SFD Report

Besishahar 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 Besishahar Municipality, Nepal, 2025

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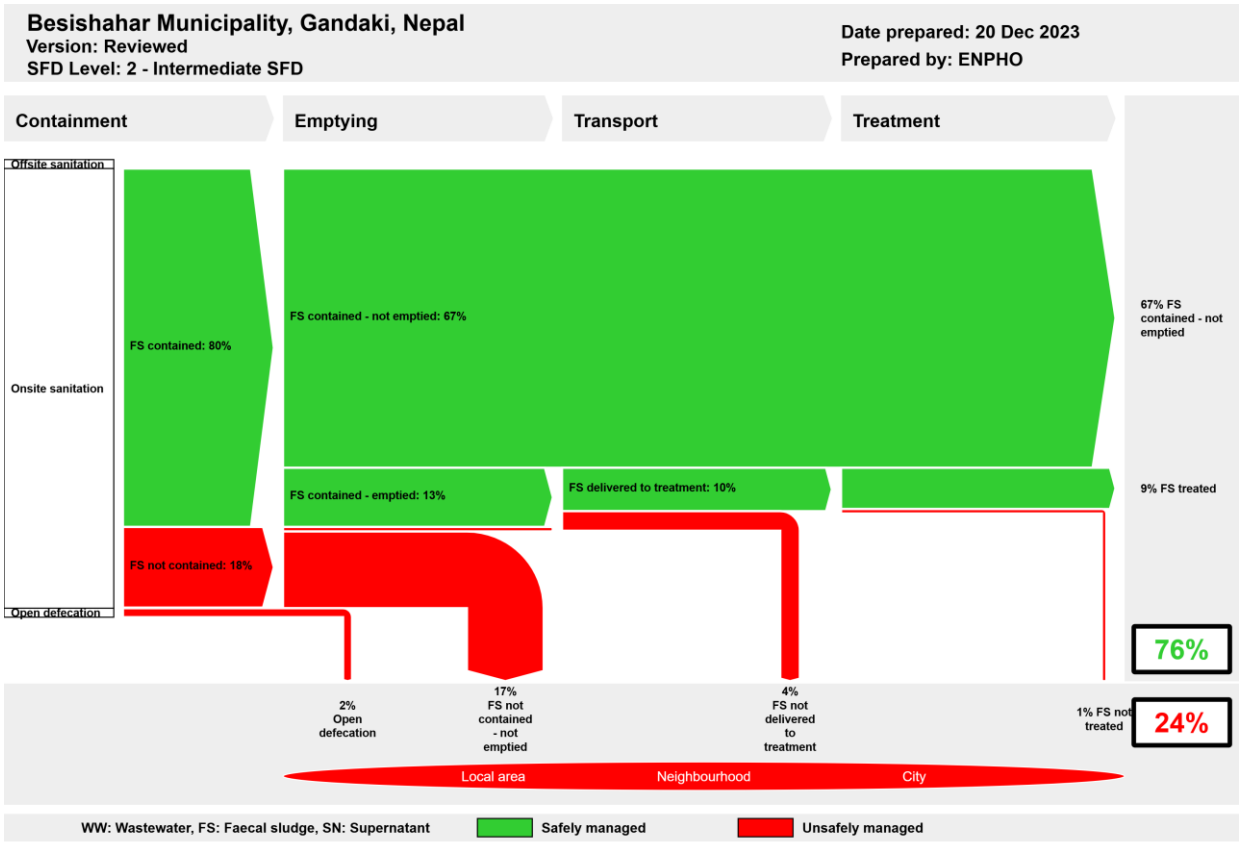
1. The SFD Graphic



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:

Besishahar Municipality

Municipal Association of Nepal (MuAN)

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

Status:

Final SFD Report.

Date of Production:

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3. General city information

Besishahar Municipality, located in the Lamjung district of Nepal's Gandaki Province, was formed through the merger of several Village Development Committees (VDCs).

According to the 2021 National Population and Housing Census, Besishahar Municipality has a population of 38,232 individuals residing in 11,038 households, with males 46.8% and females 53.2%.

The municipality experiences a temperate highland tropical climate with dry winters, having January as the coldest month. The municipality have diverse topography, including low-lying valleys, rolling hills, and rugged mountains with an elevation ranging from 650 m to 1,958 m above sea level (NSO, 2022).

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 2% of the total population are deprived from access to basic sanitation facilities and defecate in open places.

Containment:

In Besishahar Municipality, 98% of the population has access to improved sanitation facilities, relying on onsite sanitation systems. 38% utilize fully lined tanks, while 41% employ lined tanks with open bottoms. Additionally, 19% resort to unlined pits. Among the surveyed institutions all have access to safely managed sanitation systems. Notably, 16% of institutions have fully lined tanks, 76% have lined tanks with open bottoms, and 8% have septic tanks.

Emptying and transportation:

Among the 98% of households with containments, 6% were emptied due to faecal sludge overflow, 45% opted for mechanical emptying and 55% practiced manual emptying. KII findings highlighted complaints about open emptying near Jhinge Khola, particularly during the rainy season. Transportation of faecal sludge relied on a private desludging vehicle operated by Batabaran Sudhar tatha Bikas Abhiyan, averaging 1-2 trips per month. Only 4% of institutions have undergone mechanical emptying to date.

Treatment and Disposal:

None of the faecal sludges are treated due to the absence of treatment facilities. Currently, sludge emptied through mechanical desludging is disposed of by trenching method near the municipality's solid waste dumping site in ward 8, located close to the riverbank. Those who practiced manual emptying, sludge was applied directly to farms, disposed of through dig and dump methods, composted for use as manure, and dumped into water bodies.

Risk Assessment:

The findings showed that 34.95% of households rely on spring sources as their primary drinking water source, while 62.37% have access to private taps. The contamination risk is influenced by containment type and drinking water source, particularly lined tanks with open bottoms and unlined pits. Further water quality test report was also observed and analyzed accordingly to assess the risk. The water quality tests report was obtained from various sources within the municipality which revealed no E. coli contamination, but seasonal variations, notably during the rainy season, warrant attention. Proximity between spring sources and open-bottom containment systems is crucial, with springs located above residential areas posing lower contamination risks.

The SFD graphic showed that FS generated by 76% of population are safely managed while 24% are unsafely managed. The safely managed Faecal Sludge (FS) generated by 67% 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 needs of people. Particularly, the National Sanitation and Hygiene Master Plan (NSHMP) 2011 has proved as an important strategic document for all stakeholders to develop uniform programs and implementation mechanism at all levels. It strengthens institutional set up with the formation of water and sanitation coordination committee at every tier of government to actively engage in sanitation campaigns.

The municipality has implemented the Health and Sanitation Act with a strong emphasis on hospital waste management; however, faecal

sludge management has received limited attention within the framework.

6. Overview of stakeholders

Based on the regulatory framework for Faecal Sludge Management (FSM), the major stakeholders for effective and sustaining service delivery is 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 Supply
Public Institutions at Local Government	Besishahar Municipality
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, 372 households and 25 institutions were surveyed from 11 wards of the municipality. Primary data on emptying, transportation, and current sanitation practices in the municipality are validated from Key Informant Interviews (KIIs) with desludgers, 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 22 February 2024.

8. Process of SFD development

Data on sanitation situation is collected through household and institutional surveys. Enumerators from the municipality were mobilized after providing orientation on sanitation technologies, objectives of the survey and proper use of mobile application, KOBOCOLLECT for collection of data for survey. Along with this, KIIs were conducted with officers 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 was fed into SFD graphic generator to produce the SFD graphic.

8. List of data sources

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

- ENPHO. (2023). Sanitation Survey on Besishahar Municipality
- 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.
- Susana. (2018). Susana Manual.

SFD Besishahar Municipality, Nepal, 2025

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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	Kilometers
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
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
UNICEF	United Nations Children's Education Fund
VDC	Village Development Committee
WASH	Water, Sanitation and Hygiene
WSSDO	Water supply and Sanitation Divisional Office
WHO	World Health Organization
WSUC	Water Supply and User's Committee

1. City context

Besishahar Municipality is situated in the Lamjung district of the Gandaki Province, Nepal. It was established in 2014/05/08 A.D (2071/1/25 B.S) by merging Village Development Committee (VDC) named Besishahar, Gaunshahar, Udipur, Chandisthan, Nalma and Purankot which was again restructured by merging Baglungpani (ward 3,4,7,8 and 9), Bajhakhet, Hiletaksar and Chiti. The municipality is divided into 11 wards. Its geographical location makes it a gateway to various trekking routes and tourist destinations, attracting visitors from around the world (Besishahar Municipality, 2023). The centre of the municipality lies in ward 8, Besishahar Bajar.

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

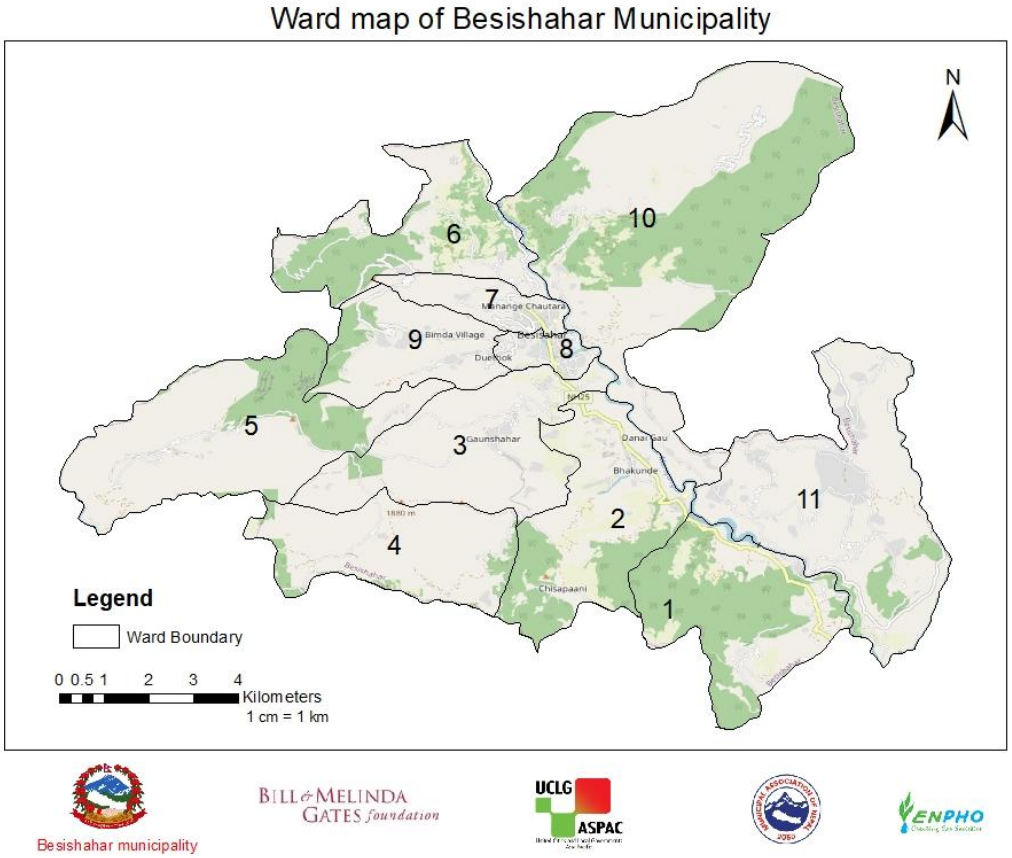


Figure 1: Map of Besishahar Municipality with ward boundaries.

1.1 Population

As of the 2021 National Population and Housing Census, the population of Besishahar municipality was 38,232 individuals, residing in 11,038 households. The male population accounted for 17,879 (46.8%) while the female population was 20,353 (53.2%) (NSO, 2021). The municipality has experienced an annual growth rate of -0.57% and a population density of 300/km² (City Population Besishahar, 2023). Among the wards, ward number 7 recorded the highest population with 8,083 individuals, while ward 4 had the least, with 831 individuals (NSO, 2021).

1.2 Climate

Besisahar has a temperate highland tropical climate with dry winters climate (Classification: Cwb). It receives about 250.62 millimetres (9.87 inches) of precipitation and has 196.04 rainy days (53.71% of the time) annually (Figure 2). June is the warmest month, and January marks the coldest month. Additionally, July is the wettest month, while November is the driest month (Weather and climate, 2020). The annual temperature of the municipality is 25 degree celsius (Besishahar Municipality, 2024).

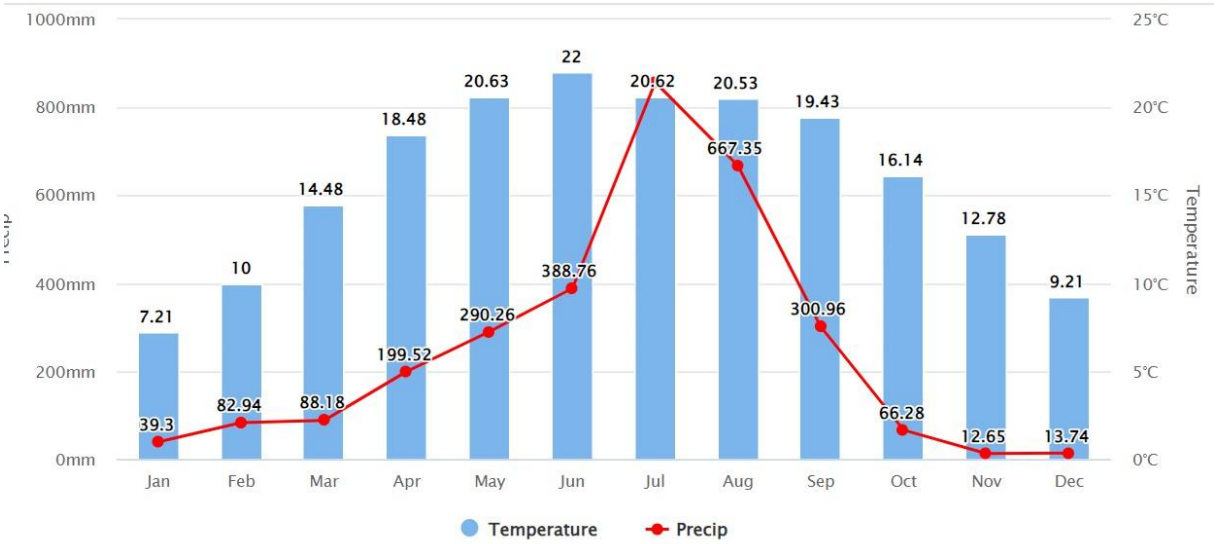


Figure 2: Climate summary of Besishahar Municipality.

1.3 Topography

Besisahar Municipality shows diverse topography encompassing low-lying valleys, rolling hills, and rugged mountainous terrain. The area is intersected by rivers and streams, facilitating irrigation, and supporting a variety of crops. It is characterized by diverse landscapes within its geographical boundaries with latitude 28°13'08.1"N and longitude 84°21'10.2"E (Places in the world, 2023). The elevation of the municipality is 650 m to 1,958 m above sea level. From Kathmandu it lies 178 km west and from Pokhara it is 108 km east. It shares its western border with Dordi Rural Municipality, Kwhlosodhar Rural Municipality and Central Nepal Municipality to West, Marsyangdhi Rural Municipality to North and Sundarbajar Municipality to South (Besishahar 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. The municipality was declared as ODF (Open Defecation Free) zones in 2016 (Besishahar Municipality, 2023).

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2023). As per the findings of this household survey, despite municipality making significant progress, 2% still resort to open defecation (ENPHO, 2023). To assess the sanitation status across the entire sanitation value chain, a household survey was conducted in 372 sampled households using a proportionate sampling across the 11 wards of Besishahar (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 is presented in this section.

2.1.1 Sanitation systems in household buildings

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, 98% of the households has access to improved sanitation facilities. Those who had containments in their house, 100% rely on onsite sanitation systems. 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). In the municipality, 12% had biogas installed and 26% of households had fully lined tanks with a single or double chamber. Additionally, 41% of households have constructed lined tanks with impermeable walls and an open bottom and 19% of households have unlined pits.

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 Besishahar 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	12%	Fully lined tank	38%
Fully Lined tank	Cemented brick/stone walls or concrete walls	PCC or plaster	One or two	NA	26%		
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	41%	Lined tank with impermeable walls and open bottom	41%
Unlined Pit	Mud mortar stone or brick wall	Soiling or nothing	NA	NA	19%	Unlined Pit	19%
Open defecation	NA	NA	NA	NA	2%	Open defecation	2%
						Total	**100%**

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, 12% of households have biogas digesters installed as shown in Figure 3. When creating SFD graphic, biogas is reclassified as SFD containment, considering it as a fully lined tank.

Figure 3: Biogas digester installed in one of the households.

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 (Strande, Ronteltap, & Brdjanovic, 2014). In the municipality, only 26% of households have fully lined tanks built.

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 the groundwater (Peal, et al., 2020). In the municipality, 41% 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. It is installed in 19% of the sampled households. 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 practice heightens the risk of contamination of water sources. Figure 4 are the unlined pit that are built in households of the municipality, while Figure 5 demonstrates the overall mapping of the different containments built within the municipality.

Figure 4: Unlined containments built in municipality.

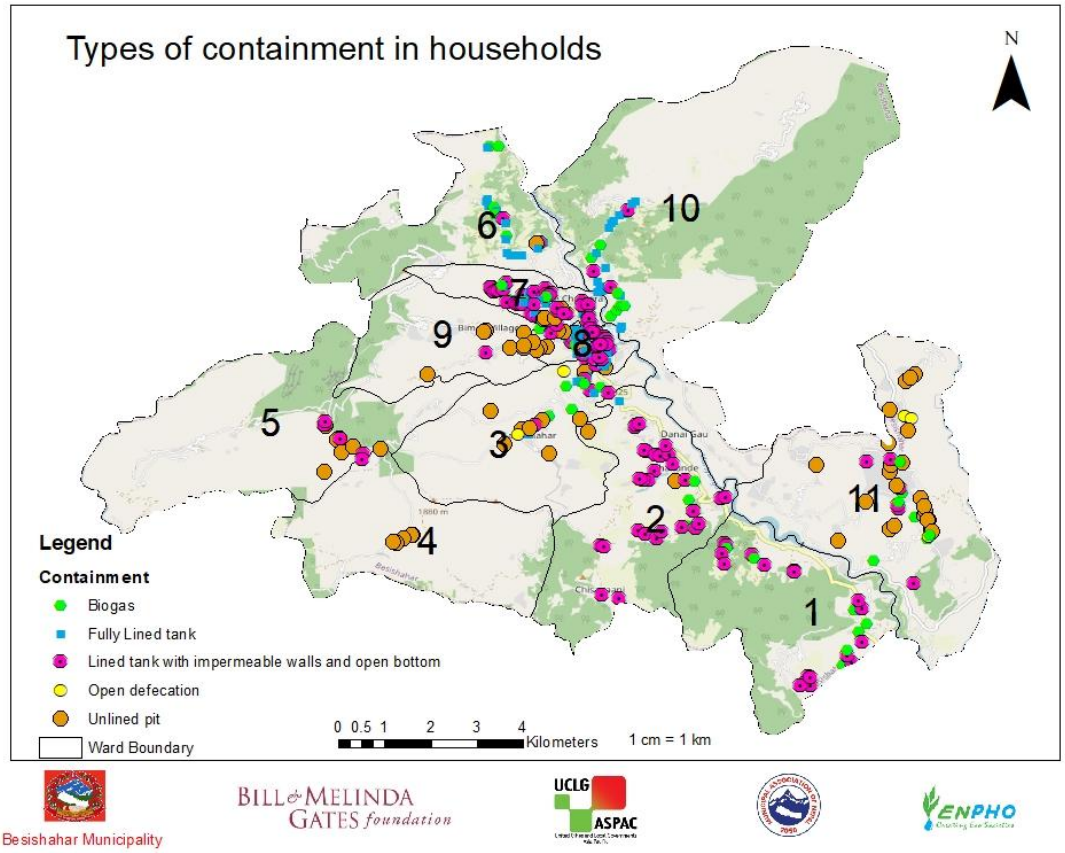


Figure 5: Map locating different types of containment in municipality.

2.1.2 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, Ronteltap, & Brdjanovic, 2014). Interestingly, of the total 98% households with containment, 6.19% have emptied their containment due to faecal sludge overflow. The data showed that 45% of the emptied containment is mechanically emptied, while the remaining 55% rely on manual emptying. The contributing factor for manual emptying includes containments being not accessible for mechanical emptying and the high cost associated with using desludging vehicles (*KII-1, 2023*). Additionally, KII findings highlighted complaints about open emptying of the containment near Jhinge Khola, observed mainly in the rainy season.

For transportation of faecal sludge, there was one private desludging vehicle (Figure 6) which received very less demand of about 1-2 trips per month (KII-3, 2023). The private desludging services is being looked by Batabaran Sudhar tatha Bikas Abhiyan (Figure 6). The service was started in 2021 with a vehicle of 3,500-4,000 litre capacity. There are 3 staff working in the vehicle and the service charge was Rs. 8,000-9,000 (USD 56-63) per trip (KII-3, 2023).

Figure 6: Private desludging vehicle operating in Besishahar Municipality.

2.1.3 Treatment and disposal/reuse of faecal sludge

None of the faecal sludge undergoes treatment because there are no treatment facilities. During the study period, mechanically emptied FS were being disposed of using the trenching method near the municipality's solid waste dumping site in ward 8. This disposal site is situated close to the river bank. While, among those who practice manual emptying, as depicted in Figure 7, practices as direct application to farms, disposed through dig and dump methods, composting for use as manure, and dumping into water bodies is used. However, the direct application of FS in farm, and water bodies cant be considered safe as it possess risks to environment and public health.

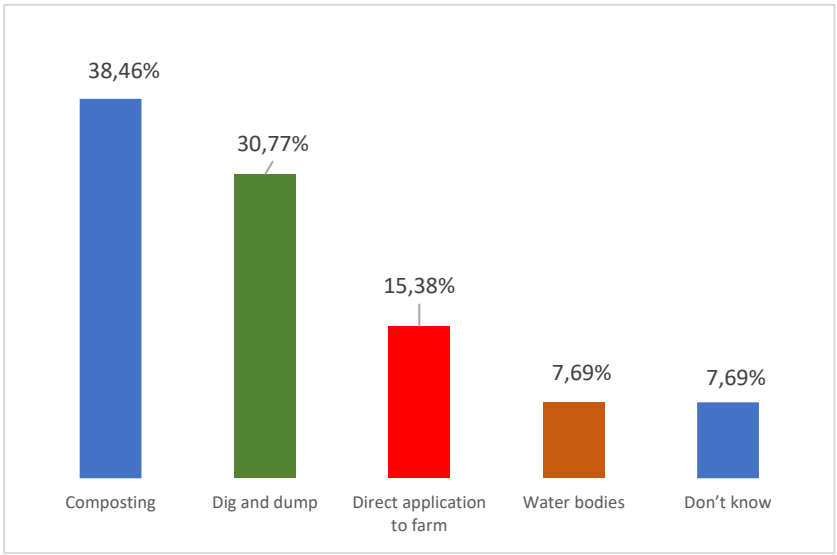


Figure 7: Disposal practices after manual emptying.

2.1.4 Sanitation system in institutional buildings of Besishahar Municipality

All the surveyed 25 institutions had access to a safely managed sanitation system in the municipality. Different institutions such as educational institutes, government and non-government offices, health care centers and hotels with lodging facilities and commercial buildings were surveyed. The findings showed that 16% of institutional buildings had made fully lined tanks, 76% had lined tanks with impermeable walls and open bottoms and 8% had built septic tank (Figure 8). Only 4% of the institutions have been emptied till date, all mechanically emptied (ENPHO, 2023).

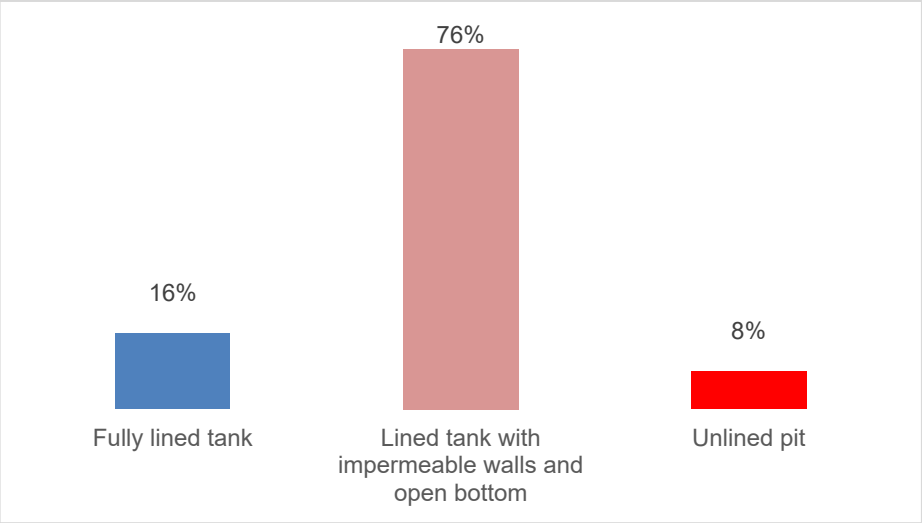


Figure 8: Containments used in institutional building.

2.1.5 Public toilets

There were about 5-6 public toilets located within municipality (KII-1, 2023). The information about 3 public toilets was taken: one near the municipal building, one in buspark area and one in Malami Chaur. One public toilet located near the municipal office had very poor sanitary condition. There was not any caretaker assigned for the toilets, and it was open to all without any charge. There were 2 separate toilets for male and female. The toilet was connected to a rectangular holding tank and had not been emptied till date. The building and sanitary condition of the toilet was very unsanitary as shown in Figure 9.

Figure 9: Public toilets near Besishahar municipal building.

There was another public toilet located in buspark area in Kalika Chowk. The sanitary condition of the toilet was good, with separate facilities for male and female toilets. As informed by the general public, caretaker has not been assigned for the toilet (Figure 10).

Figure 10: Public toilet located in buspark area.

The public toilet situated in Kupreswor Park was constructed by the Grahmin Khanepani Tatha Sarsafai Kos Bikas Samiti with a budget of Rs.1339,609 (USD 10,045). It comprises three separate sections: one for males, one for females, and one for disabled individuals, making it disability friendly. The facilities include wash basins, water taps, adequate water supply, well-ventilated rooms, and cleaning materials. The toilet is connected to a rectangular holding tank, which has not been emptied till date (Figure 11).

Figure 11: Public toilet constructed in Kupreswor park.

2.1.6 Risk assessment of spring source contamination from open bottom containment

The risk of drinking water source contamination was assessed based on source of drinking water, secondary data on water quality and the distance and vulnerability of the spring source with regards to spacing between sanitation systems.

The findings indicated that a significant portion, comprising 34.95% of households, relied on spring sources as their primary drinking water source. Moreover, 62.37% had access to private taps within their homes, while 2.15% consumed water from public taps, and 0.54% relied on jar water. However, this recorded data is based on the sources which households use for drinking purpose. It was also found that many households have a private water tap in their house, yet they still use spring water for drinking purposes. As a result, the spring source is considered the primary drinking water source (ENPHO, 2023). There are about 146 drinking water schemes, of which 59% i.e. 86 are completely safe, 37% (54) old schemes, and 4% (6) good and functioning. (Besishahar Municipality Redbook, 2024).

The vulnerability of water source contamination is specific to containment type and pollution scenarios (Andreo, 2013). Here, among the various types of onsite sanitation technologies, lined tanks with impermeable walls and open bottom and unlined pits are more prone to contribute to contamination. For considering the contamination risk of water source due to open bottom containment, water quality test report from different sources of water within Besishahar Municipality was observed and analyzed. The water quality test report was made available from the health section of the municipality.

In accordance with the World Health Organization's (WHO) guidelines for drinking water quality, the presence of *E. coli* serves as an indicator of potential faecal contamination. As per the National Drinking Water Quality Standard of 2022, drinking water should be free of *E. coli*, indicated by a count of 0 colony-forming units (CFU) per 100 millilitres of water. Consequently, the water quality test reports from various WSUCs were analyzed (present in appendix 5), revealing no *E. coli* contamination in sampled sources of drinking water. However, the fact that *E. coli* contamination is seen maximum during the rainy season making it a heading for news coverage should also be considered *(KII-4, 2023)*. Thus, a thorough analysis of the risk posed by water distributed by WSUCs, particularly in terms of open-bottom containment systems, was analyzed. Furthermore, the proximity between spring sources and open-bottom containment systems is a critical factor in assessing contamination risk. Springs located approximately 500 metres above residential areas are deemed to pose a lower risk of contaminating drinking water compared to those situated below residential areas.

Therefore, 40% of the population depends on lined tanks with impermeable walls and an open bottom, with no outlet or overflow (29%, T1A4C10, low risk and 11%, T2A4C10, high risk) and 19% relies on unlined pits (13%, T1A6C10, low risk and 6%,T2A6C10, high risk).

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 Besishahar municipality are shown in Figure 12. 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.

Following Figure 12 displays various sanitation systems in municipality, their selected outlets in the grid, and the subsequent calculation of the population proportion using each system in the SFD graphic generation process.

Figure 12: SFD selection grid for Besishahar Municipality.

A brief explanation of terms used to indicate different frames selected in the SFD selection grid is explained in Table 2.

Table 2: Explanation of terms used to indicate frame selected in the SFD selection grid.

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.
T2A4C10	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur - the excreta is therefore likely to be partially treated. The tank is not fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained.
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.
T2A6C10	This is a correctly designed, properly constructed and well-maintained unlined pit with permeable walls and base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered NOT contained;
T1B11C7 to C9	With no toilet, users defecate in water bodies, on open ground and to don't know where; consequently, the excreta is not contained.

2.3 SFD proportion and matrix

2.3.1 Proportion of faecal sludge from types of sanitation technologies

In the second step of developing SFD graphic, 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 modeled 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 modeled 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:

1. The proportion of faecal sludge (FS) in septic tanks is 0% as there was no percentage of septic tank installed.
2. 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.
3. 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 Faecal Sludge (FS) in each type of sanitation technology, the corresponding population proportions from the selected technologies in the SFD selection grids are inputted. Figure 13 illustrates the SFD matrix of the municipality.

Besishahar Municipality, Gandaki, Nepal, 20 Dec 2023. SFD Level: 2 - Intermediate SFD
Population: 38232
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	38.0	30.0	85.0	95.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	29.0	4.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0	20.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	13.0	5.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	2.0			
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	11.0	6.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	6.0	0.0	0.0	0.0

Figure 13: SFD matrix of Besishahar Municipality.

2.3.2 Proportion of faecal sludge emptied (F3)

The column labeled "Population (Pop)" in Figure 13 displays the proportion of contents for each type of onsite container (fully lined tanks (sealed), lined tanks with impermeable walls and open bottom, and unlined pit). The variable F3 represents the proportion of contents in each type of onsite container that undergoes at least one emptying after construction. The calculation of the proportion of faecal sludge emptied (F3) is based on the percentage of containment emptied and the amount of faecal sludge (FS) emptied during the process. According to findings from household surveys and key informant interviews (KII-3, 2023), approximately 80% of the FS in the containment is emptied. This is attributed to most containments getting filled and some proportion left while manual emptying. In case, where the faecal sludge is characterized by high thickness and poor water solubility, then FS remains unremoved during emptying, as reported by KII. Also, the survey data indicated that only about average 80% of the FS in the containment, are emptied as all the portions are not completely cleaned and some remains in container. The calculation of the emptied proportion of FS is adjusted accordingly as following, (Table 3):

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

Table 3: Sanitation technologies and proportion of emptied faecal sludge (ENPHO, 2023[1]; KII-3, 2023[2]).

SN	Sanitation Technologies	SFD Reference Variable	Percentage of Population Using	Percentage of Emptied Containment (1)	Emptied Proportion of FS during emptying (2)	Actual Proportion of Emptied FS (F3)
1	Fully lined tank, no outlet or overflow	T1A3C10	38%	37%	80%	30%
2	Lined tank with impermeable walls and open bottom, open ground	T1A4C8	41%	25%	80%	20%
3	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	73%	5%	80%	4%
4	Lined tank with impermeable walls and open bottom, no outlet or overflow with significant risk of groundwater pollution	T2A4C10	27%	8%	80%	6%
5	Unlined Pit, no outlet or overflow	T1A6C10	100%	6%	80%	5%

2.3.3 Proportion of FS emptied which is delivered to treatment plant and treated (F4 and F5)

Since there is not any FS delivered to the treatment plant the value of F5 is zero. FS mechanically emptied is disposed by trenching method and manually emptied FS is either

disposed of on farmlands or on open ground, dig and dump or used as composting. FS from biogas digesters is considered delivered to treatment (F4=85%) at 95% efficiency (F5=95%).

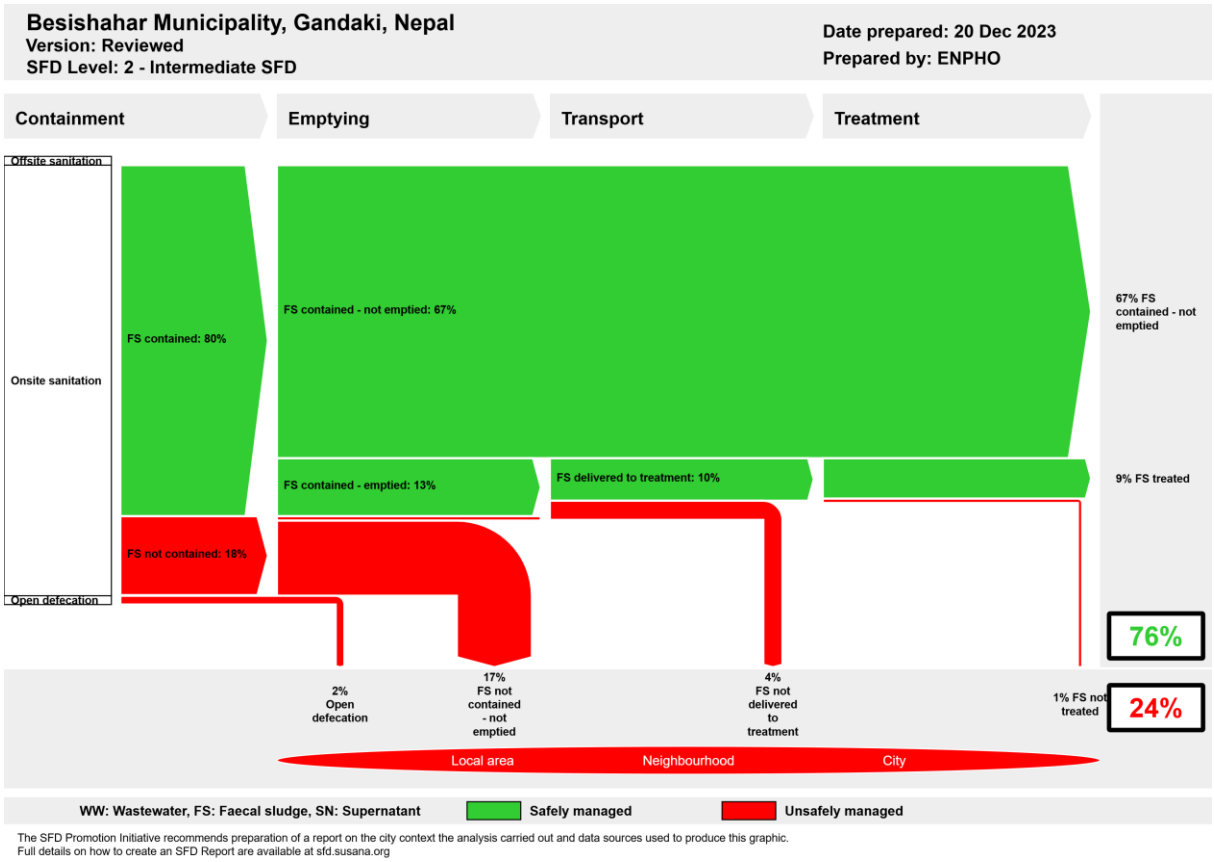
2.4 Summary of assumptions

Onsite Sanitation Systems:

- ✓ The proportion of FS in septic tanks was set to 0%, the proportion of FS in fully lined tanks was set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 100% as there are no connections made to an open drain, 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.
- ✓ 30% of the emptied FS from fully lined tanks connected to no outlet or overflow (system T1A3C10) is delivered to treatment and treated (F4 = 85% and F5 = 95%). Since there is no FSTP, all values for variables F4 and F5 were set to 0% for the rest of the systems.

2.5 SFD graphic

Figure 14 presents diagrammatic representations of the excreta flow within Besishahar 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 76% of the population is safely managed, represented by "Green" arrowheads, indicating FS stored in containment without significant risk to groundwater.



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

Figure 14: SFD graphic of Besishahar Municipality.

Conversely, FS from 24% of the population is unmanaged, represented by "Red" arrowheads. This signifies uncontained FS and openly dumped FS emptied from the containments, both considered unsafe. The SFD graphic illustrates four different factors across the sanitation value chain, arranged from left to right.

Onsite sanitation

All 100% of the population in municipality utilizes onsite sanitation technologies for managing excreta. Among them, faecal sludge (FS) from 80% of the population is appropriately stored in technically effective containment, as depicted by "FS contained" in the SFD graphic. On the other hand, FS from the remaining 18% 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). In the municipality, FS generated by 80% of the population is contained.

The value of FS contained (80%) is derived from the summation of the percentage of the population using the following containment systems: fully lined tank without outlet or overflow (T1A3C10), lined tank with impermeable walls and open bottom without outlet or overflow (T1A4C10), and unlined pit, no outlet or overflow (T1A6C10). This is multiplied by the proportion of FS contained in each specific containment.

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 to the user or the public. 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). In the municipality, FS generated by 18% of the population is not contained.

The value of FS not contained (28%) is obtained from the summation of the percentage of the population using the following containment systems: lined tank with impermeable walls and open bottom without outlet (T2A4C10) and open ground (T1A4C8), unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A6C10), and open defecation (T1B11 C7 to C9).

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 67% is obtained from the proportion of the population using sanitation systems where the FS is contained and have not emptied their containment. However, this 67% of safely managed FS should be considered as only

temporary, as most of the pits and tanks have not yet filled up and the FS generated remains 'not emptied'. Therefore, these systems will require emptying services in the short and medium term as they fill up.

FS not contained - not Emptied

It is faecal sludge that is not contained within onsite sanitation technology and not removed may persist within the container or infiltrate into the ground, depending on the type of sanitation technology in use. The value of 17% is obtained from the proportion of the population using sanitation systems where the FS is not contained and has not emptied their containment.

FS contained-emptied

It is faecal sludge which is removed from an onsite sanitation technology where it is contained and can be emptied, practicing manual emptying. 13% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

FS delivered to treatment

The proportion of FS delivered to treatment is 10% which comes from the FS contained - emptied. The FS which is mainly generated from biogas are considered as treated.

FS not delivered to treatment

The proportion of FS not delivered to treatment, i.e. 4%, is the summation of FS contained emptied and FS not contained emptied. Since FS are not delivered to treatment plant. The emptied FS is disposed of untreated to farmlands. Therefore, this proportion of disposed FS possesses risk to local area and neighbourhood.

Open defecation

It is a situation where no toilet is in use, and people resort to open defecation in fields, forests, bushes, bodies of water, or other open spaces. Despite municipality having ODF free status, 2% of population still defecate openly. Mostly, the households living in poverty and those who do not own land do not have toilets.

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

Environment protection act, 2019

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

Water supply and sanitation act, 2022

The act was promogulated to ensure the fundamental right of citizens 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 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 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 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 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 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 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 a 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, 2017) however, the target of 90% households with toilets connected to sewer system or proper FSM is yet to be achieved.

The municipality has made plans to maintain the sanitary conditions of public toilets and plans are in motion to secure suitable land for a sanitary landfill site and waste treatment center being looked under the Forest, Environment and Emergency Management Committee. Additionally, plans are to provide subsidies to marginalized, backward, and disabled individuals to construct the toilets. These initiatives are all outlined in the Red Book, under Municipal Annual Development Plan for 2024/2025(Besishahar Municipality, 2024).

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 specialized and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs, identifies sources of funding, and allocates budget. It serves as a central agency for monitoring and evaluating development policy, plans, and programs. It supports, facilitates, and coordinates with federal, provincial, and local governments for developing policy plans and implementation.

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

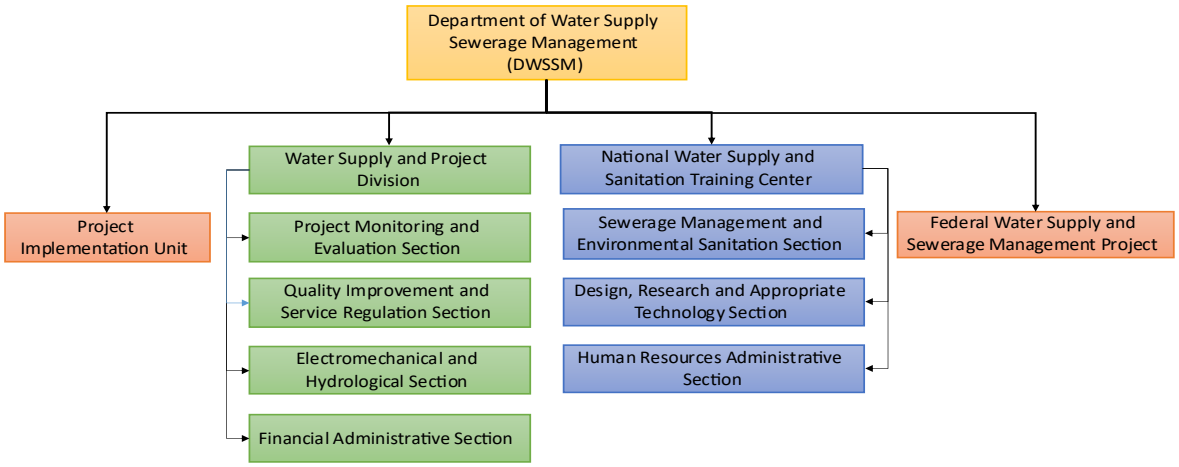


Figure 15: Organizational structure of Department of Water Supply and Sewerage Management.

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:

1. Inter local government projects.
2. Beneficiaries between 5,000 to 15,000 in terai region, 3,000 to 5,000 in hilly region and 5,00 to 1,000 in Himalayan region.

At Local Government

Municipal council: There is no specific sanitation section. However, sanitation related works are being carried out under the Forest, environment and disaster management section (Figure 16).

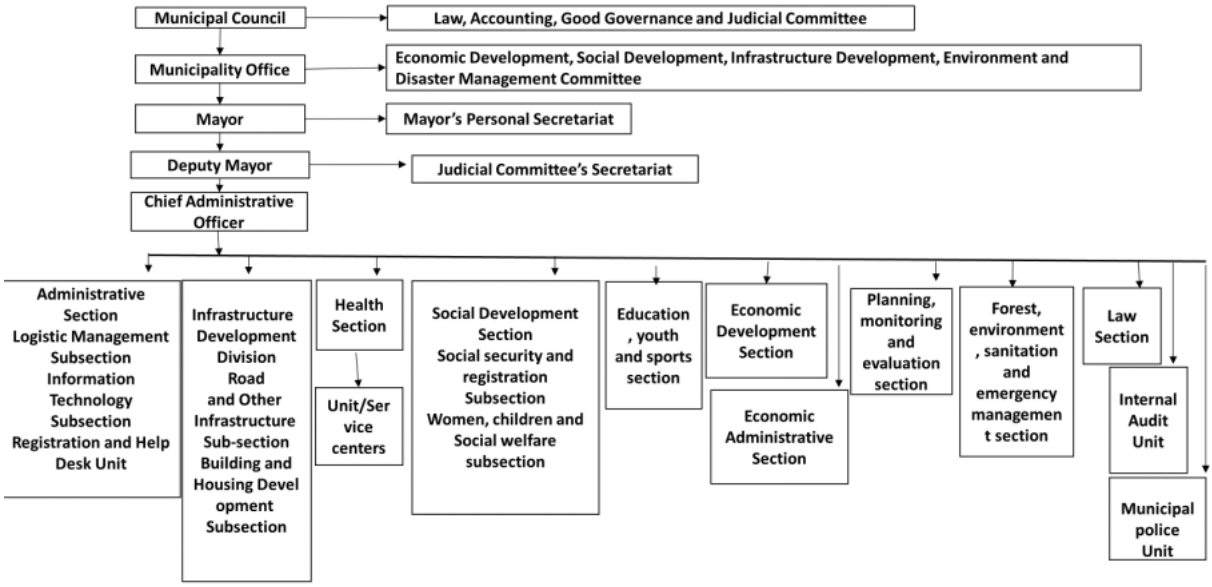


Figure 16: Organogram of Besishahar Municipality.

3.4 Service provision

Urban Water Supply and Sanitation Policy 2009 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).

3.5 Service standards

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

Table 4: Sanitation service level and its components.

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

4 Stakeholder Engagement

4.1 Key Informant Interviews (KIIs)

During the study, Key Informant Interviews (KIIs) were conducted to gather insights from key stakeholders working in the sanitation sector of Besishahar municipality. The objective was to obtain a comprehensive understanding of current sanitation service practices. Ms. Padma Gurung, Deputy mayor of Besishahar municipality, was interviewed specifically regarding sanitation service practices, covering technical, institutional, and financial aspects. Additional interviews were conducted with Mr. Suraj Pariyar, sub engineer. Similarly, caretakers from public toilets and other relevant stakeholders were interviewed to understand the status of public toilets in the municipality (Table 5).

Table 5: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organization/ Company	Purpose of KII
1.	Padma Gurung (KII-1)	Deputy Mayor	Besishahar Municipality	Sanitation status, Ongoing projects on Sanitation, Policies, and plan for Sanitation development
2.	Suraj Pariyar (KII-2)	Sub engineer	Besishahar Municipality	Sanitation status, Ongoing projects on Sanitation, Policies, and plan for Sanitation development
3.	Rishi Ram Basnet (KII-3)	Ward chairperson	Besishahar Municipality	Sanitation status, Ongoing projects on Sanitation, Policies, and plan for Sanitation development
4.	Manoj Singh Bohara	Public Health Officer, Health Section	Besishahar Municipality	Sanitation status, Ongoing projects on Sanitation, Policies, and plan for Sanitation development

4.2 Household survey

Household survey was conducted in all wards of the municipality through mobilization of enumerators selected by the municipality. The enumerators were given two days orientation about sanitation technologies and methods for conducting the household survey using the mobile application “KOBOCOLLECT” after orientation. SFD team member went on field visits in households to encourage enumerators and observe the survey process on sanitation status.

Figure 17 below depicts the enumerators learning about the SFD and process of data collection during the orientation program.

Figure 17: Enumerators during orientation program.

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	1.96	At the confidence level of 95%
p	0.5	If about 50% of the population 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 size 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 372 households were sampled from 11038 households distributed in 11 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 18.

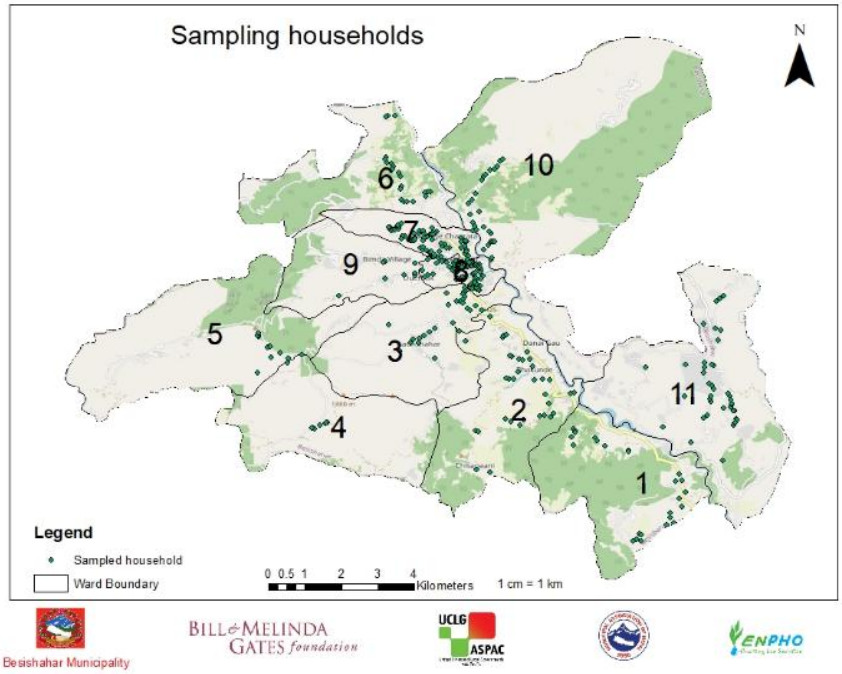


Figure 18: Distribution of sampling points in different wards of Besishahar Municipality.

4.3 Direct observation

Various sanitation technologies in the households in all the wards were observed and visual references were kept. Also, observation of the water sources, toilets and containments were done during the time of a survey, and solid waste management dumping site of the municipality was also observed.

4.4 Sharing and validation of data

The Shit Flow Diagram sharing and validation workshop was conducted in the municipality to share the finding of the sanitation situation survey and receive the suggestions from municipal stakeholders (Figure 19). Altogether, 43 participants including the mayor, deputy mayor, chief executive officer, ward chairpersons and other members from municipal executive council, sectoral staff etc. actively participated in the workshop and provided valuable suggestions. The list of participants with their designation is attached to Appendix 3.

Figure 19: SFD Validation Workshop in presence of municipal staff.

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.

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6 References

AEPC. (2018). *Alternative Energy promotion centre, Nepal*. Retrieved from https://www.aepc.gov.np/

Andreo, S. F. (2013). The aquifer pollution vulnerability concept: aid or impediment in promoting groundwater protection? *Hydrogeology Journal*.

Besishahar Municipality. (2023). *Besishahar Municipality*. Retrieved from Besishaharmunicipality: https://besishaharmun.gov.np/ne/node/3

Besishahar Municipality. (2024). *Municipality Redbook 2024/2025*. Retrieved from Besishahar Municipality: https://besishaharmun.gov.np/sites/besishaharmun.gov.np/files/Final%20Red%20Book%202080_81_besi_mun_.pdf

Besishahar Municipality. (2024). *Redbook 2024*. Retrieved from Besishahar government page: https://besishaharmun.gov.np/sites/besishaharmun.gov.np/files/Final%20Red%20Book%202080_81_besi_mun_.pdf

City Population Besishahar. (2023). *City population*. Retrieved from City Population: https://www.citypopulation.de/en/nepal/mun/admin/lamjung/3701__besishahar/

DWSSM. (2004). *National Rural Water Supply and Sanitation Sector Policy. Kathamndu, Nepal.* Department of Water Supply and Sewarage Management, Ministry of Water Supply, Goverment of Nepal.

DWSSM. (2009). *National Urban Water Supply and Sanitation Sector Policy.* Kathmandu, Nepal: Department of Water Supply and Sewerage Management, Ministry of Water Supply, Government of Nepal.

ENPHO. (2023). *Sanitation Survey on Besishahar Municipality.* Besishahar.

GoN. (2015, September 30). *Constitution of Nepal: Goverment of Nepal*. Retrieved from https://lawcommission.gov.np/en/wp-content/uploads/2021/01/Constitution-of-Nepal.pdf

Krishnan, S. (2011). *On-site Sanitation and Groundwater Contamination: A Policy and Technical Review.* Anand: INREM Foundation.

Linda Strande, M. R. (2014). *Faecal Sludge Management Systems Approach for Implementation and Operation.* London: IWA Publishing.

MICS. (2019). *Multiple Indicator Cluster Surveys.* Nepal. Retrieved from https://www.unicef.org/nepal/media/11081/file/Nepal%20MICS%202019%20Final%20Report.pdf

MoF. (2015). Public-Private Partnership Policy. In M. o. Finance. Kathmandu, Nepal: Goverment of Nepal.

MoPIT. (2009). National Urban Water Supply and Sanitation Sector Policy. Ministry of Physical Infrastructure and Transport.

MoWS. (2017). *Institutional and Regulatory Framework for Faecal Sludge Management in Urban Areas of Nepal.* Kathmandu,Nepal: Ministry of Water Supply.

NPC. (2017). *Nepal Sustainable Development Goals, Status and Roadmap: 2016-2030.* National Planning Commission.

NSO. (2021). *National Population and Housing Census*. Retrieved from National Statistics Office: https://censusnepal.cbs.gov.np/results/population?province=6&district=60&municipality=2

Peal, A., Evans, B., Ahilan, S., Ban, R., Blackett, I., Hawkins, P., . . . Veses, O. (2020). Estimating Safely Managed Sanitation in Urban Areas; Lessons Learned From a Global Implementation of Excreta-Flow Diagrams. *Frontiers in Environmental Science, 8*, 1-13.

Places in the world. (2023). *Besishahar*. Retrieved from Places in the world: https://nepal.places-in-the-world.com/12096188-region2-besishahar.html

Strande, L., Ronteltap, M., & Brdjanovic, D. (2014). *Faecal Sludge Management Systems Approach for Implementation and Operation.* London: IWA.

Susana. (2018). *Susana Manual*. Retrieved from https://sfd.susana.org/knowledge/the-sfd-manual

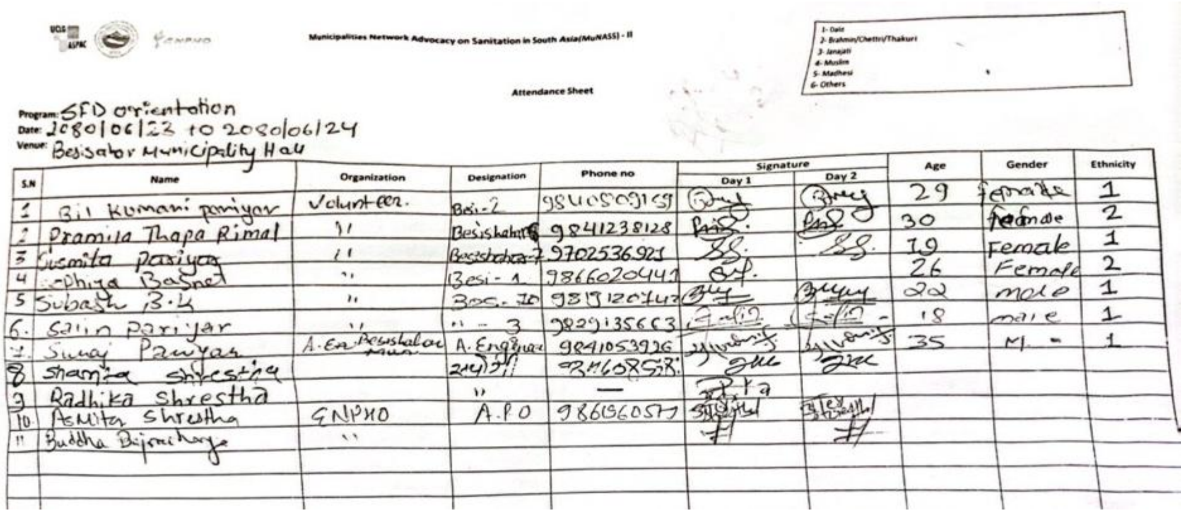
Weather and climate. (2020). *Weather and Climate, Besishahar*. Retrieved from Weather and climate: https://weatherandclimate.com/nepal/gandaki/besisahar#t5

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

Attendance Sheet

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

Program: SFD orientation
Date: 2080/06/23 to 2080/06/24
Venue: Besisahar Municipality Hall

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1	Bil Kumari pariyar	Volunteer.	Besi-2	9840809159	[illegible]	[illegible]	29	female	1
2	Pramila Thapa Rimal	"	Besishahar-8	9841238128	[illegible]	[illegible]	30	female	2
3	Susmita pariyar	"	Besishahar-7	9702536921	[illegible]	[illegible]	19	Female	1
4	Sophiya Basnet	"	Besi-1	9866020441	[illegible]		26	Female	2
5	Subash B.K	"	Besi.-10	9819120747	[illegible]	[illegible]	22	male	1
6.	Salin Pariyar	"	" - 3	9829135663	[illegible]	[illegible]	18	male	1
7.	Sunaj Pariyar	A. En. Besishahar Mun.	A. Engineer	9841053926	[illegible]	[illegible]	35	M	1
8	Sharmila Shrestha		[illegible]	[illegible]	[illegible]	[illegible]			
9	Radhika Shrestha		"	—	[illegible]				
10.	Asmita Shrestha	ENPHO	A.P.O	9861960577	[illegible]	[illegible]			
11	Buddha Bajracharya	"			[illegible]	[illegible]			

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

आज मिति २०८० साल फाल्गुन १०गतेका दिन बेसीशहर नगरपालिका नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एन्फो)को प्राविधिक सहयोग, The United cities and Local Government Asia Pacific (UCLG-ASPAC) को सहकार्यमा र Bill and Mellanda Gates Foundation (BMGF) को आर्थिक सहयोगमा मानव मलमुत्र प्रवाह रेखाचित्र (Shit flow Diagram: SFD) सम्बन्धि छलफल तथा प्रमाणिकरण कार्यक्रममा निम्न अनुसारको सरोकारवालाहरूको उपस्थिती रहेको छ ।

उपस्थिती :

क्र.सं.	नाम	पद	कार्यालय	फोन नं	हस्ताक्षर
१.	गुमान सिंह अर्याल	नगर प्रमुख	बेसीशहर न.पा.	9856046510	[illegible]
२.	चेतनाथ अर्याल	प्र. प्र. अ.	बेसीशहर न.पा.	9856009111	[illegible]
३.	महेन्द्र पोखरेल	कार्यक्रम अधिकृत	बेसीशहर नपा कार्या.	9846074740	[illegible]
४.					
५.	मदन बहादुर राना	वडाध्यक्ष	बेसीशहर - २	9856046852	[illegible]
६.	गंगा बहादुर थापा	"	" १०	9856046860	[illegible]
७.	कल्पना थापा बोहरा	का. पा. स.	" ८	9846089800	[illegible]
८.	सुकमाया गुरुङ	वा. स. पा. स.	" ६	9846134164	[illegible]
९	विमला अधिकारी	" " "	" ९	९८४६९२३६२४	[illegible]
१०.	मनिता परियार	" " "	" ०७	9745342328	[illegible]
११.	सुकमाया क्षेत्री	" " "	" ०९		[illegible]
१२	जमुना श्रेष्ठ	वडा म. सदस्य	" ११	9846554238	[illegible]
१३	रामकली गुरुङ	अधिकृत छैटौं	खानेपानी र सरसफाई	९८४६२९६४१२	[illegible]
१४	[illegible]	वडा अध्यक्ष	बे.न.पा. १	9856046851	[illegible]
१५	[illegible]	का. स.	बे. - ३	९८५६०४६२०२	[illegible]
१६	[illegible]	अध्यक्ष	बेनपा - ७	९८४६०५६३८३	[illegible]
१७	[illegible] गुरुङ	"	" - ३	९८५६०४८८७०	[illegible]
१८	राम बहादुर गुरुङ	— " —	बेनपा ४	९८५६०४६४१	[illegible]
१९.	घनश्याम तिवारी	रोजगार संयोजक	बे न.पा. कार्यालय	9849638512	[illegible]
२०.	[illegible]	स. प्र. अ.	"	9856059140	[illegible]

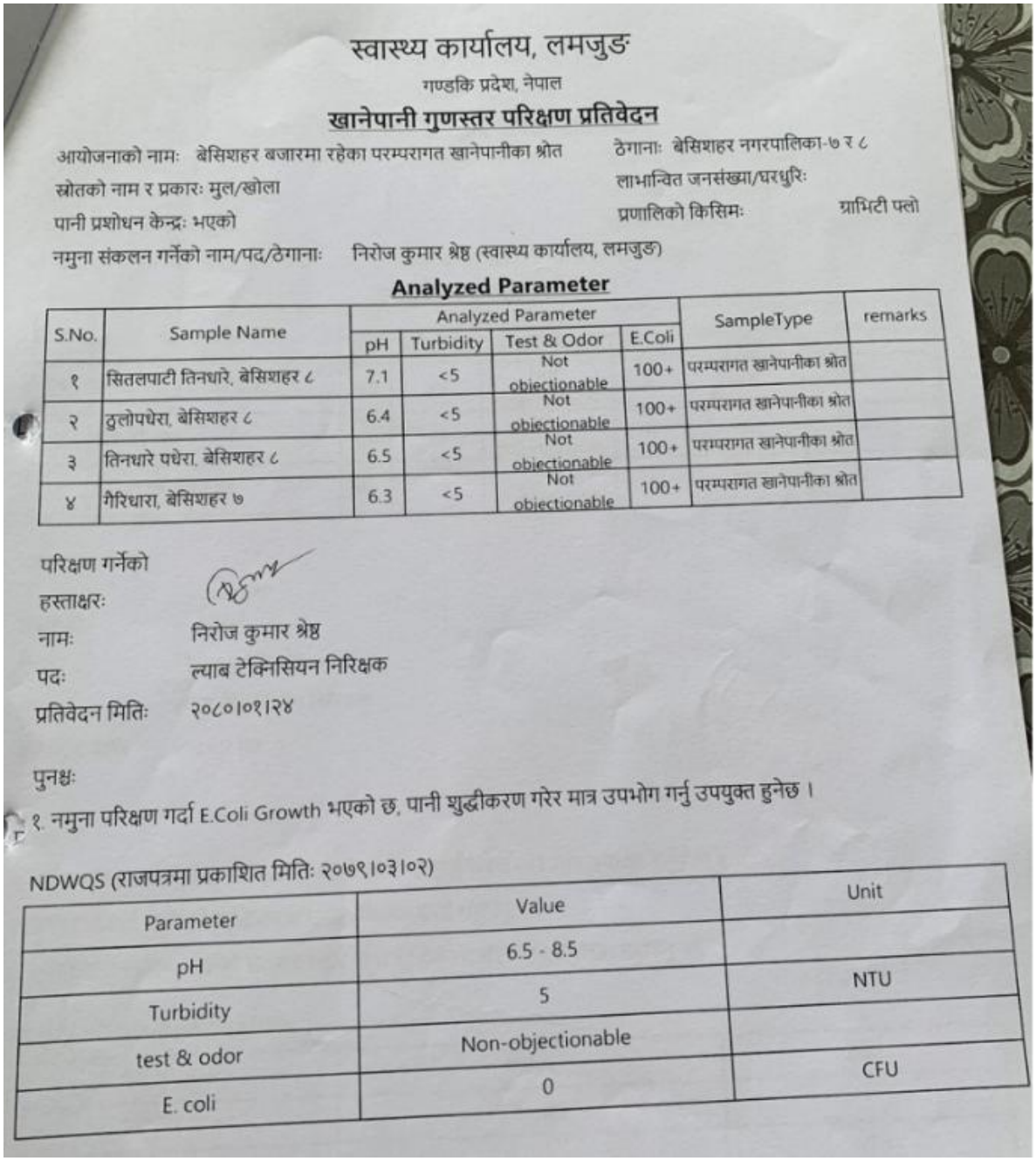
क्र.सं	नाम	पद	कार्यालय	फोन नं	हस्ताक्षर
२१	मनोज सिंह बोहरा	ज. स्वा. नि.	अ.बे.न.पा.	९८४६०४६५६६	
२२	किसान राज [illegible]	[illegible]	"	९८५६३६९७२९	
२३	सुजना पौडेल	लेखा प्रमुख	बे.न.पा	९७४५२८२५७२	
२४	धन कुमारी डुरा	[illegible]	बे.न.पा.	९८६६०२००९०	
२५	सन्तोष कुमार साह	[illegible]	बेनीबहादुर न.पा. प्रशासन शाखा	९८५६००६६९६	
२६	सुरज परियार	स. इन्जिनियर	बे.न.पा. स्वा.पा. शाखा	९८४१०५३९२६	
26	कुमार अर्याल	[illegible] सचिव	बे.न.पा	9846847311	
२८	शम्भु प्र. घिमिरे	अधिकृत	"	९८५६०७८६०५	
२९	दिपेश अधिकारी	कृषि स्नातक	बे.न.पा कृषि वि. शाखा	९८४६६४५७९९५	
३०	[illegible]	[illegible]	बे.न.पा.	9846074553	
३१	गोविन्द ब. राउत	स.प्र.अ.	बे.न.पा.	९८४६०९९२६६	
३२	दुर्गा कुमारी गुरुङ	स. पाँचौं	"	९८४६०९९५७८	
३३	अन्जु कुमारी राना	[illegible]	"	९८६४९४४६९४	
३४	[illegible] घिमिरे	एच. आइ. एस	"	९८४५३८७५४८१	
३५	डा. सन्दीप [illegible]	पशु चिकित्सक	"	९८४५३३०९९४	
३६	विष्णु [illegible]	[illegible]	[illegible]	९८५५०४२०७७	
३७	[illegible]	[illegible]	[illegible]	९८६६०२९२९६	
३८	[illegible]	[illegible]	बे.न.पा	९८५५१८१७२२	
३९	आशिष शर्मा	इन्जिनियर	FWSSMP	9856004110	
४०	[illegible]	[illegible]	[illegible]	९८४६०८९५२२	
४१	प्रेम बहादुर [illegible]		" "		
४२	[illegible] अधिकारी	का. स.	"	९८४६४२५४००	
४३	कृपा श्रेष्ठ	"	"	९८७६६५९९५५	कृपा
~~४४~~	~~दुर्गा गुरुङ~~	~~सि. पाँचौं~~	~~बे.न.पा~~	~~९८४६०९९५७८~~	
४४	सरस्वती श्रेष्ठ		बे.नगर	9806704154	
४५	साबिना वि.क.	[illegible]	"	9746524156	
46.	Asmita Shrestha	AP.O	ENPHO	9861960579	
47.	Anita Bhuju	A.P.O.	"	9849358197	

Appendix 4: Glimpses of the program

KII with Municipal Stakeholders

Mr. Guman Singh Aryal, Mayor of Besishahar Municipality concluding the validation workshop with his feedbacks

Appendix 5: Water quality test report



स्वास्थ्य कार्यालय, लमजुङ

गण्डकि प्रदेश, नेपाल

खानेपानी गुणस्तर परिक्षण प्रतिवेदन

आयोजनाको नामः बेसिशहर बजारमा रहेका परम्परागत खानेपानीका श्रोत ठेगानाः बेसिशहर नगरपालिका-७ र ८

स्रोतको नाम र प्रकारः मुल/खोला लाभान्वित जनसंख्या/घरधुरिः

पानी प्रशोधन केन्द्रः भएको प्रणालिको किसिमः ग्राभिटी पत्तो

नमुना संकलन गर्नेको नाम/पद/ठेगानाः निरोज कुमार श्रेष्ठ (स्वास्थ्य कार्यालय, लमजुङ)

Analyzed Parameter

S.No.	Sample Name	Analyzed Parameter				SampleType	remarks
		pH	Turbidity	Test & Odor	E.Coli		
१	सितलपाटी तिनधारे, बेसिशहर ८	7.1	<5	Not objectionable	100+	परम्परागत खानेपानीका श्रोत	
२	ठुलोपधेरा, बेसिशहर ८	6.4	<5	Not objectionable	100+	परम्परागत खानेपानीका श्रोत	
३	तिनधारे पधेरा, बेसिशहर ८	6.5	<5	Not objectionable	100+	परम्परागत खानेपानीका श्रोत	
४	गैरिधारा, बेसिशहर ७	6.3	<5	Not objectionable	100+	परम्परागत खानेपानीका श्रोत	

परिक्षण गर्नेको हस्ताक्षरः

नामः निरोज कुमार श्रेष्ठ

पदः ल्याब टेक्निसियन निरिक्षक

प्रतिवेदन मितिः २०८०।०१।२४

पुनश्चः

१. नमुना परिक्षण गर्दा E.Coli Growth भएको छ, पानी शुद्धीकरण गरेर मात्र उपभोग गर्नु उपयुक्त हुनेछ ।

NDWQS (राजपत्रमा प्रकाशित मितिः २०७९।०३।०२)

Parameter	Value	Unit
pH	6.5 - 8.5	
Turbidity	5	NTU
test & odor	Non-objectionable	
E. coli	0	CFU

SFD Besishahar Municipality, Nepal, 2025

Produced by:

Asmita Shrestha, ENPHO

Buddha Bajracharya, ENPHO

Anita Bhuju, ENPHO

Rupak Shrestha, ENPHO

Sabuna Gamal, ENPHO

Jagam Shrestha, ENPHO

This Executive Summary and the SFD Report are available from: www.sfd.susana.org