SFD Report

Bhojpur Municipality
Nepal

Final Report

This SFD Report - SFD level 2 - was prepared by
Environment and Public Health Organization (ENPHO)

Date of production: 28/05/2024

Last update: 08/07/2026

SFD Report Bhojpur Municipality, Nepal, 2026

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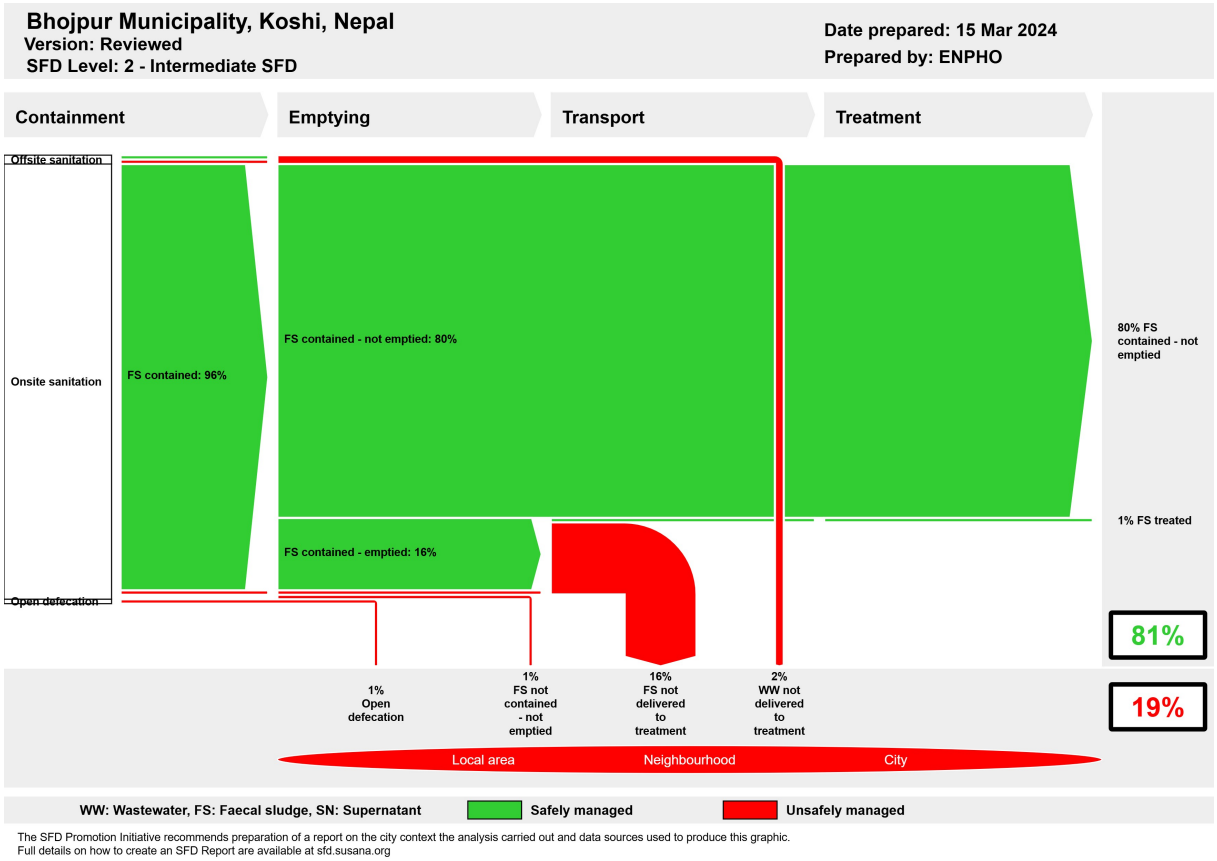
1. The SFD Graphic



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:

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

Status:

Final SFD report.

Date of production: 28/05/2024

3. General city information

Bhojpur Municipality is situated in Bhojpur District of Koshi Province in the eastern region of Nepal. It is divided into 12 wards and covers an area of 159.52 km^2.

It was established on May 16, 2014 and was reformed on 2016. It is formed by merging 8 Village Development Committees (VDCs) namely Gupteshwar, Siddheshwar, Bokhim, Helauchha, Bhaisipankha, Amtek, Taksar and Bhojpur. It lies at 28°53' to 27°46' N latitude and 86°53' to 87°17' E longitude and at the altitude approximately 1,550 metres above sea level (masl) (Bhojpur Municipality, 2024).

A population of 26,007 is residing on 6,744 households in the municipality (National Statistics Office, 2023). The annual population growth rate of the municipality is -0.44%. This shows that the municipality has increasing out migration. The municipality has a temperate climate (Cwb) with warm summers and dry winters. The annual average temperature of the municipality is 16.9°C and receives 3,860 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, 2024). Bhojpur district was declared Open Defecation Free (ODF) on September 21, 2019. But 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:

Among households with improved sanitation facilities, about 2% of households rely on an offsite sanitation system and 97% rely on onsite sanitation systems. In the municipality, exiguous households having sewer network and toilet with outlet to an open space are taken as offsite sanitation systems. Moreover, the sewer network is undergoing construction in wards 6, 7, 8, 9 and 12. Households with onsite sanitation systems have different sanitation technologies. The majority of households, i.e. 77%, have unlined pits followed by 16% of households have lined tanks with impermeable walls and only 4% of households have fully lined tanks.

Here, all the institutional buildings have toilets with 100% onsite sanitation system. Among which, 6% of institutional buildings have septic tanks, 21% have fully lined tanks, 24% have lined tanks with impermeable walls and open bottom and 49% have unlined pits.

Bhojpur municipality has five public toilets which were observed for the study. The toilets at *Buspark,* and *Deurali* were constructed by the municipality while others were constructed jointly including I/NGOs, CSO and users' committees. Every day, almost 500 people use these toilets. The restrooms are mostly used by local bus staff, passengers, local shopkeepers, customers and city dwellers. The users are charged Rs. 5 (USD 0.03) for urination and Rs. 10 (USD 0.08) for defecation.

Emptying and Transport:

Among the buildings with onsite sanitation systems, only 20% of households and 6% of institutional buildings have emptied their containment. Both manual and mechanical emptying is practiced at households and institutional buildings while some households also practice open emptying in the municipality. Moreover, manual emptying is prevalent at households.

The available municipal desludging vehicle is not functional at the time of study. However, a private desludging service provider is serving in the municipality. The service provider has a vehicle with a tank capacity of 5,000 litres. The service charge for each trip is NRs. 4,000 - NRs. 5,000 (USD 30.1 - USD 37.6) to empty a containment.

Treatment and Disposal/Reuse:

Here, mechanically emptied faecal sludge (FS) is disposed in an open environment owned by the private desludging service provider. The manually emptied FS is dig and dumped, disposed into farmlands or water bodies or composted. Therefore, all the emptied FS is disposed unsafely into an open environment or water bodies.

Approximately 52% of households have piped drinking water supply services in the municipality. Among other service providers, Silichung Water and Sanitation Users' Committee is one of the major drinking water services providers in Bhojpur Municipality. It serves in wards 5, 6, 7, 8, 9 and 12. It has distributed 2,280 taps to households and institutions. Among the remaining households, 5% of households have access to drinking water from community taps and 43% of households rely on spring sources.

Spring sources are vulnerable of contamination. The vulnerability of sources depends on lateral spacing between sanitation systems and the sources. However, sample water from spring source and drinking water of Silichung water supply scheme showed absence of *E. coli* contamination concluding, drinking water from private taps are at less risk of contamination.

The SFD graphic shows that excreta generated from 81% of the population are safely managed while 19% of the population are unsafely managed. Only 1% of FS generated in the municipality was treated from biogas digester at household while safely managed FS generated from 80% of population is temporary as the FS has not been emptied. 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 emphasized on a right to quality sanitation services and prohibited direct discharge of wastewater and sewage into water bodies or public places.

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

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 FSM, the major stakeholders for effective and sustaining service delivery as presented in Table 1.

Table 1: Overview of Stakeholders.

Key Stakeholders	Institutions / Organizations
Public Institutions at Federal Government	Ministry of Water Supply
Public Institutions at Provincial Government	Ministry of Water Supply, Irrigation and Energy
Public Institutions at Local Government	Bhojpur Municipality
Non-governmental Organizations	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, 2024) . Enumerators of the municipality were mobilized 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, 363 households and 44 institutions were surveyed from 12 wards of Bhojpur 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:

- Bhojpur Municipality, 2024. *Bhojpur Municipality.* [Online] Available at: https://bhojpurmun.gov.np/en [Accessed 28 May 2024].
- Climate-Data, 2021. *Climate-Data*. [Online] Available at: https://en.climate-data.org/asia/nepal/eastern-development-region/bhojpur-1061909/ [Accessed 28 May 2024].

- ENPHO, 2024. *Sanitation Situation Assessment of Bhojpur 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.

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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
Lps	Liters per second
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
WRIDD	Water Resource and Irrigation Development Division
WSUC	Water and Sanitation Users Committee
WW	Wastewater
WWTP	Wastewater Treatment Plant

1 City context

Bhojpur Municipality is situated in Bhojpur District of Koshi Province in the eastern region of Nepal. It was established on May 16, 2014 (Bhojpur Municipality, 2024) and was reformed on 2016. The municipality was formed by merging 8 Village Development Committees (VDCs) namely, Gupteshwar, Siddheshwar, Bokhim, Helauchha, Bhaisipankha, Amtek, Taksar and Bhojpur. It is divided into 12 wards. It shares its boundary with Arun and Pauwadungma Rural municiplities on the east, Temkemaiyum Rural Municipality on the west, Shadananda Municipality on the north and Temkemaiyum and Ramprasad Rai Rural Municipality on the south (Bhojpur Municipality, 2016) . Figure 1 shows the ward boundary map of Bhojpur Municipality.

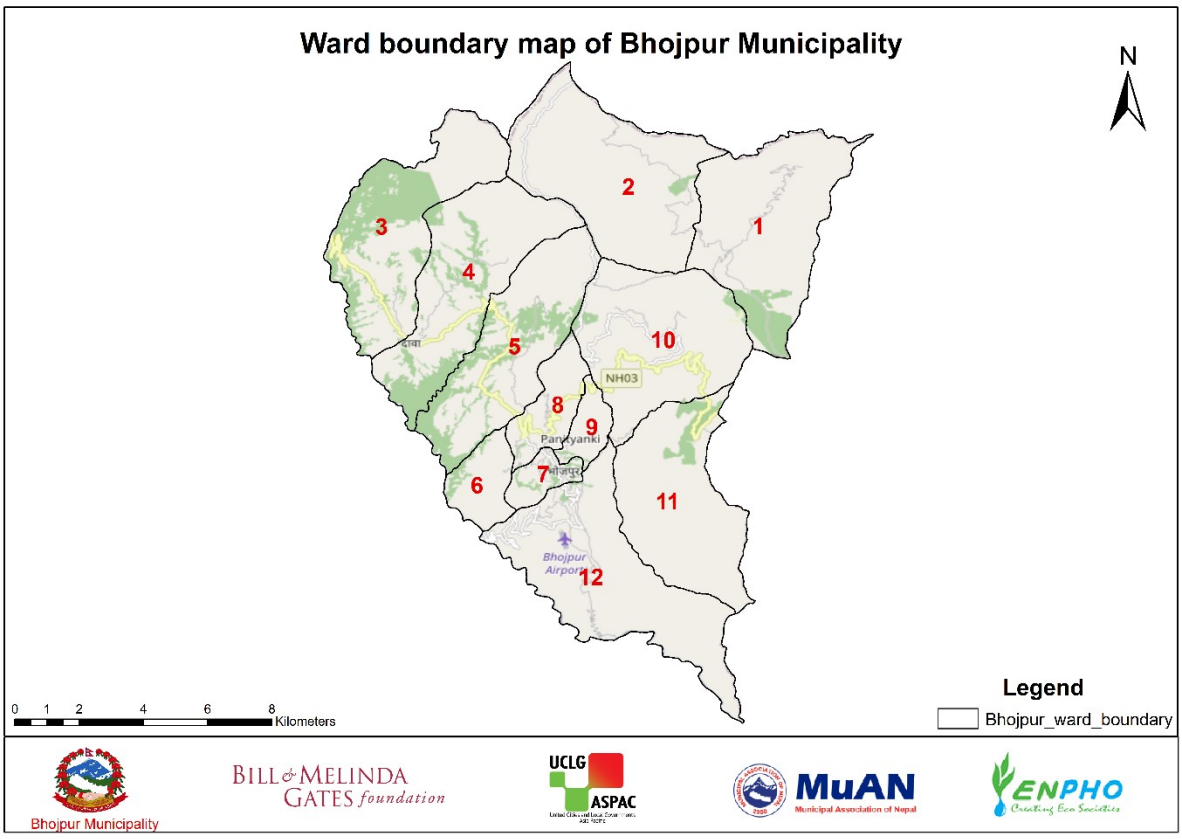


Figure 1: Ward boundary map of Bhojpur Municipality.

1.1 Population

As per the national population and housing census conducted in 2021, Bhojpur Municipality has a total population of 26,007 with 12,645 male and 13,362 female population. There are altogether 6,744 households. The average household size is 3.90 and population density is 163.03 per km^2 (National Statistics Office, 2023) . The annual population growth rate of the municipality is -0.44%. This shows that the municipality has increasing out migration deceasing the overall population size.

1.2 Topography and Geography

Bhojpur Municipality lies at 28°53' to 27°46' N latitude and 86°53' to 87°17' E longitude. The altitude of the municipality is approximately 1,550 metres above sea level (masl). It covers a total area of 159.52 km^2. on the eastern region of Nepal. The municipality lies in the Midlands based on the physiographic division of Nepal (Bhojpur Municipality, 2016). Thus, it has the topography based on the range. The region has a composition of Phyllites, Schist, gneiss, quartzite, granite and limestone (Upreti, 1999).

1.3 Climate

Köppen–Geiger classification is one of the most used systems for climatic categorization. This classification is a widely used method for portraying climates worldwide, based on monthly air temperature and precipitation. The climatic condition of Bhojpur Municipality falls on temperate climate (Cwb) based on Köppen–Geiger classification. This climatic condition has warm summers and dry winters (Karki, et al., 2015). The warmest month of the year is August with an average temperature of 21.6°C and coldest month is January with average temperature of 9.7°C. The annual average temperature of the municipality is 16.9°C. It receives 3860 mm rainfall on average annually. The most rainfall occurs in July and the least in December (Climate-Data, 2021). Figure 2 shows the graph of the monthly average for precipitation and temperature of Bhojpur Municipality.

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

2 Service Outcomes

2.1 Overview

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2024). A total of 363 households were sampled from 6,744 households distributed in 12 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

Bhojpur district was declared Open Defecation Free (ODF) on September 21, 2019 (MoWS, 2020). The status of ODF indicates accessibility to basic sanitation on each household (HH). In Bhojpur Municipality, still 1% of the households do not have toilets and practice open defecation. The households practising open defecation goes to an open space. Figure 3 shows sanitation technologies present at households in Bhojpur Municipality.

Figure 3: Sanitation technologies at households of Bhojpur Municipality.

The remaining 99% of the households have improved sanitation facilities either with offsite or onsite sanitation systems. Offsite sanitation refers to a sanitation system in which excreta (referred to as wastewater) is collected and transported away from the plot where they are generated. An offsite sanitation system relies on sewer technology for transport. 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) . In the municipality, 2% of the households have offsite sanitation systems whereas 97% have onsite sanitation systems. Figure 4 presents the location map of households with status of access to improved sanitation.

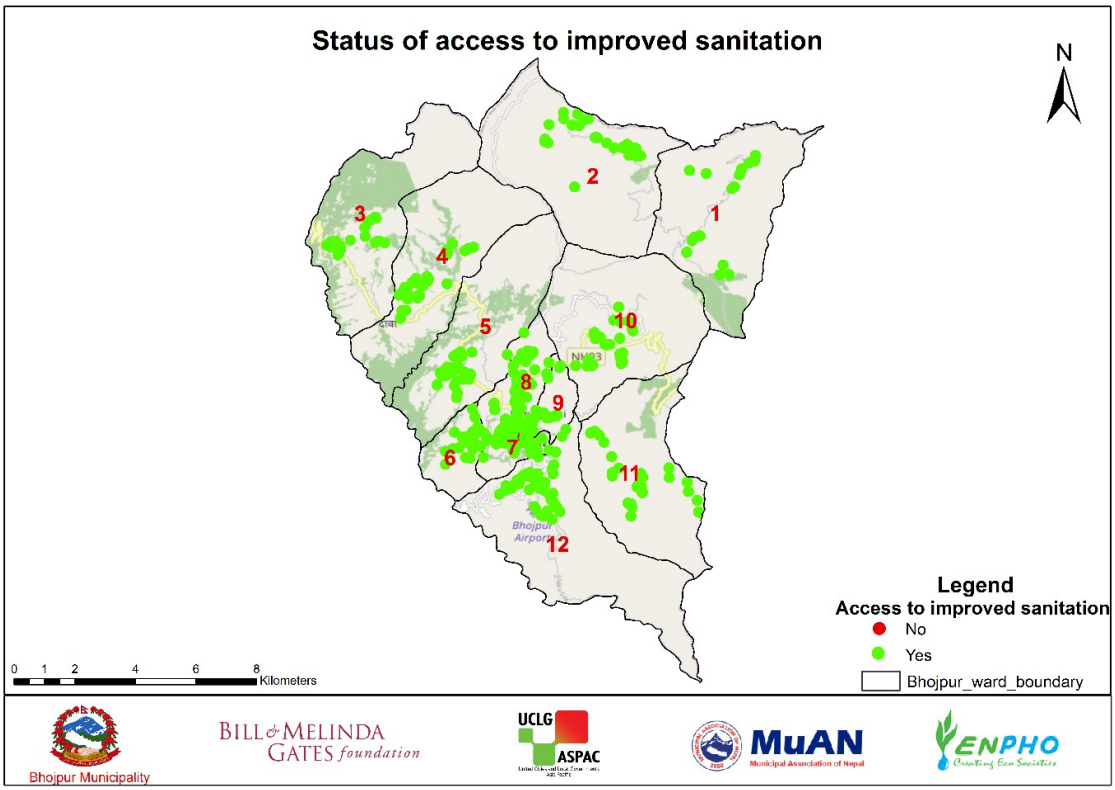


Figure 4: Location map of households with status of access to improved sanitation.

Types of Offsite Sanitation Systems

Bhojpur Municipality is planning to have sewerage network in wards 6, 7, 8 and 9 while sewerage network has already been constructed in ward 12 but has not been executed. In addition, some households in ward 7 have well-functioning sewerage network with an outlet to an open space. In the municipality, 2% of the households have offsite sanitation systems. Here, households that have the outlet of toilet to a sewerage network or to an open environment is considered as offsite sanitation system. It is taken as toilet with no onsite container for the SFD graphic.

Types of Onsite Sanitation Systems

In the municipality, 97% of the households have onsite sanitation systems. Table 1 shows the types of onsite sanitation technologies and percentage of households using it at Bhojpur Municipality.

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

Containment	Wall construction materials	Bottom of containment	Chamber	Number	Connected to	%
Biogas digester	NA	NA	NA	NA	No outlet/overflow	1%
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	3%
Lined tank with impermeable walls and open bottom	Concrete walls OR Cemented brick/stone walls	Soiling or Nothing	one two More than two	NA	Soak pit Sewer Open drain/open ground No outlet/overflow	16%
Unlined pit	Mud mortar brick wall/Mud mortar cement wall/No lining/Dry stone wall	Nothing	NA	NA	NA	77%

Biogas Digester is a waste to energy conversion technology designed to treat household organic waste and faecal sludge (FS) to generate biogas. 1% 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 the types of biogas digester in Resunga Municipality.

Figure 5: Biogas digesters found at households in Bhojpur 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). 3% 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) . 16% of households have these types of containments in the municipality.

Unlined Pit is a dug pit in the ground. It has no lining in walls and a permeable base. It allows infiltration of effluents from walls and as well as bottom of the pit (SuSanA, 2018) . 77% of households have unlined pits. Figure 6 shows unlined pits found in Bhojpur Municipality.

Figure 6: Unlined pits found at households in Bhojpur Municipality.

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

Table 2: Types of sanitation technologies recategorized according to Shit Flow Diagram Promotion Initiativ (SFD PI)

Sanitation System	Percentage
No toilet/Open defecation (T1B11 C7 TO C9)	1%
No onsite container (T1A1C3 and T1A1C8)	2%
Onsite Sanitation System	
Fully lined tank (T1A3C10)	4%
Lined tank with impermeable walls and open bottom (T1A4C8 and T1A4C10)	16%
Unlined pit (T1A6C10)	77%
Grand Total	**100%**

According to Shit Flow Diagram Promotion Initiative (SFD PI), biogas digester and fully lined tanks are recategorized as fully lined tanks. Thus, 4% of households have fully lined tanks.

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

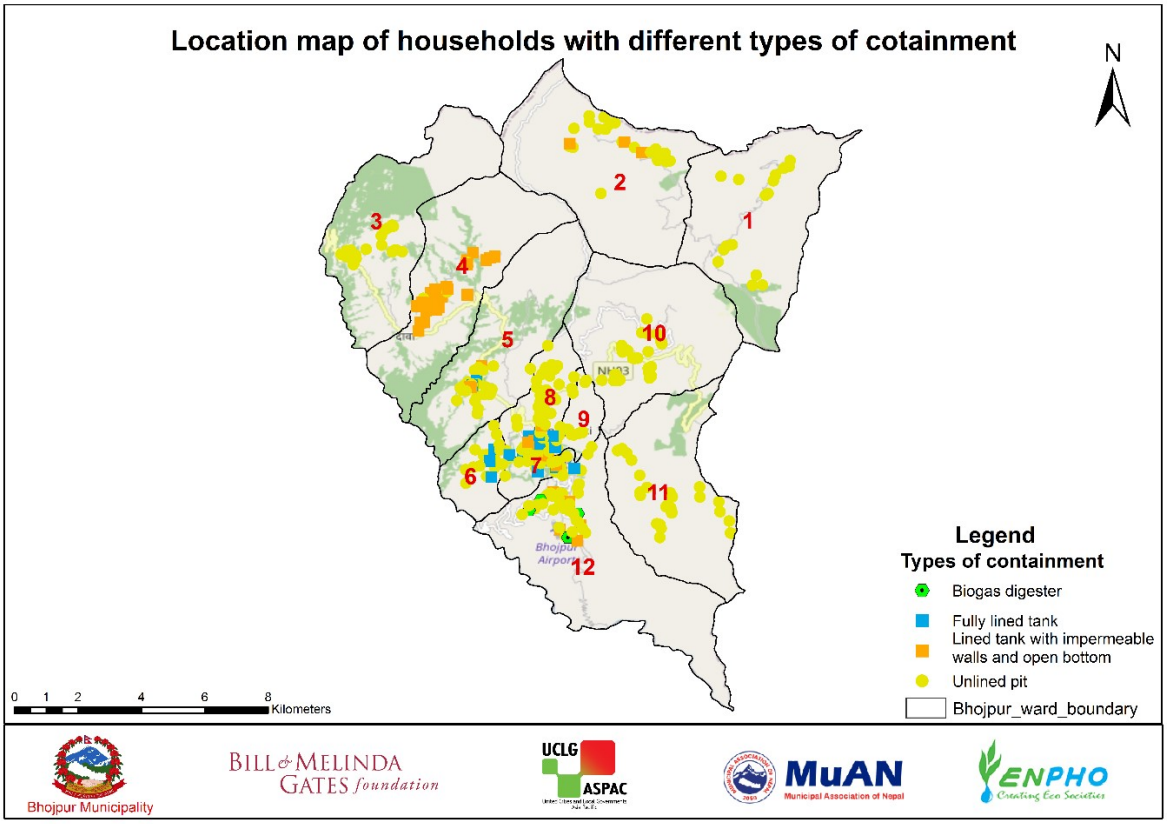


Figure 7: Location map of household with different types of containment.

2.1.2 Sanitation Systems in Institutional Buildings

Altogether 33 institutional buildings were surveyed. The sanitation data of institutional buildings were 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	10
Health care centre	10
Grand Total	**44**

All the institutional buildings in the municipality have toilets with 100% onsite sanitation systems. Among this sanitation system, 6% of the buildings have septic tanks, 21% have fully lined tanks, 24% have lined tanks with impermeable walls and open bottom and 49% have unlined pits. The data shows that only 30% of the institutional buildings have safer FS collecting containments whereas 70% 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 Bhojpur Municipality.

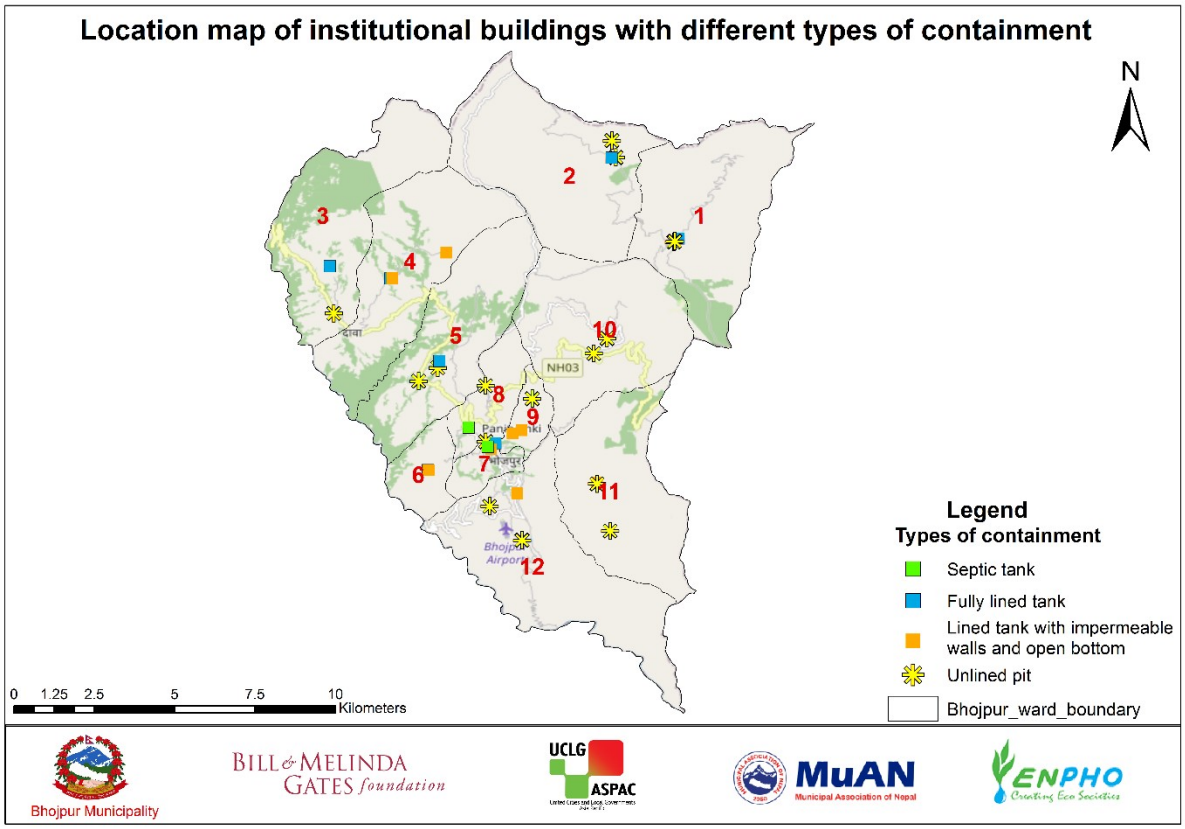


Figure 8: Location map of institutional buildings with different types of containment in Bhojpur Municipality.

2.1.3 Public Toilets

There are five public toilets in Bhojpur Municipality (KII-1, 2024) which were observed for the study. Among which, one public toilet at *Khukuri Bazar* is not functional. The information about public toilets obtained during KII and observation are fed in this report.

Public toilet at *Buspark*

The toilet located at *Buspark* in ward 7 was constructed by the Bhojpur Municipality on 2022. It has a separate male and female compartments. It serves 4 users at a time with 2 pans in male compartment and 2 pans in female compartment. The public vehicle staffs and passengers are the major service recipients of this toilet. About 100 users uses the toilet per day. The users are charged Rs. 5 (USD 0.03) for urination and Rs. 10 (USD 0.08) for defecation.

The outlet of the toilet is connected to a rectangular containment. The containment has not filled yet. The toilet is cleaned regularly. Water required for the toilet is supplied from a 1,000 litres overhead tank on the taps of each compartment. The toilet compartments have a ventilation. Two basins are placed outside the compartment for handwashing facility. A caretaker is responsible for overall management of the toilet (KII-4, 2024).

Public toilet at *Paani Tanki Chowk*

The toilet located at *Paani Tanki Chowk* in ward 9 was jointly constructed by the Bhojpur Municipality and Paani Tanki Users' Committee on July 16, 2020. It has separate male and female compartments. It serves 2 users at a time with 1 pan in male compartment and 1 pan in female compartment. The public vehicle staffs, passengers and local shopkeepers are the service recipients of the toilet. In an average 450 users uses the toilet per day. The users are charged Rs. 5 (USD 0.03) for urination and Rs. 10 (USD 0.08) for defecation.

The outlet of the toilet is connected to a Lined tank with impermeable walls and open bottom of size 26 m^3. The containment requires regular emptying and has been emptied 5 times since its construction. The municipality empty the containment after filling up without any charges. The toilet is cleaned regularly. Water required for the toilet is supplied from 3 overhead tanks of sizes one 1,000 litres and two 500 litres. A handwashing basin is placed outside the toilet for the handwashing facility. The toilet compartments have proper ventilation (KII-4, 2024). A caretaker is responsible for the overall management of the toilet.

Public toilet at *Deurali*

The toilet located at *Deurali* in ward 6 was constructed by the Bhojpur Municipality on July 6, 2019. It has a separate male and female compartments. It can serve 8 users at a time with 3 urinals and 1 pan in each compartment. The service recipients used to be the local bus passengers and city dwellers. About 20 people used to use the toilet per day and users were charged Rs. 5 (USD 0.03) for urination and Rs. 10 (USD 0.08) for defecation.

The outlet of the toilet is connected to a rectangular containment which have been emptied once after its construction. A two overhead tanks of sizes 1000 litres and 500 litres is placed to supply water inside the compartments. Both the compartments have proper ventilation. However, the toilet is not functional at the time of study due to lack of caretaker and cleanliness inside the compartments (KII-4, 2024).

Public toilet at *Hatiya Bazar*

Based on the observation, the toilet located at *Hatiya Bazar* was jointly constructed by PEACE CORPUS, USAID, the then Bhojpur VDC and Users Group with financial support and Drinking Water Supply Office with technical support. It has a separate male and female compartments. It serves 4 users at a time with 2 pans in each compartment. As per the KII, the customers, local shopkeepers of haitya bazar and city dwellers are the service of recipients of the toilet (KII-1, 2024).

Public toilet at *Yalamber Chowk*

Based on the observation, the toilet located at *Yalamber chowk* in ward 11 does not have separate male and female compartments. It serves 2 users at a time with available 2 pans. It does not have a proper ventilation, taps inside compartment and a basin for handwashing facility.

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

Figure 9: Public toilets and their status in Bhojpur 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 20% of the households have emptied their containment whereas 80% have not emptied yet. Similarly, only 6% of the institutional buildings have emptied their containments while almost 94% have not emptied. The municipality, mostly, has the containment types with open bottom (ENPHO, 2024). The

type of containments allows effluents to infiltrate (Peal, et al., 2020), preventing them from filling up quickly. Thus, this has reduced the frequency of emptying of the containments. Furthermore, the emptying ratio of fully lined tanks are greater than containment types with open bottom. The maximum sizes of the containments are 18 m^3, 27 m^3 and 22 m^3 respectively for fully lined tanks, lined tanks with impermeable walls and open bottom and unlined pits (ENPHO, 2024) . The size of the containments also affects the emptying frequency. Thus, due to comparatively smaller size of fully lined tanks and its characteristics of preventing infiltration resulted in higher frequency of emptying than other containment types. Figure 10 shows emptying status of different types of containment at households.

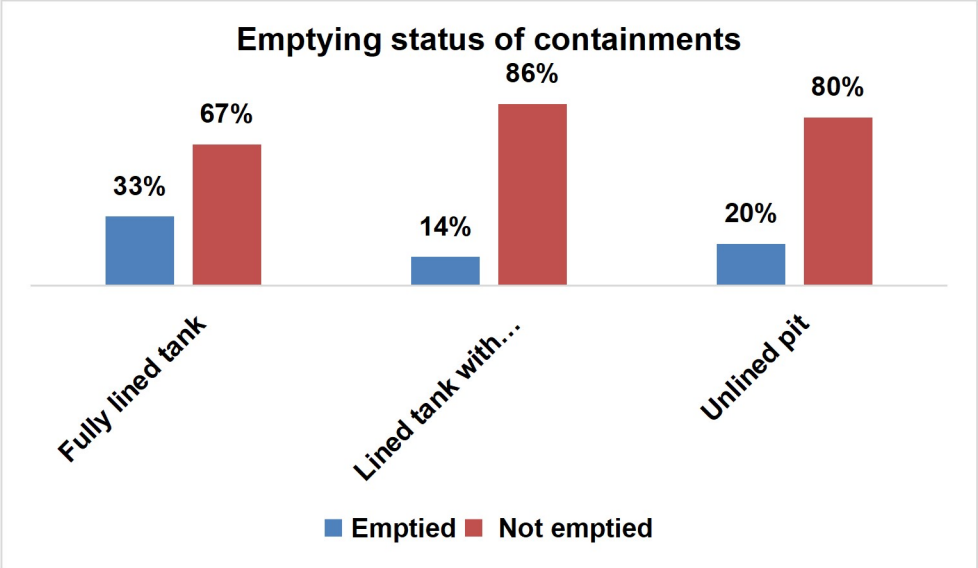


Figure 10: Status of emptying of different types of containment.

The municipality does not have regular containment emptying practice as most containments are with open bottom and does not get filled in standard time as per the containment size. The frequent emptying is challenging due to topography of the municipality as well. Thus, on-demand emptying practice is found the municipality (KII-2, 2024). In the municipality, manual, mechanical and open emptying is practiced at households, but manual emptying is more prevalent. Among the households that have emptied their containments, 90% of households emptied manually while only 6% of households emptied mechanically and 4% of households practiced open emptying. Open emptying method is the practice of discharging effluent into an open/stormwater drain during rainy season. Unlike the emptying practice at households, 50% of institutional buildings practiced manual emptying and 50% practiced mechanical emptying (ENPHO, 2024). The inadequate desludging vehicle, high service charge and lack of motorable road networks are the reasons for practicing manual emptying.

The municipality has a desludging vehicle however is not functional. Moreover, a private desludging service provider is serving in the municipality. It started the desludging service on 2017. but is not registered in any governmental agencies. The service provider has desludging vehicle with a tank capacity of 5,000 litres. The service charge for each trip is NRs. 4,000 - NRs. 5,000 (USD 30.1 - USD 37.6). There are only about 2 trips per month. A driver and a helper are assigned for the desludging service (KII-2, 2024).

2.1.5 Treatment and Disposal/Reuse

Bhojpur Municipality does not have a Faecal Sludge Treatment Plant (FSTP) but is constructing a Wastewater Treatment Plant (WWTP) as a part of sewerage system. The sewerage system is designed for conveyance of sewage and stormwater to treatment plants. Three WWTP are being constructed with capacities 2.4 litres per second (lps), 3.2 lps and 2.6 lps. The components in designed WWTPs includes screen chamber, grit chamber, parshall flume, flow divider, primary sedimentation tank, valve chamber, sludge drying bed, sludge storage yard, anaerobic baffle reactor, anaerobic filter and horizontal flow constructed wetland. The WWTP at Dhakre khola in ward 8 will treat wastewater (WW) from ward 8 and 9, WWTP at Ramailo ban in ward 7 will treat WW received partially from ward 7 and WWTP at Mauriya in ward 12 will treat WW from ward 12 and partially received from ward 7. As the construction of treatment plant has not completed, WW and FS is not treated (KII-5, 2024).

Therefore, mechanically emptied FS is disposed in an open environment owned by the service provider (KII-2, 2024) while manually emptied FS is mostly dig and dumped, as well as disposed into farmlands or water bodies or composted. Thus, in the municipality, all the emptied FS is disposed of unsafely and untreated in an open environment or water bodies.

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 52% of households in the Bhojpur Municipality have piped drinking water supply services while 5% of households get drinking water from community taps and 43% of households rely on spring sources. About 15 Water and Sanitation Users' Committee (WSUCs) are providing drinking water supply service at households and institutions in the municipality (ENPHO, 2024). Figure 10 shows community taps in the municipality.

Figure 11: Picture showing spring source and community tap in Bhojpur Municipality.

Silichung Water and Sanitation Users' Committee is one of the major water service providers in the municipality. It was established in 2000 and has been providing water supply services since its establishment (KII-3, 2024). Silichung WSUC upgraded on the water supply scheme

on 2022. The service aimed to reach 2,280 households in wards 5, 6, 7, 8, 9 and 12 while planning the upgradation of the water supply project (Suwal, 2019) . The water supply scheme lifts water from 6 different spring sources which includes 2 sources from ward 1, 1 source from ward 5 and 3 sources from ward 11. The lifted water from sources is processed through treatment systems including sedimentation tanks, horizontal roughing filter and chlorine dosing. Water is collected in 10 reservoir tanks with total capacity of 1,000 m^3 including largest one at Bhokim of capacity 150 m^3. The treated water is then distributed in the taps of households and institutions of the municipality. Water quality of this system is also performed (KII-3, 2024) . Figure 11 shows the treatment plant of Silichung Water Supply Scheme.

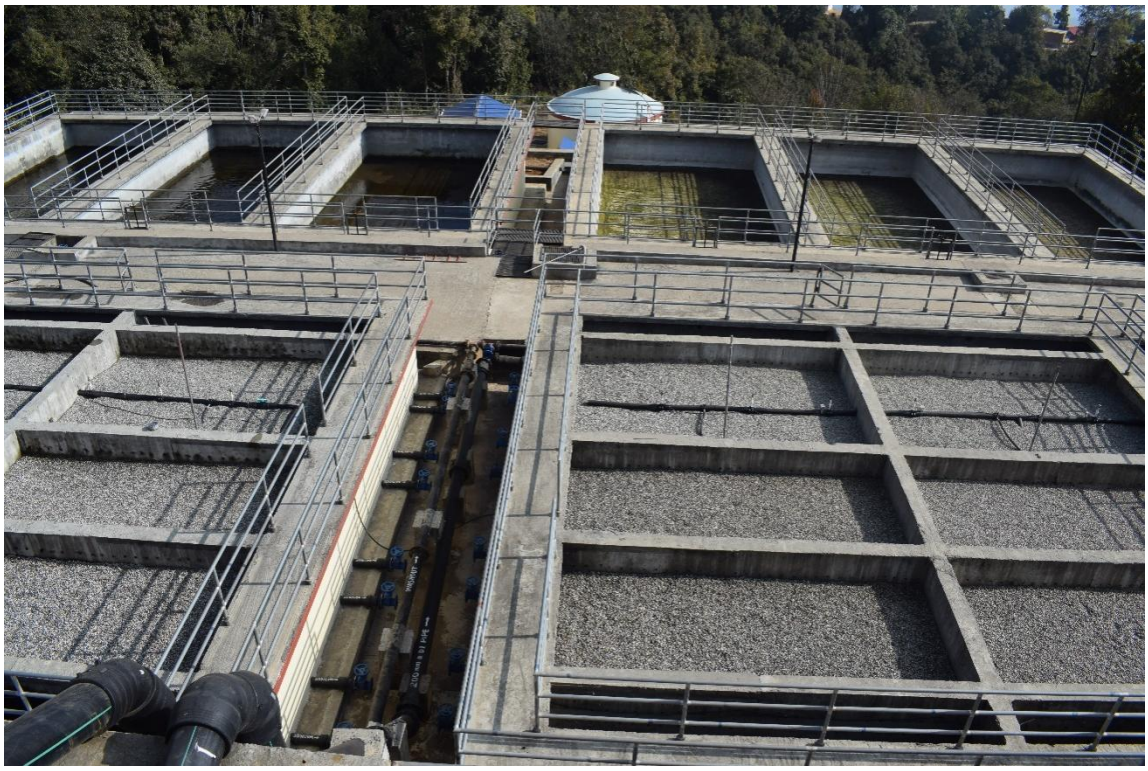


Figure 12: Drinking water treatment plant of Silichung Water Supply.

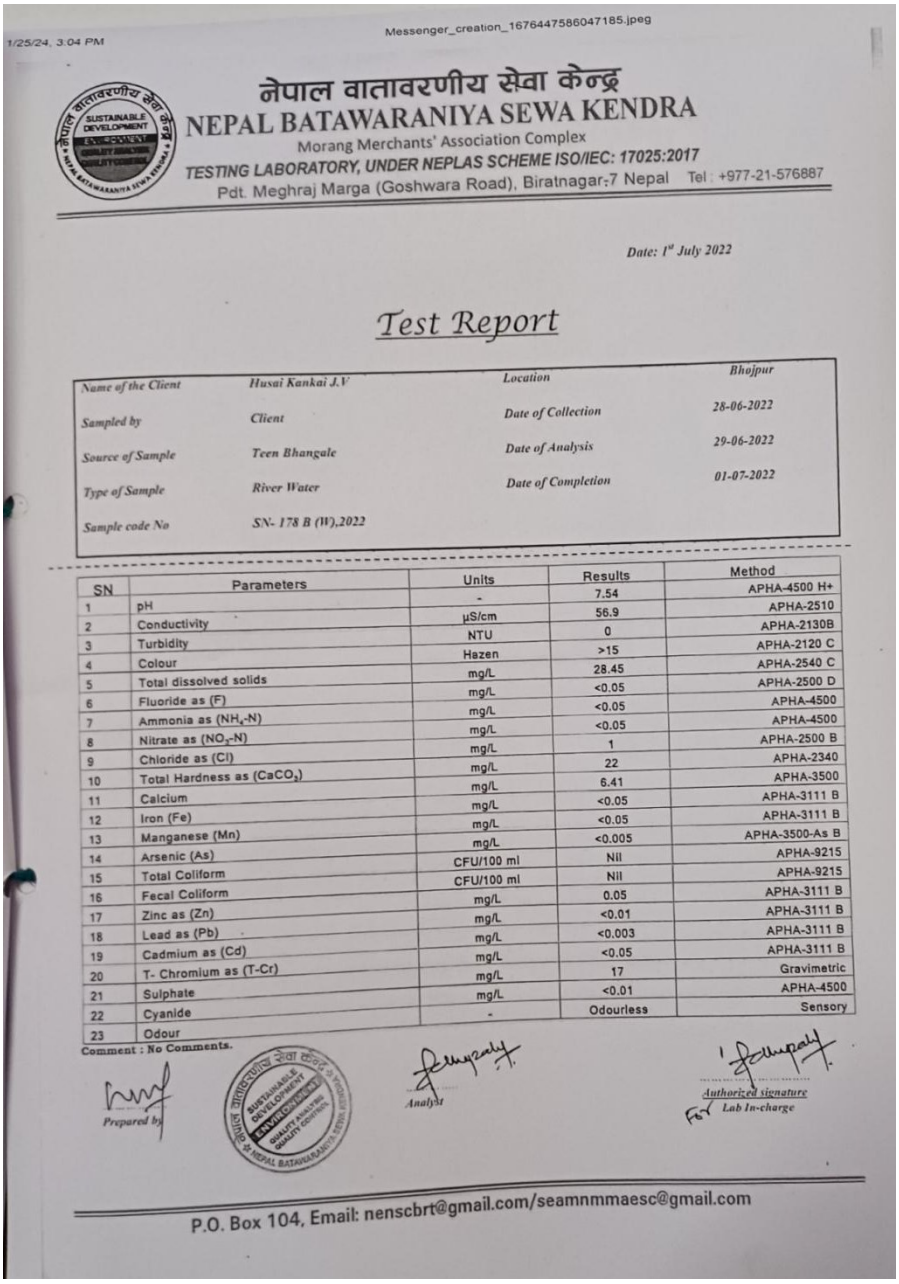
Apart from this water service provider, Amtek, Bhaisipakha, Tinbhangale and Chhabuk are some WSUC among others in the municipality (ENPHO, 2024) (KII-1, 2024) . The water supply service is not uniformly distributed in the municipality thus, locals are obliged to rely on spring sources for drinking water 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 metres to more than 25 metres horizontally from their containment. A study suggests that *E. coli* can travel up to hundreds of metreers horizontally in fractured rocks and gravels (Krishnan, 2011). As the geology of Bhojpur Municipality consists of rocky landscape, such as quartzite, granite and limestone (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 Bhojpur (ENPHO, 2023) . But spring water contamination is low in Bhojpur 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 water quality test report of spring source and drinking water of Silichung Water Supply Scheme showed the absence of *E. coli* (Figure 13 and Figure 14). Also, a study finding showed the absence of *E. coli* in spring source of Silichung river (Gupta, et al., 2023). 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, 1% depends on lined tanks with impermeable walls and an open bottom, with no outlet or overflow (T1A4C10, low risk) and 77% relies on unlined pits (T1A6C10, low risk).



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नेपाल वातावरणीय सेवा केन्द्र
NEPAL BATAWARANIYA SEWA KENDRA
Morang Merchants' Association Complex
TESTING LABORATORY, UNDER NEPLAS SCHEME ISO/IEC: 17025:2017
Pdt. Meghraj Marga (Goshwara Road), Biratnagar-7 Nepal Tel : +977-21-576887

Date: 1st July 2022

Test Report

Name of the Client	Husai Kankai J.V	Location	Bhojpur
Sampled by	Client	Date of Collection	28-06-2022
Source of Sample	Teen Bhangale	Date of Analysis	29-06-2022
Type of Sample	River Water	Date of Completion	01-07-2022
Sample code No	SN- 178 B (W),2022		

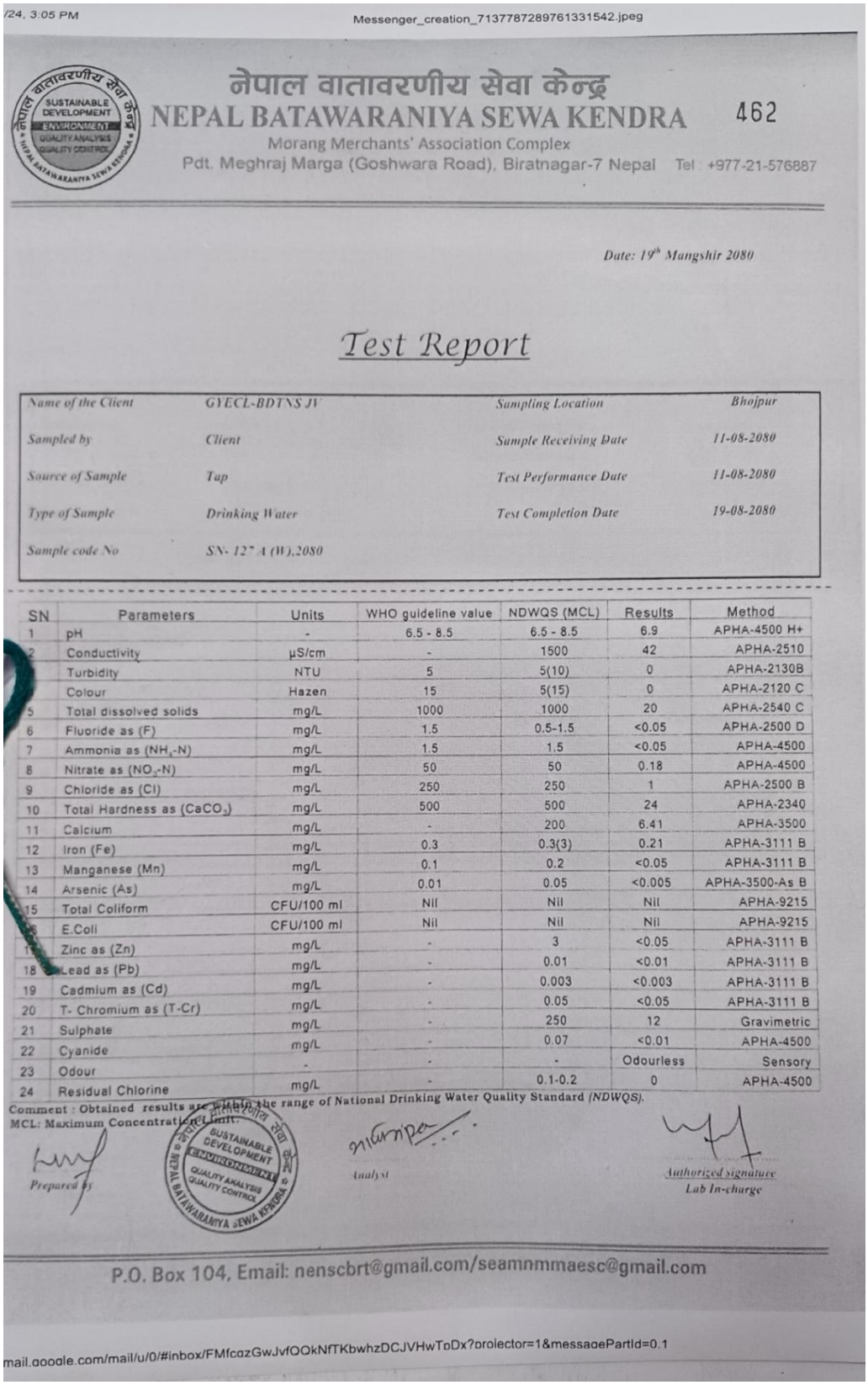
SN	Parameters	Units	Results	Method
1	pH	-	7.54	APHA-4500 H+
2	Conductivity	µS/cm	56.9	APHA-2510
3	Turbidity	NTU	0	APHA-2130B
4	Colour	Hazen	>15	APHA-2120 C
5	Total dissolved solids	mg/L	28.45	APHA-2540 C
6	Fluoride as (F)	mg/L	<0.05	APHA-2500 D
7	Ammonia as (NH_4-N)	mg/L	<0.05	APHA-4500
8	Nitrate as (NO_3-N)	mg/L	<0.05	APHA-4500
9	Chloride as (Cl)	mg/L	1	APHA-2500 B
10	Total Hardness as ($CaCO_3$)	mg/L	22	APHA-2340
11	Calcium	mg/L	6.41	APHA-3500
12	Iron (Fe)	mg/L	<0.05	APHA-3111 B
13	Manganese (Mn)	mg/L	<0.05	APHA-3111 B
14	Arsenic (As)	mg/L	<0.005	APHA-3500-As B
15	Total Coliform	CFU/100 ml	Nil	APHA-9215
16	Fecal Coliform	CFU/100 ml	Nil	APHA-9215
17	Zinc as (Zn)	mg/L	0.05	APHA-3111 B
18	Lead as (Pb)	mg/L	<0.01	APHA-3111 B
19	Cadmium as (Cd)	mg/L	<0.003	APHA-3111 B
20	T- Chromium as (T-Cr)	mg/L	<0.05	APHA-3111 B
21	Sulphate	mg/L	17	Gravimetric
22	Cyanide	-	<0.01	APHA-4500
23	Odour		Odourless	Sensory

Comment : No Comments.

Prepared by | Analyst | Authorized signature For Lab In-charge

P.O. Box 104, Email: nenscbrt@gmail.com/seamnmmaesc@gmail.com

Figure 13: Water quality test report of spring source of Silichung Water Supply Scheme.



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Date: 19th Mangshir 2080

Test Report

Name of the Client	GYECL-BDTNS JV	Sampling Location	Bhojpur
Sampled by	Client	Sample Receiving Date	11-08-2080
Source of Sample	Tap	Test Performance Date	11-08-2080
Type of Sample	Drinking Water	Test Completion Date	19-08-2080
Sample code No	SN- 127 A (W).2080		

SN	Parameters	Units	WHO guideline value	NDWQS (MCL)	Results	Method
1	pH	-	6.5 - 8.5	6.5 - 8.5	6.9	APHA-4500 H+
2	Conductivity	µS/cm	-	1500	42	APHA-2510
3	Turbidity	NTU	5	5(10)	0	APHA-2130B
4	Colour	Hazen	15	5(15)	0	APHA-2120 C
5	Total dissolved solids	mg/L	1000	1000	20	APHA-2540 C
6	Fluoride as (F)	mg/L	1.5	0.5-1.5	<0.05	APHA-2500 D
7	Ammonia as (NH_3-N)	mg/L	1.5	1.5	<0.05	APHA-4500
8	Nitrate as (NO_3-N)	mg/L	50	50	0.18	APHA-4500
9	Chloride as (Cl)	mg/L	250	250	1	APHA-2500 B
10	Total Hardness as ($CaCO_3$)	mg/L	500	500	24	APHA-2340
11	Calcium	mg/L	-	200	6.41	APHA-3500
12	Iron (Fe)	mg/L	0.3	0.3(3)	0.21	APHA-3111 B
13	Manganese (Mn)	mg/L	0.1	0.2	<0.05	APHA-3111 B
14	Arsenic (As)	mg/L	0.01	0.05	<0.005	APHA-3500-As B
15	Total Coliform	CFU/100 ml	Nil	Nil	Nil	APHA-9215
16	E.Coli	CFU/100 ml	Nil	Nil	Nil	APHA-9215
17	Zinc as (Zn)	mg/L	-	3	<0.05	APHA-3111 B
18	Lead as (Pb)	mg/L	-	0.01	<0.01	APHA-3111 B
19	Cadmium as (Cd)	mg/L	-	0.003	<0.003	APHA-3111 B
20	T- Chromium as (T-Cr)	mg/L	-	0.05	<0.05	APHA-3111 B
21	Sulphate	mg/L	-	250	12	Gravimetric
22	Cyanide	mg/L	-	0.07	<0.01	APHA-4500
23	Odour	-	-	-	Odourless	Sensory
24	Residual Chlorine	mg/L	-	0.1-0.2	0	APHA-4500

Comment : Obtained results are within the range of National Drinking Water Quality Standard (NDWQS).
MCL: Maximum Concentration Level.

Prepared by
Analyst
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Lab In-charge

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mail.google.com/mail/u/0/#inbox/FMfcgzGwJvfQQkNfTKbwhzDCJVHwTpDx?projector=1&messagePartId=0.1

Figure 14: Water quality test report of drinking water from Silichung Water Supply Scheme.

2.2 SFD Selection Grid

Figure 15 shows the types of sanitation technologies present in the Bhojpur 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			T1A1C3		Significant risk of GW pollution Low risk of GW pollution			T1A1C8		Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution					
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution					T1A3C10
Lined tank with impermeable walls and open bottom	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution			T1A4C8		Significant risk of GW pollution T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution Low risk of GW pollution
Unlined pit										Significant risk of GW pollution T1A6C10
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable							T1B11 C7 TO C9		Not Applicable

Figure 15: SFD selection grid for Bhojpur 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 15.

T1A1C3	A fully functioning toilet discharging directly to a correctly designed, properly constructed, fully functioning decentralised combined sewer. The excreta is raw, untreated and hazardous, but since it is captured in the sewer, all the excreta in this system is considered contained.
T1A1C8	A fully functioning toilet discharging directly to open ground. The excreta is raw, untreated and hazardous and since it discharges directly to open ground, all the excreta in this system is considered NOT 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.
T1A4C8	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes wall-lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks. Since the tank is fitted with a supernatant/effluent overflow connected to open ground, the excreta in this system is considered NOT contained.
T1A4C10	A correctly designed, properly constructed and well maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. It includes all lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks (e.g. cubluks in Indonesia). However, since the tank is NOT fitted with a supernatant/effluent overflow this system is considered contained.
T1A6C10	A correctly designed, properly constructed and well maintained unlined pit with permeable walls and base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow so this system is considered contained.
T1B11C7 to C9	With no toilet, users defecate in water bodies, on open ground and to don't know where; consequently, the excreta is NOT contained.

2.3 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 none 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 16 shows the SFD matrix of Bhojpur Municipality.

Bhojpur Municipality, Koshi, Nepal, 15 Mar 2024. SFD Level: 2 - Intermediate SFD
Population: 26007
Proportion of tanks: septic tanks: 0%, fully lined tanks: 100%, lined, open bottom tanks: 100%

Containment						
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment
	Pop	W4b	W5b	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	Proportion of wastewater in sewer system, which is delivered to decentralised treatment plants	Proportion of wastewater delivered to decentralised treatment plants, which is treated	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
T1A1C3 Toilet discharges directly to a decentralised combined sewer	1.0	0.0	0.0			
T1A1C8 Toilet discharges directly to open ground	1.0					
T1A3C10 Fully lined tank (sealed), no outlet or overflow	4.0			43.0	51.0	100.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	15.0			10.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0			80.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	77.0			17.0	0.0	0.0
T1B11 C7 TO C9 Open defecation	1.0					

Figure 16: SFD Matrix of Bhojpur 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, 2024) and amount of FS emptied during the process (KII-2, 2024) . 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, 2024) . 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], 2024; KII-2, 2024[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)
Toilet discharges directly to a decentralized combined sewer	T1A1C3	1%	0%	0%	0%
Toilet discharges directly to open ground	T1A1C8	1%	0%	0%	0%
Fully lined tank (sealed), no outlet or overflow	T1A3C10	4%	54%	80%	43%
Lined tank with impermeable walls and open bottom, connected to open ground	T1A4C8	1%	100%	80%	80%
Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	15%	13%	80%	10%
Unlined pit, no outlet or overflow	T1A6C10	77%	21%	80%	17%
Open defecation	T1B11 C7 TO C9	1%	0%	0%	0%

2.3.3 Proportion of WW transported which is delivered to Treatment Plant (W4b and W5b)

The variable W4b is the proportion of wastewater in decentralised sewer network that is delivered to treatment plant and variable W5b is the proportion of wastewater delivered to treatment plant and treated. The amount of wastewater (WW) generated could not be measured and wastewater treatment plant (WWTP) in the municipality is in construction phase. The wastewater is not treated and thus, the value for variables W4b and W5b is set to 0%.

2.3.4 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 51% (F4 = 51%) and the capacity of fully functioning biogas digester is taken to 100% (F5 = 100%). Apart from biogas digester, FS emptied from other sanitation technologies are disposed in an open environment or in water bodies. Hence, the portion of FS delivered to treatment plant for the remaining technologies (F4) and treated (F5) is 0%.

2.4 SFD Graphic

Figure 17 shows the SFD graphic of Bhojpur 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 81% of the population are safely managed and excreta from 19% of the population are unsafely managed. It also represents the sanitation value chain going from left to right.

Offsite Sanitation

As sewer network in Bhojpur Municipality is in construction phase, the sewer network has not been begun. However, few households have constructed sewer network without treatment system for their locality, other than this, some households also discharge effluent directly to an open environment. Therefore, wastewater from 2% of the population is not treated and is unsafely managed.

Onsite Sanitation

In the municipality, 97% of households rely on onsite sanitation systems. Of the total households having an onsite sanitation system, 96% of the population uses containment where FS is contained.

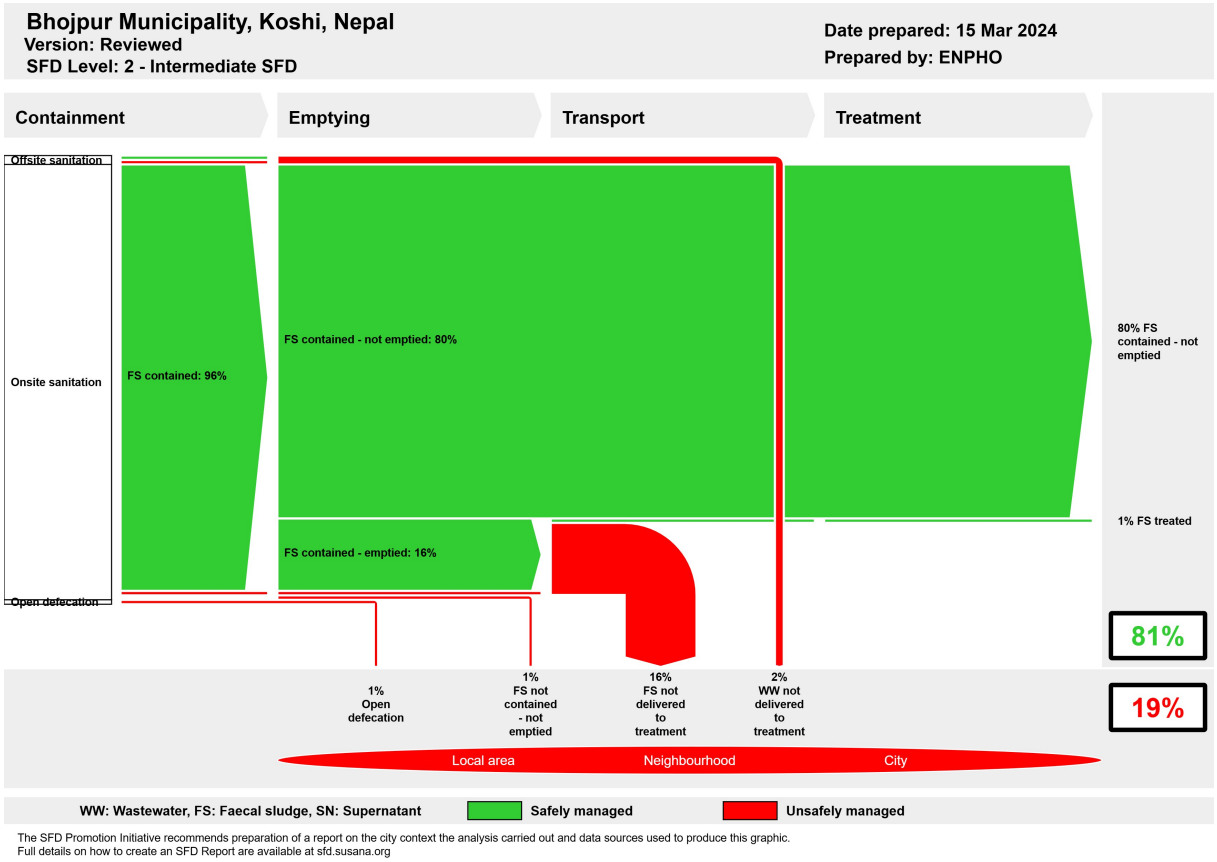

Figure 17: SFD Graphic of Bhojpur Municipality.

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. 96% is obtained from the summation of population using fully lined tanks with no outlet or overflow (T1A3C10), lined tanks with impermeable walls and open bottom with no outlet or overflow (T1A4C10) 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. 1% is obtained from the population using lined tanks with impermeable walls and open bottom connected to an open ground (T1A4C8).

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 16% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

FS not contained - not Emptied

The value of 1% 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. 16%, is the FS contained emptied. Since Bhojpur Municipality does not have FSTP, emptied FS is disposed of untreated to an open environment or water bodies. Therefore, this proportion of disposed FS possesses risk to local area and neighbourhood.

FS treated

In the municipality, 1% of households in the municipality have biogas digesters. 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. 1% 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.

3 Service delivery context

3.1 Policy, legislation, and regulation

The constitution of Nepal 2015 has established right to access to clean drinking water and citizen as fundamental right. In Article 35 (4) related to right to health recognizes citizen's rights to access to clean drinking water and sanitation. In addition, Right to Clean Environment, Article 30 (1) recognizes that every person shall have the right to live in a healthy and clean environment (GoN 2015). To respect and promote the right of citizens to wards accessing clean drinking water and sanitation services, the government has promulgated and amended necessary laws. The most relevant legislation for promotion of safe sanitation services is discussed here.

Local Government Operation Act, 2017

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

Environment Protection Act, 2019

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

Water Supply and Sanitation Act, 2022

The act was promulgated to ensure the fundamental right of 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 marginalized and vulnerable groups. However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery. Thus, the National Urban Water Supply and Sanitation Sector Policy (NUWSSSP) was formulated and enforced in 2009. It focused on achieving coherent, consistent, and uniform approaches of development in urban areas with the involvement of different agencies and institutions. Both these policies were limited to addressing emerging issues and challenges in the rural and urban areas. Thus, the National Water Supply and Sanitation Policy (NWSSP) was formulated in 2014 by GON to address the emerging challenges and issues with the adoption of new approaches and resolve the inconsistency in RWSSNP and NUWSSSP.

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

Nepal is a signatory of the historical resolution of 2010 United Nations General Assembly on the Human Right to Water and Sanitation. Nepal committed to Millennium Development Goals (MDGs) for 2000- 2015. 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 prioritized 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 harmonization in the sector. The SDP classified service system and delineated roles and responsibilities for effective and sustainable service delivery. The SDP highlighted that majority of households rely on onsite sanitation system (70%) that requires effective treatment of faecal sludge. However, there is lack of concrete policies, guidelines, and indicators on Faecal Sludge Management in the sector for effective planning, implementation, and service delivery. Nepal was declared ODF nation on September 23, 2019 (MoWS, 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 specialized and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs,

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

Ministry of Water Supply: Ministry of Water Supply is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015). Under the MoWS, Department of Water Supply and Sewerage Management (DWSSM) plan and implement water and sanitation projects funded by foreign donors or inter provincial projects or serves at least 15,000, 5,000 and 1,000 people in terai, hilly and mountain region respectively (GoN, 2015). The organizational structure of DWSSM is shown in Figure 18.

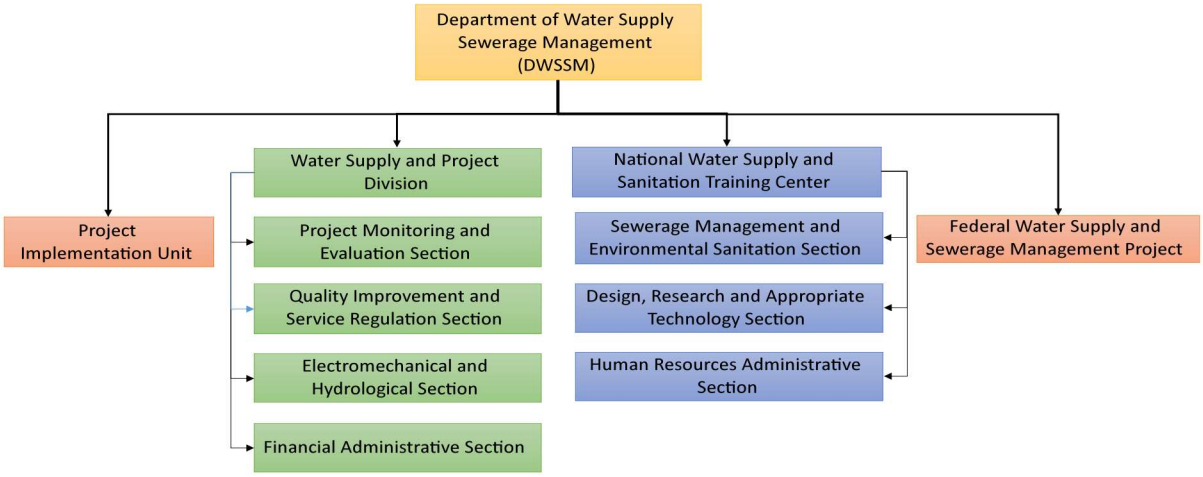

Figure 18: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).

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 Water Supply, Irrigation and Energy: Ministry of Water Supply, Irrigation and Energy of provincial government in Koshi 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 Bhojpur is executed through Water Resource and Irrigation Development Division (WRIDD), Bhojpur. WRIDO 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

There is no specific section or unit to oversee the activities and planning of sanitation in the Bhojpur Municipality. However, the activities specifically for sanitation management is supervised under administrative section in close coordination with WASH Focal Person.

3.4 Service provision

Urban Water Supply and Sanitation Policy 2009 has emphasized the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, 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 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 19).

Table 7: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organization/Company	Purpose of KII	Date
1.	Ram Prasad Dhungel (KII-1)	Chief Administrative Officer	Bhojpur Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	24 January, 2024
2.	Khagendra Khadka (KII-1)	WASH Focal Person	Bhojpur Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	24 January, 2024
3.	Bina Shrestha (KII-2)	Owner	Private Desludging Service Provider	Emptying practices, finances requirement, disposal and treatment	25 January, 2024
4.	Tufan Kirat Bantawa (KII-3)	Chairperson	Silichung Water and Sanitation Users' Committee	Water supply services and water quality in Bhojpur Municipality	24 January, 2024
5.	Bina Tamang (KII-4)	Caretaker	Public toilet-Buspark	Quantitative and qualitative management on public toilet and public toilet operation	24 January, 2024
6.	Ang Tenji Sherpa (KII-4)	Caretaker	Public toilet-Paani Tanki Chowk	Quantitative and qualitative management on public toilet and public toilet operation	25 January, 2024
7.	Narayan Bahadur Karki (KII-4)	Caretaker	Public toilet-Deurali	Quantitative and qualitative management on public toilet and public toilet operation	24 January, 2024
8.	Laxmi Prasad Chaudhary (KII-5)	Construction Supervision Engineer	Urban Water Supply and Sanitation Project Office	Ongoing projects and activities on sewerage system	24 January, 2024

Figure 19: KII with municipal representatives and engineer for sewerage network management at Bhojpur.

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 mobilized 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 20).

Figure 20: SFD orientation to local enumerators for data collection.

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 363 households were sampled from 6,744 households distributed in 12 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 21.

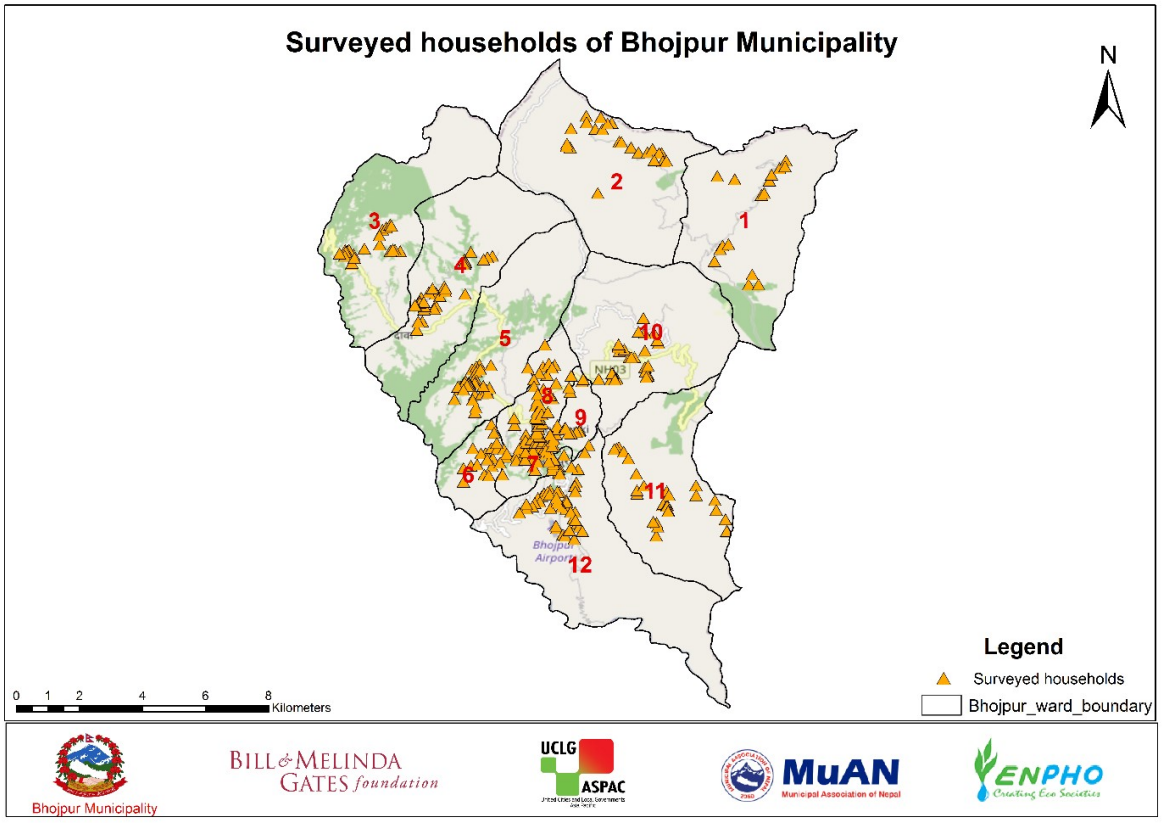

Figure 21: Location map of surveyed households.

4.3 Direct Observation

Various sanitation technologies in the households were observed and visual references were kept. Also, observation of the toilet, water source, containments and treatment plant for sewerage network were carried out. Figure 22 shows the wastewater treatment plant in construction phase at Bhojpur Municipality.

Figure 22: Wastewater treatment plant in construction phase at Bhojpur Municipality.

4.4 Sharing and Validation of Data

The Shit Flow Diagram Sharing and Validation Workshop was conducted at Bhojpur Municipality to share the findings on sanitation situation survey and receive the suggestions from the municipal stakeholders. Altogether, 22 participants including mayor, CAO, ward chairpersons, municipal council members, sectoral staffs and other relevant stakeholders actively participated on the workshop and provided valuable suggestions. Mayor expressed his interest on improving FSM by constructing FSTP and FSM policy in the municipality. Figure 23 shows the picture of SFD findings sharing to the participants. The list of participants with their designation is attached in Appendix 4.

Figure 23: 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. Kailash Kumar Ale, Mayor, Mr. Ram Prasad Dhungel, CAO, and Mr. Khagendra Khadka, WASH Focal Person of the municipality for providing valuable time and information during study. 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.

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

We are grateful to Ms. Bhawana Sharma, Executive Director and Mr. Rajendra Shrestha, Program Director of Environment and Public Health Organization (ENPHO) for tremendous support and guidance during the whole process of the study. Together, we would like to thank the entire team of ENPHO for their support and MuNASS-II team without whom the study would not have been possible.

We are grateful towards the enumerators, Ms. Nimlamu Shrepa, Ms. Nirmala Rayamajhi, Ms. Rabina Pandey, Ms. Mandira Khadka, Ms. Sabita Rai, Mr. Suman Khatri, Ms. Susmita Tamang, Ms. Kopila Rai, Ms. Anita Tamang, Mr. Nagendra Rai, Ms. Asmita Phuyal and Mr. Anuj Karki for their support during the survey.

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7 Appendix Annexes

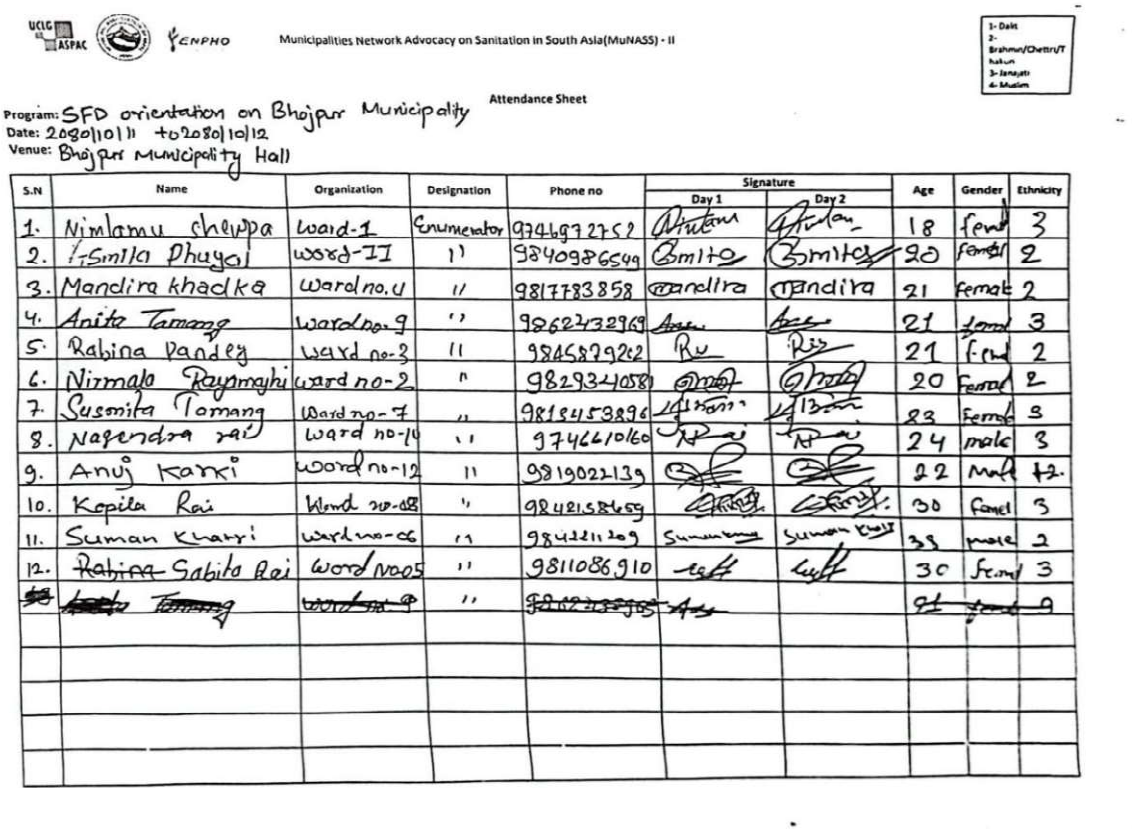
7.1 Appendix 1: Roles and Responsibility of Various Tiers of Governments Delineated in Drafted SDP 2016 – 2030

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	1,268	304	16
2	1,882	430	23
3	1,830	453	24
4	2,678	659	36
5	2,579	662	36
6	1,800	461	25
7	3,106	900	48
8	1,398	380	20
9	2,187	611	33
10	1,997	543	29
11	2,186	529	29
12	3,096	812	44
Total	**26,007**	**6,744**	**363**

7.3 Appendix 3: List of Participants on SFD Survey Orientation



UCLG ASPAC | ENPHO | Municipalities Network Advocacy on Sanitation in South Asia(MuNASS) - II

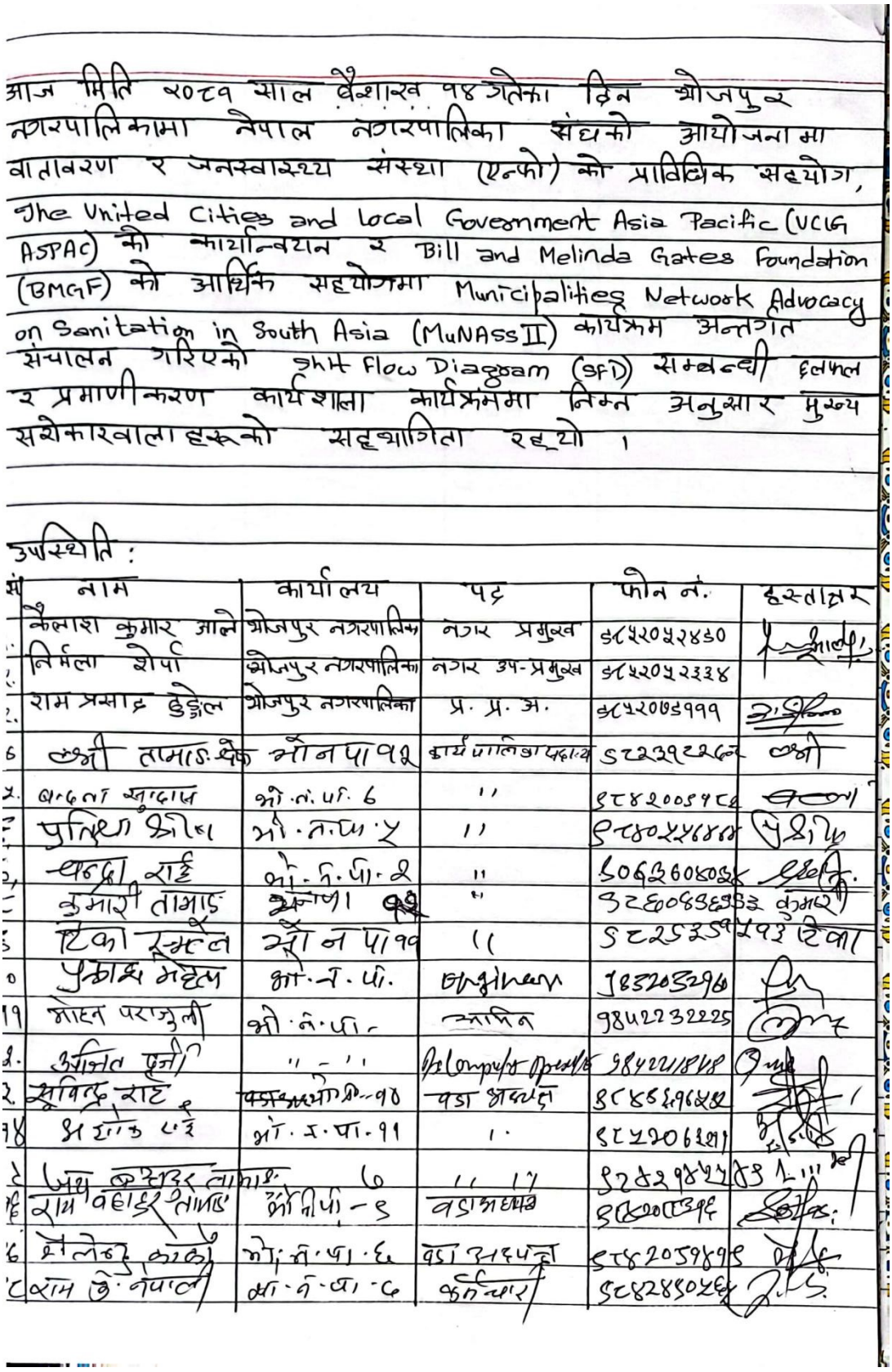
1- Dalit
2- Brahmin/Chettri/Thakuri
3- Janajati
4- Muslim

Attendance Sheet

Program: SFD orientation on Bhojpur Municipality
Date: 2080/10/11 to 2080/10/12
Venue: Bhojpur Municipality Hall

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1.	Nimlamu chelppa	ward-1	Enumerator	9746972752			18	female	3
2.	Smilla Dhugal	ward-II	"	9840986549			20	female	2
3.	Mandira khadka	ward no. 4	"	9817783858			21	female	2
4.	Anita Tamang	ward no. 9	"	9862432969			21	female	3
5.	Rabina Pandey	ward no-3	"	9845879262			21	female	2
6.	Nirmala Rayamajhi	ward no-2	"	9829340581			20	female	2
7.	Susmita Tamang	Ward no-7	"	9818453896			23	female	3
8.	Nagendra rai	ward no-14	"	9746410160			24	male	3
9.	Anuj karki	ward no-12	"	9819022139			22	Male	12.
10.	Kopila Rai	Ward no-08	"	9842158659			30	Femel	3
11.	Suman Khatri	ward no-06	"	9841211209			33	male	2
12.	Rabina Sabita Rai	ward no05	"	9811086910			30	female	3
~~13~~	~~[illegible] Tamang~~	~~ward no-9~~	"	~~9802[illegible]~~			~~21~~	~~female~~	~~9~~

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



आज मिति २०८१ साल वैशाख १४ गतेका दिन भोजपुर नगरपालिकामा नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एन्फो) को प्राविधिक सहयोग, The United Cities and Local Government Asia Pacific (UCLG ASPAC) को कार्यान्वयन र Bill and Melinda Gates Foundation (BMGF) को आर्थिक सहयोगमा Municipalities Network Advocacy on Sanitation in South Asia (MuNASS II) कार्यक्रम अन्तर्गत संचालन गरिएको Shit Flow Diagram (SFD) सम्बन्धी तथ्यांक र प्रमाणीकरण कार्यशाला कार्यक्रममा निम्न अनुसार मुख्य सरोकारवाला हरूको सहभागिता रहेको ।

उपस्थिति :

सं	नाम	कार्यालय	पद	फोन नं.	हस्ताक्षर
१	कैलाश कुमार आले	भोजपुर नगरपालिका	नगर प्रमुख	९८५२०५२४४०	
२	निर्मला शेर्पा	भोजपुर नगरपालिका	नगर उप-प्रमुख	९८५२०५२३३४	
३	राम प्रसाद ढुङ्गेल	भोजपुर नगरपालिका	प्र. प्र. अ.	९८५२०७९९९९	
४	[illegible]	[illegible]	[illegible]	[illegible]	
५	[illegible]	[illegible]	[illegible]	[illegible]	
६	[illegible]	[illegible]	[illegible]	[illegible]	
७	[illegible]	[illegible]	[illegible]	[illegible]	
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१७	[illegible]	[illegible]	[illegible]	[illegible]	
१८	[illegible]	[illegible]	[illegible]	[illegible]	
१९	[illegible]	[illegible]	[illegible]	[illegible]	
२०	[illegible]	[illegible]	[illegible]	[illegible]	

क्र.सं.	नाम	कार्यालय	पद	फोन नं.	हस्ताक्षर
१८	प्रभाराज राई		[illegible]	[illegible]	
२०	लक्ष्मी [illegible]		अधिकृत [illegible]	[illegible]	
२१	शारदा तामाङ	ओ.न.पा.	कार्यक्रम संयोजक	[illegible]	
२२	[illegible]	ओ.न.पा.	सूचना प्रविधि अधिकृत	[illegible]	
[illegible]	[illegible]	" "	[illegible]	[illegible]	
२५.	राजेन्द्र श्रेष्ठ	ENPHO	P.D.	9851042148	
२६.	बुद्ध बज्राचार्य	"	P.C.	9849132020	
२७.	अनिता भुजेल	"	A.P.O.	9849358197	

SFD Bhojpur Municipality, Nepal, 2026

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