sustainable service delivery. The SDP highlighted that majority of households rely on onsite sanitation system (70%) that requires effective treatment of faecal sludge. However, there is lack of concrete policies, guidelines, and indicators on Faecal Sludge Management in the sector for effective planning, implementation, and service delivery. Nepal was declared ODF nation on September 23, 2019 (MoWS, 2020) however, the target of 90% households with toilets connected to sewer system or proper FSM is yet to be achieved.

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 is the specialised and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs,

identifies sources of funding, and allocates budget. It serves as a central agency for monitoring and evaluating development policy, plans and programs. It supports, facilitates, and coordinates with federal, provincial, and local government for developing policy plans and implementation.

Ministry of Water Supply: Ministry of Water Supply is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015). Under the MoWS, Department of Water Supply and Sewerage Management (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 organisational structure of DWSSM is shown in Figure 17.

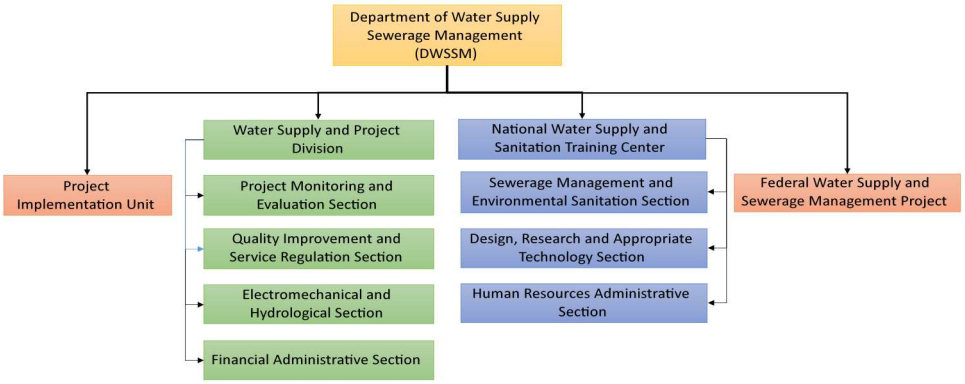


Figure 17: Organisational Structure Department of Water Supply and Sewerage Management (DWSSM).

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 Level

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 in the province 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 Water Supply and Sanitation Division Office (WSSDO), Gulmi. 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 Level

Gorkha Municipality has an Environment, Sanitation and Disaster Risk Management Unit under Infrastructure Development and Environment Management Section. The unit manages all the activities related to sanitation.

3.4 Service provision

Urban Water Supply and Sanitation Policy 2009 has emphasised the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, 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 directly connected to open drain, water bodies or open ground. The toilets that are connected to containments are emptied mechanically by desludging suction truck from municipality or private service providers whereas others are manually emptied by traditional desludgers.

3.5 Service standards

The sanitation service standards have been set by Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030). It classifies sanitation services as high, medium, and basic based on sanitation facilities in place. The sanitation service levels with indicators are shown in Table 6. However, FSM specific standards have yet to be developed and implemented.

Table 6: 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. The focal person at the municipality was interviewed on current sanitation services with respect to technical, institutional, and financial aspects. Also, the KII was performed with the private desludging service provider to understand the emptying practice, disposal and treatment of FS as well as finance requirement. Similarly, information related to drinking water supply was obtained from Water Supply Users' Committee. Also, an interview was performed with caretaker of public toilet along with observation to find sanitation status and management practice of public toilet (Table 7 and Figure 18).

Table 7: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organisation/Company	Purpose of KII	Date
1.	Dhurba Prasad Ghimire Gautam (KII-1)	Environment Officer	Gorkha Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	12 October, 2023
2.	Prakash Dhakal (KII-2)	Engineer	Gorkha Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	12 October, 2023
2.	Som Prasad Shrestha (KII-2)	Owner	Private Desludging Service Provider	Emptying practices, finances requirement, disposal and treatment	13 October, 2023
3.	Sushil Aryal (KII-3)	Manager	Prithivi Narayan Small Town Water Supply Users' Committee	Water supply services and water quality in Gorkha Municipality	12 October, 2023
4.	Dil Kumari Gurung (KII-4)	Caretaker	Public toilet-Harmatari	Quantitative and qualitative management on public toilet and public toilet operation	13 October, 2023
5.	Mera Parajuli (KII-4)	Caretaker	Public toilet-temple	Quantitative and qualitative management on public toilet and public toilet operation	15 October, 2023
6.	(KII-4)	Caretaker	Public toilet-Laxmibazar	Quantitative and qualitative management on public toilet and public toilet operation	15 October, 2023

Figure 18: KII with private desludger and caretaker of public toilet.

4.2 Household Survey

A random household survey was conducted in all wards of the municipality. The local enumerators selected from the municipality were oriented prior to the survey and were mobilised for data collection. A mobile application "KOBOCOLLECT" was used for data collection from the households. 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 (Figure 19).

Figure 19: Orienting local enumerators on SFD survey questionnaire and use of Kobo Collect.

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.

A total of 375 households were sampled from 14,988 households distributed in 14 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 20.

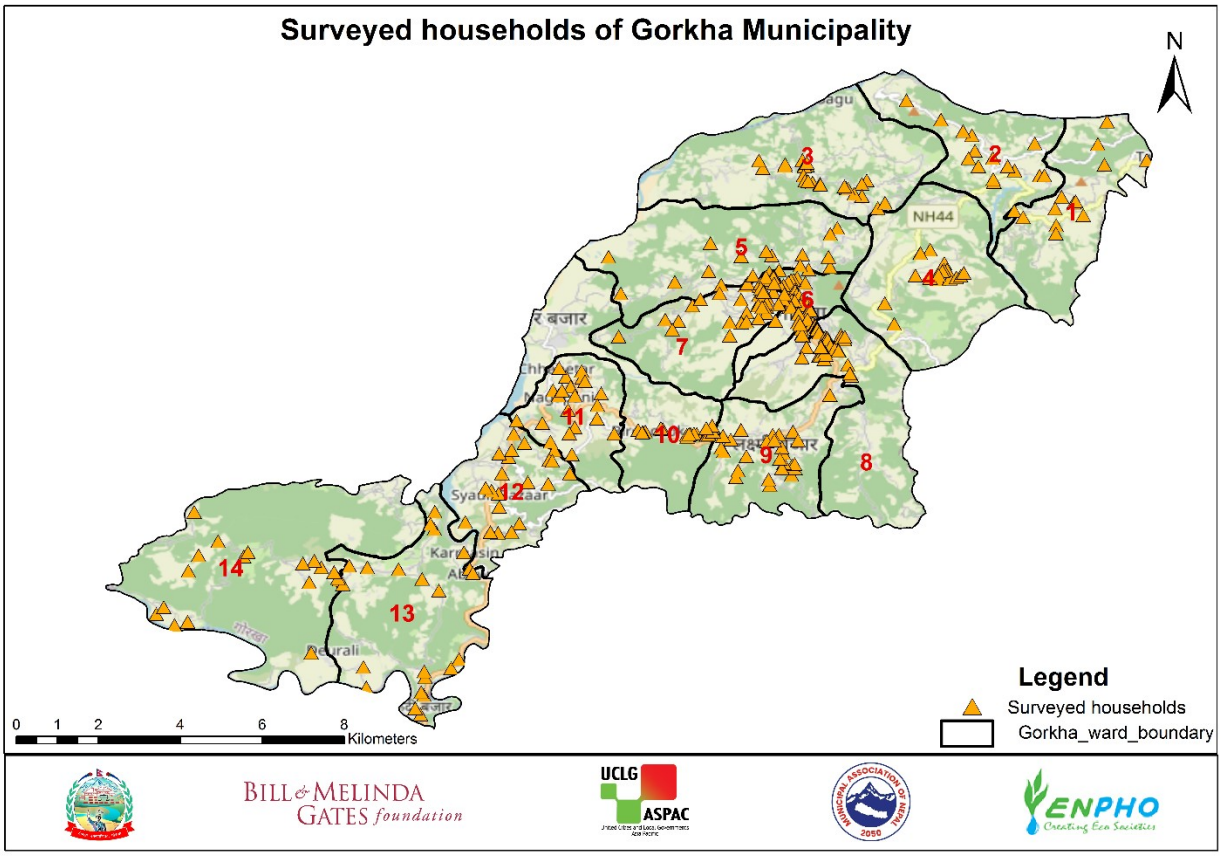


Figure 20: Location map of surveyed households.

4.3 Direct Observation

Various sanitation technologies within the municipality were observed and visual references were kept. Also, observation of the toilet, water source and containments were carried out. Observation of public toilet in Gorkha Municipality (Figure 21).

Figure 21: Observation during KII at public toilet of Gorkha Municipality.

4.4 Sharing and Validation of Data

The Shit Flow Diagram Sharing and Validation Workshop was conducted at Gorkha Municipality to share the findings on sanitation situation survey and receive the suggestions from the municipal stakeholders. Altogether, 36 participants including mayor, deputy mayor, chief administrative officer (CAO), ward chairpersons, municipal council members, sectoral staffs and other relevant stakeholders actively participated on the workshop and provided valuable suggestions. Participants appreciated the evidence-based data of Gorkha Municipality and discussed for further improvement of FSM in the municipality. Figure 22 shows the picture of SFD findings sharing to the participants. The list of participants with their designation is attached in Appendix 4.

Figure 22: Sharing of findings during validation workshop.

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 municipality.

We offer sincere acknowledgement to Mr. Krishna Bahadur Rana Magar, Mayor, Ms. Masali Maya Thokar, Deputy Mayor, Mr. Krishna Prasad Subedi, CAO and Mr. Prakash Dhakal, Engineer of the municipality for providing valuable time and information during study and Mr. Dhurba Prasad Ghimire, Environment Officer for the coordination of the program. Similarly, we would like to thank all the respective staffs of the municipality and key stakeholders 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

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 population and household in each ward and number of surveyed households

Wards	Total Population	Total Household	No. of Surveyed Households
1	1,708	529	13
2	1,972	582	15
3	2,986	965	24
4	2,678	758	19
5	3,113	823	21
6	7,689	2,258	56
7	5,384	1,505	38
8	7,079	2,084	52
9	4,043	1,114	28
10	4,084	1,069	27
11	3,153	896	22
12	3182	831	21
13	3,247	925	23
14	2,150	649	16
Total	**52,468**	**14,988**	**375**

7.3 Appendix 3: List of Participants on SFD Survey Orientation

UCLG ASPAC

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 at Gorkha Municipality
Date: 26-27 Asoj, 2080
Venue: Gorkha Municipality Hall

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1.	Durga Kharel	Gorkha M.	9	[illegible]	[illegible]	[illegible]	21	female	2
2.	Kajal Thapa	Gorkha M.	5	9823841656	[illegible]	[illegible]	26	Female	6
3.	Alisha Thapa Roka	Gorkha	7	970272353[illegible]	[illegible]	[illegible]	29	Female	6
4.	Binita Devkota Bhatta	"	4	9865208258	Binita	[illegible]	24	"	2
5.	Mina Bharati Thapa	Gorkha	3	[illegible]	[illegible]	[illegible]	25	Female	2
6.	Chu Ali Mira	Gorkha	2	[illegible]	[illegible]	[illegible]	40	Male	4
7.	Sagal Jesi	Gorkha	6	[illegible]	[illegible]	[illegible]	19	Male	3
8.	Apsara Chumi Magar	Gorkha	10	9818070629	[illegible]	[illegible]	28	femal	3
9.	[illegible]	Gorkha	12	[illegible]	[illegible]	[illegible]	29	male	3
10.	Bigyan Thapa Magar	Gorkha	11	[illegible]	[illegible]	[illegible]	[illegible]	male	3
11.	Anita Darkoti Sigmai	Gorkha	4	[illegible]	[illegible]	[illegible]	26	Female	1
12.	Pratima Shrestha	Gorkha	8	9818132970	[illegible]	[illegible]	21	female	3
13.	Sandhya BK	Gorkha	13	[illegible]	[illegible]	[illegible]	25	Female	1
14.	Suna Kanchha Rana	Gorkha	14	[illegible]	[illegible]	[illegible]	25	Male	3
1									

7.4 Appendix 4: List of Participants in Sharing and Validation Workshop

आज मिति २०८० साल फागुन ११ गतेका दिन गोरखा नगरपालिकामा नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (इन्फो को) प्राविधिक सहयोग, The United cities Local Government Asia Pacific (UCLG ASPAC) को सहकार्यमा र Bill and Mellanda Gates foundation (BMGF) आर्थिक सहयोगमा मानव मलमुत्र रेखा प्रवाह चित्र (Shit flow Diagram - SFD) सम्बन्धि छलफल तथा प्रमाणिकरण कार्यक्रममा निम्न अनुसारको सरोकारवालाहरुको उपस्थिति रहेको छ ।

उपस्थिती :

क्र.स	नाम	पद	कार्यालय	फोन नं	हस्ताक्षर
१.	कृष्ण बहादुर राना मगर	नगर प्रमुख	गोरखा न.पा	9856040112	
२.	मसली माया घोकर	नगर उपप्रमुख	गोरखा न.पा	9856070363	
३.	कृष्ण प्रसाद सुवेदी	प्रमुख प्रशासकीय अधिकृत	गोरखा न.पा	985602811[illegible]	
४.	रहम तुल्ला मियाँ	वडा अध्यक्ष	गो. न.पा-२	9856040333	
५,	कुल बहादुर कुँवर	वडा अध्यक्ष	गो.न.पा-[illegible]	9856040717	
६-	मित्रा पाण्डे	वडा अध्यक्ष	गो.न.पा-१३	9856041599	
७	टिल बहादुर थापा मगर	वडा अध्यक्ष	गो.न.पा-१२	98560400 33	
८	राधिका थापा पुलामी	कार्यपालिका सदस्य	गो.न.पा १०	9856065640	
९	Anish Aryal	सूचना प्रविधि	गोरखा	9816777190	
१०	विजय उपाध्याय	प्र. अ.	,,	9856040315	
११.	तिलक बहादुर पाण्डेय	लेखा अधिकृत	गो.न.पा	9849961326	
१२	प्रकाश ढकाल	इन्जिनियर	,,	९८४१२९३६९०	
१३	नारायण भट्टराई	स.इ. अ.	,,	९८४६७८८६०५	
१४	किरण बाबु खतिवडा	प्र.प्र.अ.	,,	९८६५०२६६९०	
१५	अनुका कुँवर (थापा)	का.स.	,,	९८४६०४६३१४	
१६	सुशिला कानियाँ	फिल्ड सहायक	,,	९८४६२४३६८३	
१७	विमला वाग्ले	क्रां तथा पं.अं.शाखा प्रमुख	,,	९८४६०६८३३९	
१८	सावित्री अधिकारी	लेखापाल	,,	९८४६०८९१४३	

क्र.सं	नाम	पद	कार्यालय	फोन नं	हस्ताक्षर
१९	बद्री गतौला	अधिकृत छैठौं	स्वास्थ्य शाखा	९८४६०४९१३४	[signature]
२०	निरक के.सी.	केन्द्रिय सदस्य	[illegible]	[illegible]	[signature]
२१	भुवन सिंह बस्नेत	अध्यक्ष	खानेपानी	९८४६०८५३८	[signature]
२२.	बाबुराम खत्री	अध्यक्ष	गो.न.पा.८ [illegible] खा. पानी	९८४१८३२००९	[signature]
२३.	राज कुमार श्रेष्ठ	अध्यक्ष	[illegible] गोरखा	९८५६०८१९०८	[signature]
२४.	राजेन्द्र कुमार जोशी	वडा अध्यक्ष	गो न.पा.९	[illegible]	[signature]
२५	चेत प्रसाद अर्याल	अधिकृत	गो. न. पा.	९८४६०८९००६	[signature]
२६	चुडबहादुर कुँवर	वडा अध्यक्ष	गो न पा ३	९८५६०६५३३	[signature]
२७	लाल प्र. भट्टराई	वडा अध्यक्ष	गो न पा ४	[illegible]	[signature]
२८	राम कुमार श्रेष्ठ	प्र. प्र. अ.	गोरखा न.पा.	[illegible]	[signature]
२९	[illegible]	"	"	९८४६०८८१०८	[signature]
३०	ई. सुरचना [illegible]	[illegible]	"	[illegible]	[signature]
३१	राम बहादुर खड्का	वडा अध्यक्ष	गो.न.पा.११	[illegible]	[signature]
३२	लक्ष्मी राम [illegible]	वडा अध्यक्ष	गो न पा ८	९८५६०८२८६	[signature]
३३	राजेश राना मगर	सा.क.अ	गोरखा नगरपालिका	९८६६६७१४३२	[signature]
३४	जीवन कुमार श्रेष्ठ	ई. नि.	गो. न. पा.	[illegible]	[signature]
३५	रिता मगराती	का.पा.स	गो.न.पा ५	[illegible]	[signature]
३६	पम्फा [illegible]	"	" ६	[illegible]	[signature]
37.	Asnita Shrestha	A.P.O	ENPHO	986060570	[signature]
38.	Anita Bhuju	A.P.O.	"	9849238197	[signature]

SFD Gorkha Municipality, Nepal, 2026

Produced by:
Anita Bhuju, ENPHO
Rupak Shrestha, ENPHO
Buddha Bajracharya, ENPHO
Asmita Shrestha, ENPHO
Sabuna Gamal, ENPHO

This Executive Summary and the SFD Report are available from:

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