SFD Report

Vyas 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 of Vyas Municipality, Nepal, 2025

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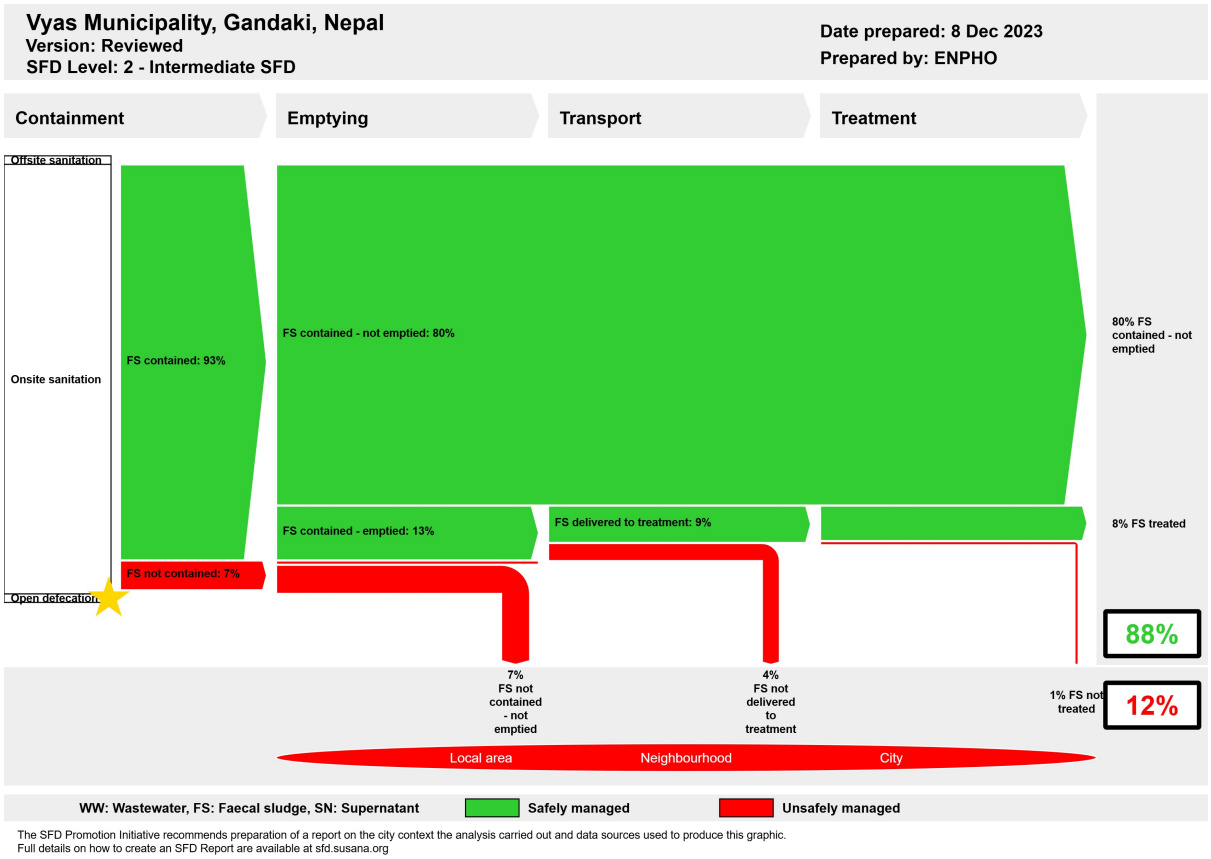
1. The SFD Graphic



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:

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

Status:

Final SFD report.

Date of Production: 04/19/2024

3. General city information

Vyas Municipality was established in 1991. The municipality is located in Tanahun District, Gandaki Province. The municipality is divided into 14 political wards.

The municipality has a total population of 78,939 with 36,157 males and 42,782 females. (Census 2021, n.d.)

Out of all the wards, ward number 1 has the most residents (14,594), while ward number 8 has the fewest (1,816). The number of households in Vyas Municipality is 22,585. With a total of 4,253 households, Ward 1 has the most, while Ward 8 has the fewest, with a total of 588 households. Table 1 shows the total population and households in each ward.

The district's average yearly temperature is 20.4 °C. The average annual rainfall is 1,960.6 mm. (Weather and Climate, n.d.)

4. Service outcomes

The overview of different sanitation technologies across the sanitation value chain in the municipality is briefly explained in this section. Basic sanitation coverage in the municipality is 100%. Basic sanitation is defined as having access to facilities for the safe disposal of human waste (faeces and urine), as well as having the ability to maintain hygienic conditions, through services such as garbage collection, industrial/hazardous waste management, and wastewater treatment and disposal. All the households surveyed in the municipality have access to basic toilet facilities. Among the households having their own toilets 100% of HHs rely on the onsite sanitation system (ENPHO, 2023).

Containment:

Different types of containment used to store faecal sludge in the onsite sanitation systems are: Fully lined tanks (14.76%), lined tanks with impermeable walls and open bottom (65.10%), lined pits with semipermeable walls and open bottom (4.69%) and unlined pits (15.45%).

Emptying and Transportation:

There are regular emptying practices for the containments. 14.58% of the households have emptied the containment at least once since installation. Both manual and mechanical desludging mechanisms are practiced.

The municipality lacks a faecal sludge treatment facility. The majority of faecal sludge emptied is used in agricultural lands as well as dumped in the environment untreated. Households having a biogas digester installed utilize their energy in cooking and other purposes.

The SFD graphics show that 88% of the excreta generated are safely managed while 12% of the excreta generated are unsafely managed. The safely managed percentage of FS generated by 80% of the population is temporary until the tanks and pits become full and FS from the containment is emptied.

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 the 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.

Nepal committed to the SDGs early on, and this commitment has been reaffirmed in key policy documents, such as the current 15th development plan and the 25-year long term vision 2100 that internalises the Goals. SDGs codes are assigned for all national development programmes through the Medium-Term Expenditure Framework. Further, Nepal has prepared the SDG status and roadmap to localize the SDG indicators with baselines and targets 2030.

6. Overview of stakeholders

The major stakeholders envisioned by the regulatory framework for faecal sludge management (FSM) in urban cities are presented in Table 1.

Table 1: Overview of Stakeholders.

Key Stakeholders	Institutions / Organizations
Public Institutions at Local Government	Vyas Municipality
Non-governmental Organizations	Environment and Public Health Organization (ENPHO)
Private Sector	Water Users committee, Public Toilet Operators.
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC

7. Credibility of data

The major data had been collected from random household sampling. Altogether, 575 households and 50 institutions were surveyed from 14 wards of Vyas municipality. Primary data on emptying, transportation and current

sanitation practices in the municipality are triangulated with the data obtained from KII with Municipal Officers, Operator of public toilet, sanitation, and environmental section. Also, a data sharing and validation workshop with key stakeholders was performed.

8. Process of SFD development

Data on sanitation situations was collected through household and institutional surveys. Enumerators from the municipality have been 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 was conducted with officers and engineers of municipality, Water Supply and Sanitation Users Committee. 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 was fed into SFD graphic generator to produce the SFD graphics.

8. List of data sources

List of data sources to produce this executive summary:

- CBS. (2021). National Population and Housing Census 2021. Kathmandu, Nepal: Central Bureau of Statistics. Retrieved from chrome-extension:// https://censusnepal.cbs.gov.np/results/downloads/ward
- ENPHO. (2023). Sanitation Situation Assessment of Vyas Municipality: Unpublished.
- MoFAGA. (2017). Ministry of Federal Affairs & General Administration. Retrieved from Government of Nepal, Ministry of Federal Affairs & General Administration: https://www.sthaniya.gov.np/gis/.

SFD Vyas Municipality, Nepal, 2025

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Abbreviations

ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
GoN	Government of Nepal
HH	Household
JMP	Joint Monitoring Programme
KII	Key Informant Interview
KM	Kilometres
mm	Millimetre
MoEST	Ministry of Education, Science and Technology
MoFAGA	Ministry of Federal Affairs and General Assembly
MoH	Ministry of Health
MoHP	Ministry of Health and Population
MoUD	Ministry of Urban Development
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NPC	National Planning Commission
NUWSSP	National Urban Water Supply and Sanitation Sector Policy
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
RWSSNP	Rural Water Supply and Sanitation National Policy
SCEIS	Sector Coordination and Efficiency Improvement Section
SDG	Sustainable Development Goal
SDP	Sector Development Plan
SFD	Shit Flow Diagram
SFD PI	Shit Flow Diagram Promotion Initiative
SN	Supernatant
UCLG ASPAC	United Cities and Local Governments Asia Pacific
UNICEF	United Nations Children's Education Fund
VDC	Village Development Committee
WASH	Water, Sanitation and Hygiene
WASH-CC	Water, Sanitation and Hygiene Coordination Committee
WHO	World Health Organization
WSP	Water Supply Providers
WSUC	Water Supply and User's Committee
WW	Wastewater

1. City context

Vyas Municipality is established in 1991. It is located in Tanahun District, Gandaki Province. The Municipality has a total of fourteen political wards.

Vyas municipality occupies an area of 248 km^2. The Municipality is enclosed by Bhanu Municipality in the East, Myagde Rural Municipality and Shuklagandaki Municipality in the West, Rhishing and Bandipur Rural Municipality in the North and Kaski and Lumjung District in the South. (Nepal Archives, n.d.) . Figure 1 shows the Geo-political map of Vyas Municipality.

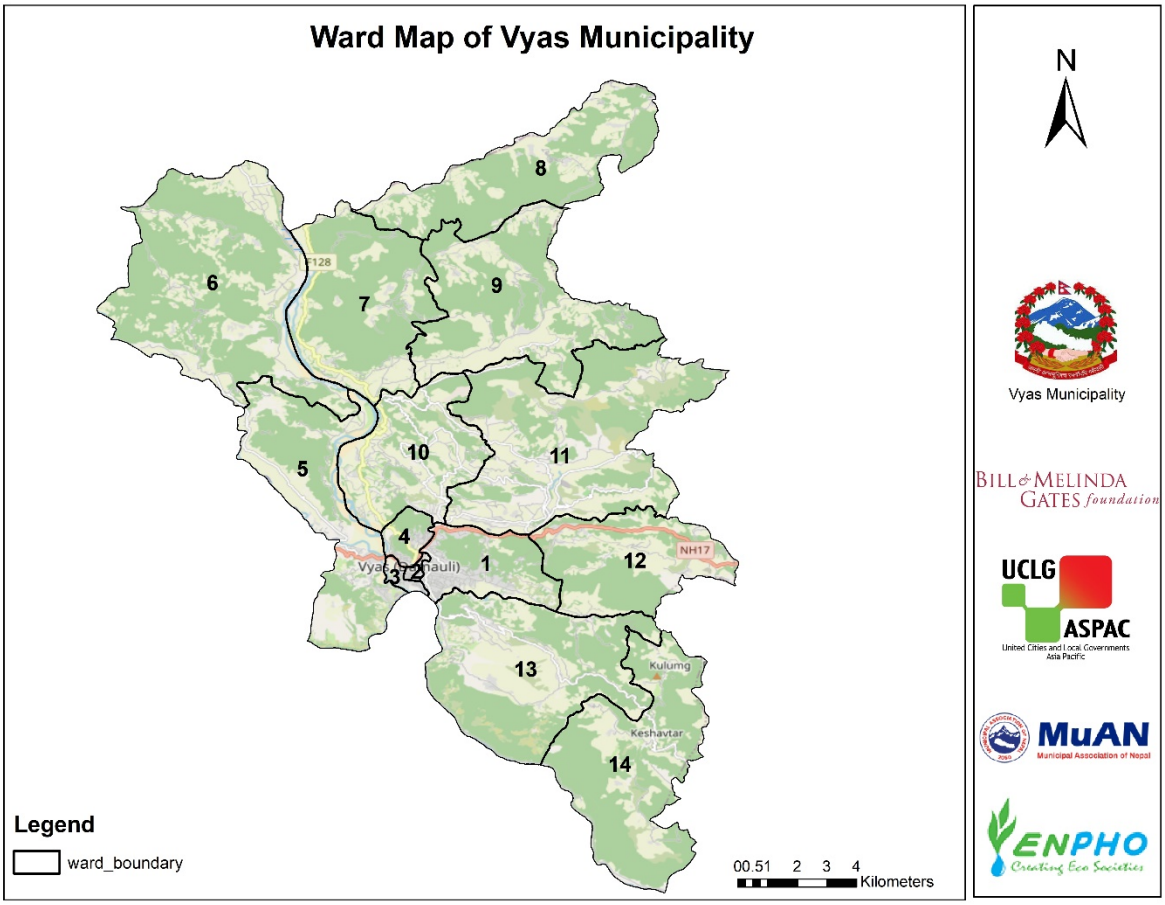

Figure 1: Map of Vyas Municipality with ward boundaries.

1.1 Population

There are 78,939 people living in Vyas Municipality, with 36,157 men and 42,782 women. Out of all the wards, ward number 1 had the most residents (14,594), while ward number 8 had the fewest (1,816). The number of households in Vyas Municipality is 22,585. With a total of 4,253 households, Ward 1 had the most, while Ward 8 had the fewest, with a total of 588 households. Table 1 shows the total population and households in each ward (CBS, 2021).

Table 1: Ward Wise Household and Population Data.

Wards	Households	Population	Male	Female
1	4,253	14,594	6,448	8,146
2	2,265	7,611	3,539	4,072
3	1,069	3,851	1,794	2,057
4	2,407	8,000	3,723	4,277
5	2,137	8,083	3,736	4,347
6	1,284	4,529	2,092	2,437
7	960	3,344	1,531	1,813
8	588	1,816	830	986
9	966	3,061	1,349	1,712
10	1,925	7,194	3,331	3,863
11	1,775	6,316	2,964	3,352
12	1,321	4,703	2,103	2,600
13	961	3,525	1,659	1,866
14	674	2,312	1,058	1,254
Total	**22,585**	**78,939**	**36,157**	**42,782**

(Census 2021, n.d.)

1.2 Climate

Vyas municipality has mid climatic condition, the average maximum temperature is up to 37 degrees Celsius, the average lowest temperature is up to 8.40 degrees Celsius, and the average temperature is 20.4 degrees Celsius. The municipality is located at least 280 metres above sea level and 1,220 meters above sea level. Annual rainfall here is 1,960.6mm. (Vyas Municipality, n.d.)

1.3 Topography

The municipality lies at 27°58'35" North latitude and 83°16'05" East longitude. Vyas municipality occupies an area of 248 km^2. (Vyas Municipality, n.d.)

2 Service Outcomes

2.1 Overview

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2023) . A total of 575 households were sampled from 22,585 households distributed in 14 wards (further details are presented in section 4). The results obtained after the triangulation and validation of the data with all the data sources including literature reports, Key Informant Interviews (KIIs) and a validation workshop are presented in this section.

2.1.1 Sanitation Status

Tanahun District declared an open defecation free zone on 19th July 2011. It suggests that everyone has access to basic sanitation facilities, where it is defined as having access to facilities for the safe disposal of human waste (feces and urine), as well as having the ability to maintain hygienic conditions, through services such as garbage collection, industrial/hazardous waste management, and wastewater treatment and disposal. The sanitation situation assessment conducted by ENPHO in 2022 showed that 100% of surveyed households in the municipality have access to basic sanitation coverage. (ENPHO, 2023).

Onsite sanitation refers to a sanitation technology or sanitation system in which excreta (referred to as faecal sludge) is collected and stored and emptied from or treated on the plot where they are generated (Susana, 2018). Figure 2 shows the types of sanitation system in the municipality.

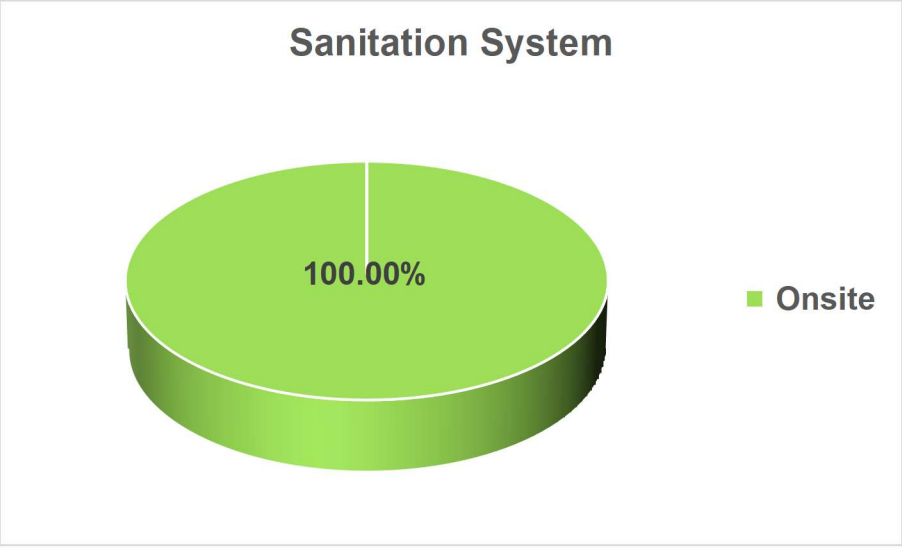

Figure 2: Household sanitation status of Vyas Municipality.

Onsite sanitation systems are prevalent in the municipality. Any toilet system designed to handle or treat feaces at its source rather than transporting them to another location is termed an onsite sanitation system. (Augustine Chioma Affam, 2021) . Here 100% of households rely on onsite sanitation technologies in the municipality.

2.1.2 Types of Containment

100% of the households in the municipality use an onsite sanitation system. The different types of containment installed to store faecal sludge are explained as below:

4.86% of households use fully lined tanks in their houses, which is a rectangular onsite sanitation technology which is used to safely store faecal sludge. There are no outlets or overflow to discharge effluent. The walls and bottom of tank are totally lined and sealed. Figure 3 shows the types of fully lined tank constructed in the household level at Vyas Municipality.

Figure 3: Fully Lined Tank.

Also 9.90% of the households in municipality connected to biogas digester that uses natural anaerobic decomposition of organic matter under controlled conditions. Figure 4 shows the types of Biogas Digester built in the household level at Vyas Municipality.

Figure 4: Biogas Digester.

Figure 5 shows the types of Lined tank with impermeable wall and open bottom built in the household level at Vyas Municipality.

Figure 5: Lined Tank with Impermeable wall and Open Bottom.

65.10% of the households in the municipality have built lined tank with impermeable walls and open bottom, which are rectangular onsite technology where the walls of the tank are lined and the bottom of tank is not lined and allows infiltration of effluents. Similarly, 4.69% of the households have Single pits installed by assembling pre-cast concrete rings one after another.

15.45% of households in the municipality use unlined pits. An unlined pit is a containment constructed with mud mortar stone or brick wall or dry-stone walls and open bottom or could be of no lining. An unlined pit with dry stone wall is popular in the rural areas of the municipality.

Table 2: Shows the percentage of households with different types of containments in the municipality (ENPHO, 2023).

Types of Containment	Percentage
Biogas Digester	9.90%
Fully Lined Tank	4.86%
Lined Tank with impermeable wall and open bottom	65.10%
Single Pit	4.69%
Unlined Pit	15.45%
Grand Total	**100.00%**

Figure 6 shows the distribution of various types of sanitation technologies in different wards of Vyas Municipality.

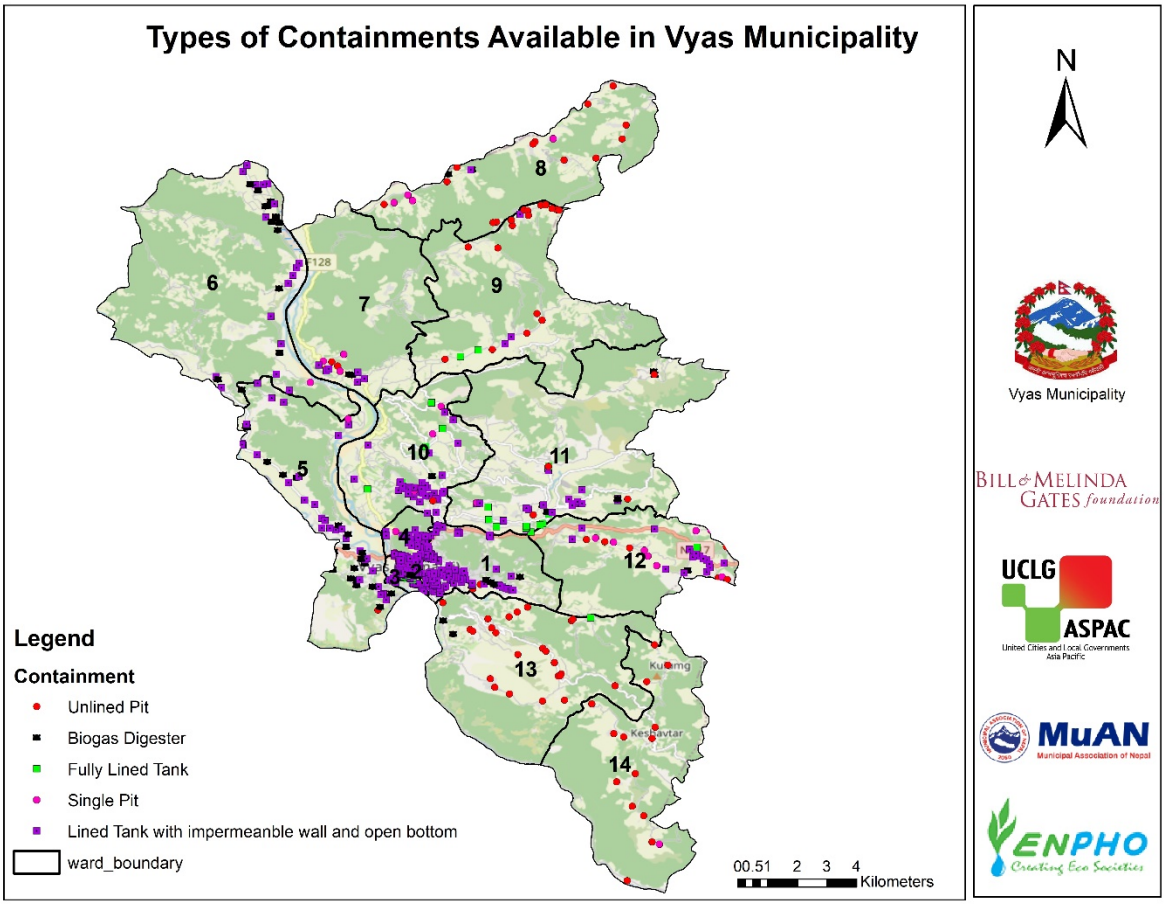

Figure 6: Sanitation Technologies installed in household levels (ENPHO, 2023).

The types of household containments in the municipality are re-categorized to match the containments defined by Shit Flow Diagram Promotive Initiative (SFD PI). For that anaerobic biogas digester used to treat household organic waste is also utilized by households to store and treat their faecal sludge. For the purpose of generating the SFD graphic, the biogas digester is modelled as a fully lined tank. Similarly, single pits constructed by assembling pre-cast concrete rings one above another are classified as lined pits with semi-permeable walls and open bottom. Table 3 shows the types of containment re-categorized according to Shit Flow Diagram Promotive Initiative (SFD PI).

Table 3: Types of containment re-categorized according to Shit Flow Diagram Promotive Initiative (SFD PI) (ENPHO, 2023).

Containments	Percentage of Households
Fully Lined Tank (T1A3C8, 1%; T1A3C10, 14%)	15%
Lined pit with semipermeable walls and open bottom (T1A5C10, 4%)	4%
Lined Tank with impermeable wall and open bottom (T1A4C10, 60%; T2A4C10, 4%;T1A4C8, 1%)	65%
Unlined Pit (T1A6C10, 15%;T2A6C10, 1%)	16%
Grand Total	**100%**

2.1.3 *Emptying and Transportation*

Emptying is one of the major components of the sanitation value chain. It ensures proper functioning of containment basically for septic tank which functioned well until the volume of sludge is one-third of the total column of the tank. Also, in other containments, regular emptying prevents overflow of the sludge and blockages (Linda Strande, 2014) . Figure 7 represents the map of Vyas municipality showing the status of sanitation technology that has been emptied at least once.

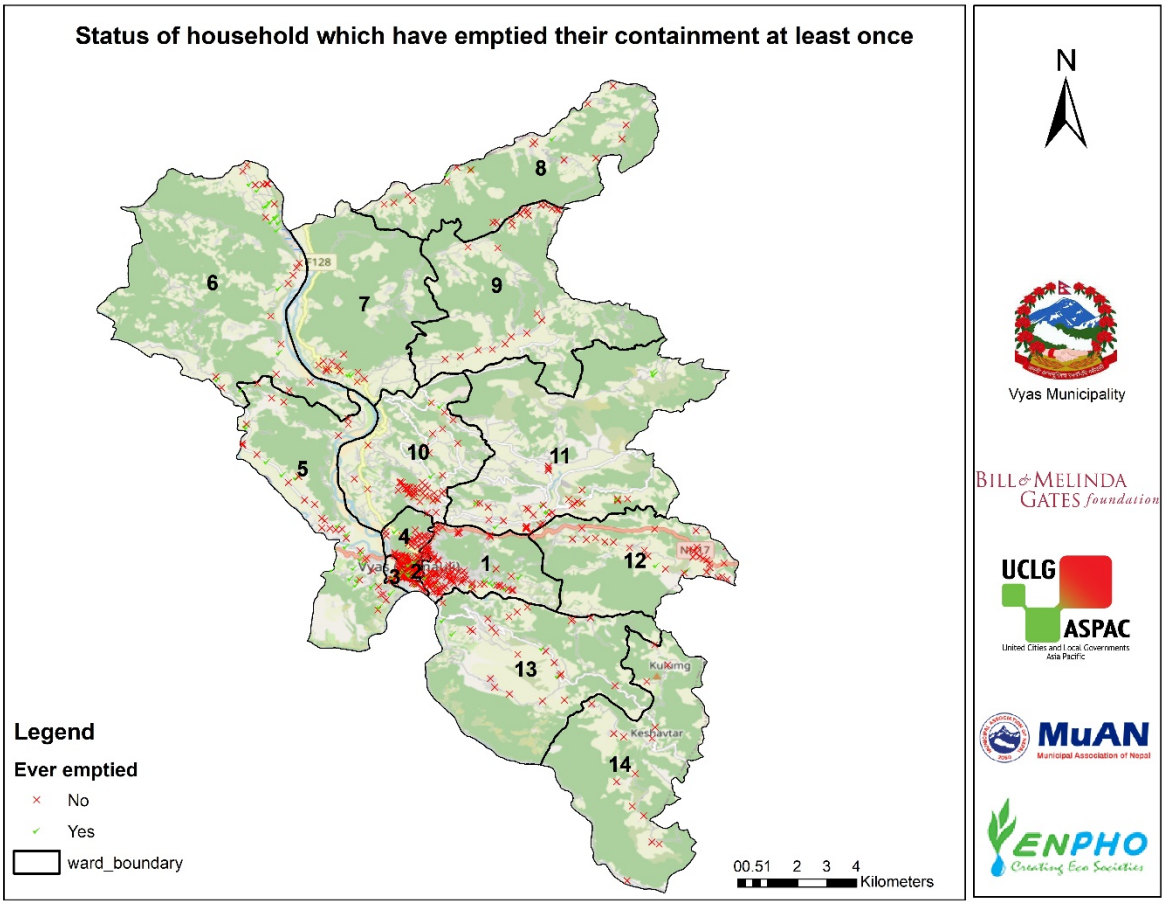

Figure 7: Status of household which have emptied their containment at least once.

Here 14.58% HHs have emptied the containment at least once since installation through manual or mechanical emptying services. Whereas the remaining HHs did not empty their containment as it has not been filled yet. Table 4 displays the overall proportion of containment that has been emptied at least once since installation.

Table 4: Overall Emptying percentage of Containment at least once since installation (ENPHO, 2023).

Containment	Never emptied	Emptied at least once	Total
Fully Lined Tank	4.34%	10.42%	14.76%
Lined pit with semipermeable wall and open bottom	3.82%	0.87%	4.69%
Lined Tank with impermeable wall and open bottom	62.33%	2.78%	65.10%
Unlined Pit	14.93%	0.52%	15.45%
Grand Total	**85.42%**	**14.58%**	**100.00%**

Vyas Municipality is providing the desludging service within and outside the municipalities i.e. Lumjung, Besisahar and Gorkha Municipality. The service provider is equipped with a vacuum truck with a tank capacity of 5,000 litres. One driver and two helping staff works in the vacuum truck. The staff wear gloves, boots and masks for safety during work. It charges NPR 6,500 to 7,000 (USD 47 to 50) per trip for the containments which also varies according to travel distance. (KII-4, 2023)

Figure 8: Desludging Vehicle available in the Vyas Municipality.

2.1.4 Treatment and Disposal/Reuse

The Vyas Municipality lacks a faecal sludge treatment plant of any kind. Due to various issues, the construction of one faecal sludge treatment facility in municipality has not been completed yet and has not been turned over to the municipality for additional processing.

The municipality operates a cowshed (Gaushala) on the bank of Madi Khola for old and abandoned cattle. Here biogas digester (Figure 9) is being used to produce gas and dried sludge is being used as fertilizer for agricultural land. This biogas digester is also being used to treat the emptied FS that was collected from household's level (KII-1, 2023).

Figure 9: Biogas Digester available in the Vyas Municipality.

Figure 9 shows the percentage of perception of people residing in the municipality about disposal of FS after the onsite sanitation system is emptied. Application in farm and composting is the most practiced way for disposal of FS, which are both considered as unsafely managed practice.

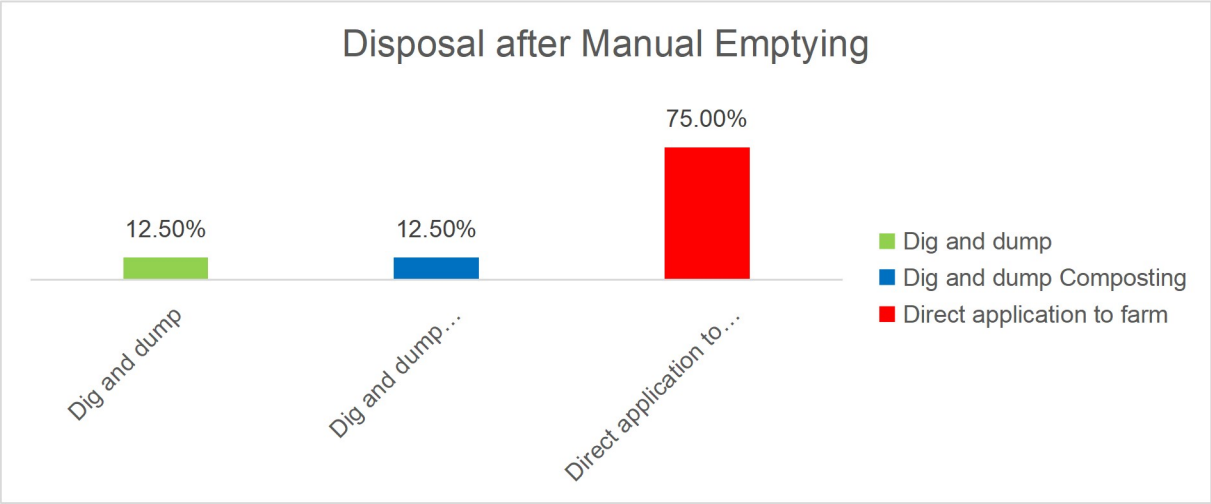

Figure 10: Disposal of Manually emptied faecal sludge.

2.1.5 Institutional Level Sanitation System

Altogether 50 institutions from commercial buildings, educational institutions, governmental and non-governmental offices, health care centers and hotels were assessed randomly. It was revealed that 100% of such buildings had connected their toilet to onsite sanitation technologies. The percentage of types of onsite sanitation technologies in these buildings are shown in Figure 11.

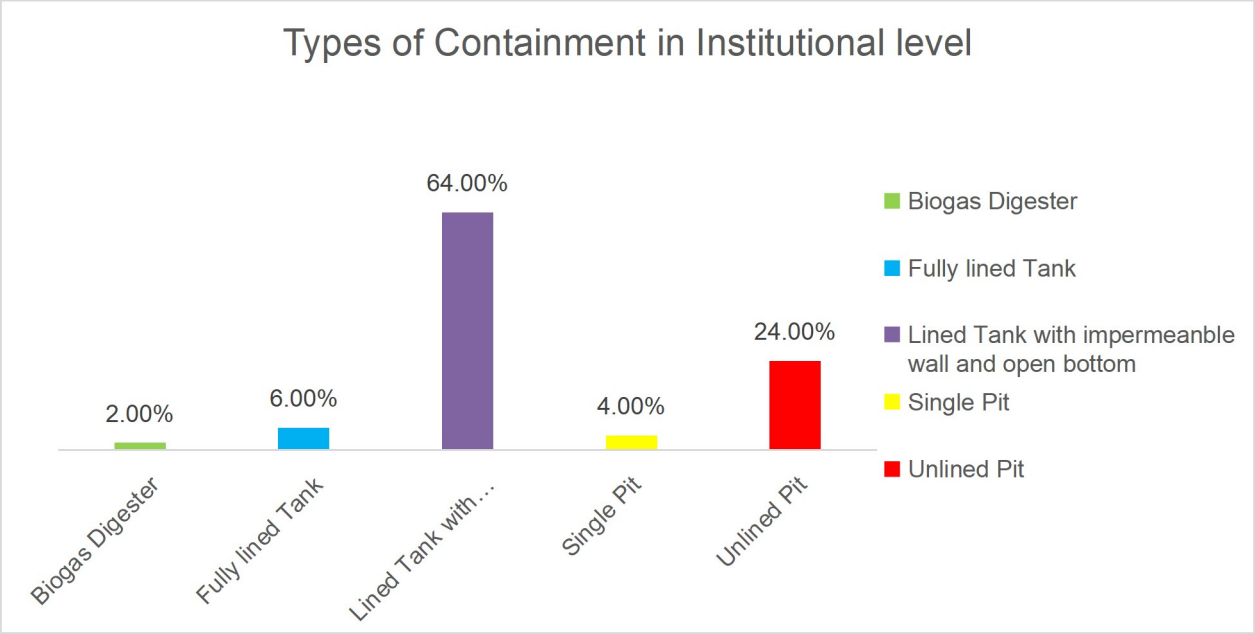

Figure 11: Types of containment in institutions of Vyas Municipality.

From the institutional survey, 4.35% of institutions in Vyas Municipality have emptied their containments and 95.65% of institutions have not emptied because they were never filled. Distribution of different types of onsite sanitation technologies of institutions in various wards of Vyas municipality is shown in Figure 12.

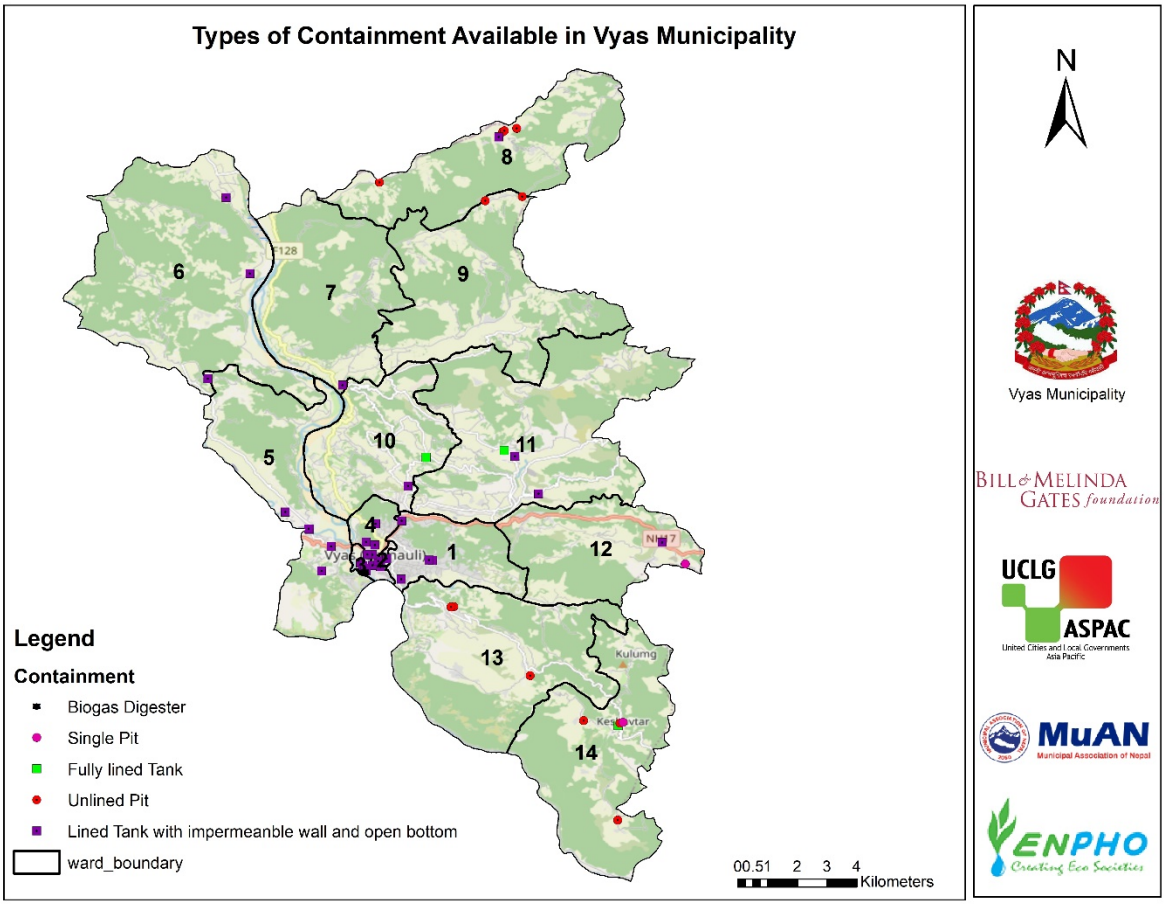

Figure 12: Types of onsite sanitation systems in institutions of Vyas Municipality.

2.1.6 Public Toilets

Vyas Municipality has only two public toilets available. Mobile public toilet is not being used as for now whereas one public toilet lies near Damauli Market area which was constructed in 2003 that consists of 2 compartments for male (6 numbers of urinal and 3 pan) and female (3 pan). (KII-3, 2023). Figure 13 shows the public toilets available in Vyas Municipality.

Figure 13: Public Toilets available at various location of Vyas Municipality.

2.1.7 Risk of Ground Water Pollution:

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

2.1.8 Source of Drinking water and water Production

a) Water Supply:

Damauli Drinking Water and Sanitation Users Committee and Bhadgaun Drinking Water and Sanitation Users Committee are the major drinking water and sanitation users committee in the municipality.

Table 5: Details of Water Users Committee available in Vyas Municipality

Name	Damauli Drinking Water and Sanitation Users Committee	Bhadgaun Drinking Water and Sanitation Users Committee
		
Established Date:	2036 B.S (1979 A.D)	2056 B.S (1999 A.D)
Sources:	Barahi khola and Madi Khola	Chapdi khola and Khir Khadi Khola
Catchment Area:	Ward: 2, 3 and 4	Ward: 1 and 12
Tap numbers:	3,786 HHs	2,680 HHs
Treatment Units:	Sedimentation Unit, Refining Unit and Slow Sand Filter	Sedimentation Unit, Roughing Filter, Slow Sand Filter and Chlorination Unit
Reservoirs:	5 nos of Reservoir Tank - 500 m^3, 400 m^3, 300 m^3, 250 m^3 and 100 m^3 Tank	5 nos of Reservoir Tank - 250 m^3, 100 m^3 and 10 m^3 of 3 nos. Tank
Pipeline:	Transmission Line: 2.63 km Distribution Line: 63 km	Transmission Line: 21.1 km Distribution Line: Around 36 km

Figure 14: Water Treatment Plant of Bhadgaun Drinking water supply and Sanitation Users committee.

b) The vulnerability of the aquifer and lateral spacing between sanitation system and groundwater source

The term aquifer pollution vulnerability is intended to represent the varying level of natural protection afforded by the contaminant attenuation capacity of the unsaturated zone or semi-confining beds above an aquifer, because of physicochemical processes (filtration, biodegradation, hydrolysis, adsorption, neutralization, volatilization, and dispersion)—all of which vary with their texture, structure, clay content, organic matter, pH, redox and carbonate equilibria. Groundwater vulnerability is specific to containment type and pollution scenarios (Andreo, 2013) Here, among the various types of onsite sanitation technologies, lined tanks with impermeable walls and open bottom and lined pits are more prone to contribute to aquifer pollution as the nature of such containments impose more containment load from the land surface to groundwater.

A key determinant of risk variation is the soil and geological setting. Especially for consolidated hard rock sediments with poor soil cover and shallow water tables, the risk is higher. According to WHO criteria, if the travel time of pollutant to groundwater source is less than 25 days, there is significant risk to contamination; low risk, if the travel time is between 25 and 50 days; and very low risk if the travel time is greater than 50 days (Krishnan, 2011). The size of pores in the soil determines the infiltration rate. In the sandy loam soil, the permeability is approximately 2.5 cm per hour. Thus, between 25 and 50 days the pollutant could travel to a depth of approximately 30 metres (98.67 feet) in sandy loam soil. Hence, the people using open bottom tanks and consuming water from the handpumps with a depth up to 98.67 feet (30 m) and horizontal distance of the pump within 25 feet (7.62 m) from the source of pollutants are assumed at significant risk to groundwater pollution.

However, most households in the municipality rely on private tap water for drinking water supply. 78.65% of the Households in the municipality depend on private tap water sources for drinking and other daily activities. Whereas remaining households depend on groundwater, public taps, Jar water and groundwater for drinking. Figure 15 shows the various sources of drinking water supply in the municipality.

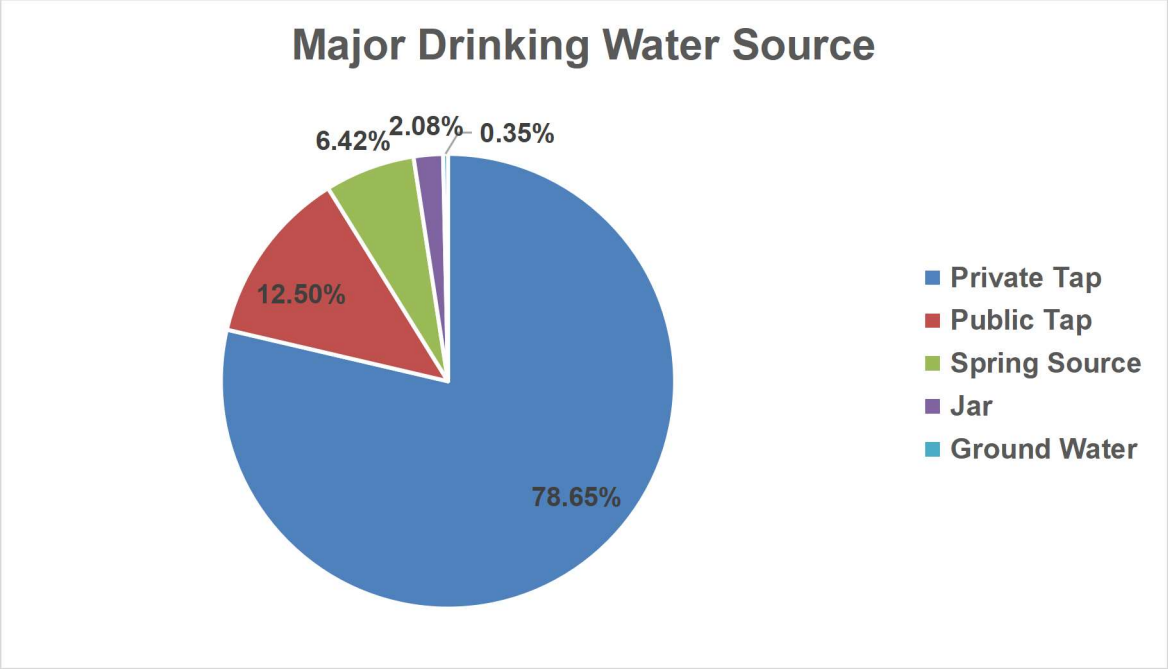

Figure 15: Sources of Drinking water supply in the Municipality.

Nevertheless, population using spring sources (located near residential areas with high percentage of households having lined tanks with open bottom and unlined pits) as major sources of drinking water without using any form of point of use options are considered at significant risk. Therefore, 4% of the population use lined tanks with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A4C10) and 1% of the population relying on unlined pits, no outlet or overflow, where there is a 'significant risk' of groundwater pollution (T2A6C10).

2.2 SFD Selection Grid

Types of sanitation technology selected in the SFD selection grid in the municipality are shown in figure 16. The vertical column in the left side of the SFD selection grid has a list of technologies to which the toilet is connected to and open defecation in case of households without toilets. Similarly, horizontal row at the top of the selection grid shows options for connection for outlet or overflow discharge from toilet.

The types of household containments in the municipality are re-categorized to match the containments defined by Shit Flow Diagram Promotive Initiative (SFD PI). For that anaerobic biogas digester used to treat household organic waste is also utilized by households to store and treat their faecal sludge. For the purpose of generating SFD graphics, the biogas digester is connected as fully lined tank. Similarly, single pits constructed by assembling pre-cast concrete rings one above another are classified as lined pits with semipermeable walls and open bottom.

Thus, different types of sanitation systems and their outlet are selected in the selection grid and the proportion of the population using such types of systems is calculated in the SFD graphic generation process.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B					Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					Significant risk of GW pollution Low risk of GW pollution					
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution			T1A3C8		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		T2A4C10 T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution T1A5C10
Unlined pit										T2A6C10 T1A6C10
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable									Not Applicable

Figure 16: SFD selection grid for Vyas Municipality.

Brief explanation of terms used to indicate different frames selected in the SFD selection grid in Figure 16 is explained in Table 6.

Table 6: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 16.

T1A3C8	This is a correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks, instead they are acting as sealed vaults (consequently the excreta are potentially more toxic than the excreta in a septic tank). Since the tank is fitted with a supernatant/effluent overflow connected to open ground the excreta in this system are considered NOT contained; contributes to variable F10 only.
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.
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.
T1A4C10 (Low Risk)	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.
T2A4C10 (High Risk)	This is a correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered NOT contained.
T1A5C10 (Low Risk)	A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow, so this system is considered contained.
T2A6C10 (High Risk)	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.
T1A6C10 (Low Risk)	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.

2.2.1 SFD Matrix

SFD matrix is the second step to generate SFD graphics. The 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 of faecal sludge which remains in the container and, in the case of open-bottomed tanks, infiltrate. The other half of the contents is modelled as supernatant discharging into the sewer network or to open drains. The formula obtained from SFD PI used for FS proportion calculation is shown below:

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

Here, data for each selected sanitation system on the SFD Matrix is entered. The proportion of the contents of each type of onsite container (either septic tanks; or fully lined tanks (sealed); or lined tanks with impermeable walls and open bottom and all types of pits), is shown in column Population (Pop) of Figure 17.

Since the Municipality does not have proper sewer networks or a wastewater treatment plant, the proportion of wastewater delivered to the treatment plant is 0%. Similarly, the proportion of FS emptied and delivered to treatment is shown in column F4 and F5 respectively. The FS emptied from the containments is dumped openly in farmland or water bodies. Thus, variables F4 and F5 for all sanitation systems are set to 0% (Susana, 2018) . Figure 17 shows the SFD matrix of Vyas Municipality.

Vyas Municipality, Gandaki, Nepal, 8 Dec 2023. SFD Level: 2 - Intermediate SFD
Population: 78939
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	14.0	66.0	95.0	95.0
T1A3C8 Fully lined tank (sealed) connected to open ground	1.0	15.0	0.0	0.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	60.0	4.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0	0.0	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	4.0	20.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	15.0	3.0	0.0	0.0
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	4.0	0.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	1.0	0.0	0.0	0.0

Figure 17: SFD Matrix of Vyas Municipality.

2.2.2 A proportion of FS emptied and transported.

The proportion of faecal sludge emptied (F3) is calculated based on percentage containment emptied and amount of FS emptied during the process. The information on FS emptied from containment is obtained from Key Informant Interviews (KIIs) with desludging service providers. As per the desludging service provider portion of liquid in the FS is high which can be easily pumped out by the desludging vehicle. So, almost 90% of the FS content in the containment is removed during emptying. Hence, actual proportion of FS emptied from each containment is calculated as:

$$FS\ proportion\ emptied\ from\ containment = percentage\ of\ containment\ emptied \times proportion\ of\ FS\ emptied$$

The proportion of FS emptied from the types of sanitation technologies are shown in Table 7.

Table 7: Sanitation Technologies and Proportion of Faecal Sludge Emptied (ENPHO, 2023).

S.N.	Sanitation Technologies	SFD Reference Variable	Percentage of Emptied Containment	Proportion of FS emptied during emptying	Proportion of FS emptied (F3)
1	Fully lined tank (sealed) connected to open ground	T1A3C8	17.00%	90%	15%
2	Fully lined tank (sealed), no outlet or overflow	T1A3C10	73.14%	90%	66%
3	Lined tank with impermeable walls and open bottom, connected to open ground	T1A4C8	0.00%	90%	0%
4	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	4.63%	90%	4%
5	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	21.75%	90%	20%
6	Unlined pit, no outlet or overflow	T1A6C10	3.47%	90%	3%
7	Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A4C10	0.00%	90%	0%
8	Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A6C10	0.00%	90%	0%

2.3 Summary of Assumptions:

Offsite sanitation System:

- ✓ There is not any sewer network hence all households in the municipality depend on Onsite Sanitation in Vyas Municipality.

Onsite Sanitation System:

- ✓ The proportion of FS in septic tank were set to 0%, the proportion of FS in fully lined tanks were set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 100% according to the relative proportions of the systems in the municipality, as per the guidance given in the Frequently Asked Question (FAQs) in the sustainable Sanitation Alliance (SuSanA) website.
- ✓ Variables F3, F4 and F5 for all onsite sanitation systems were derived from the HH survey and cross-checked with KIIs conducted.
- ✓ The municipality does not have any form of treatment plant to treat faecal sludge. Also, the people using single pits reclassified as lined pits with semi-permeable walls and open bottoms are not using them properly. The FS emptied from the containments is dumped openly in farmland or water bodies. Thus, variables F4 and F5 for all sanitation systems are set to 0%.

2.4 SFD Graphic

Figure 18 shows the SFD graphic for Vyas Municipality In the graphic, percentage of Faecal Sludge (FS) and wastewater (WW) indicated by colour green represent safely managed or stored excreta (88%) whereas the percentage in colour red represents unsafely stored or managed excreta (12%).

Similarly, FS contained, i.e., FS kept in a container which is safe from human contact, in onsite sanitation, either emptied or not are safe. This percentage of FS not emptied are either stored in septic tank or fully lined tank. A large percentage of such FS contained not emptied are also FS stored in lined tank and pits which are in safe distance from sources of drinking water. Further, FS not contained are FS kept in containment which possess risk to human health through groundwater contamination. The lack of FSTP in the Municipality leads to disposal of FS in farmland and water bodies.

The faecal sludge that is safely managed is further segregated as 80% of FS safely collected in the containment which has not been emptied. This 80% 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 empty section services in the short and medium term as they fill up. The remaining 8% corresponds to FS safely treated and managed in the biodigesters.

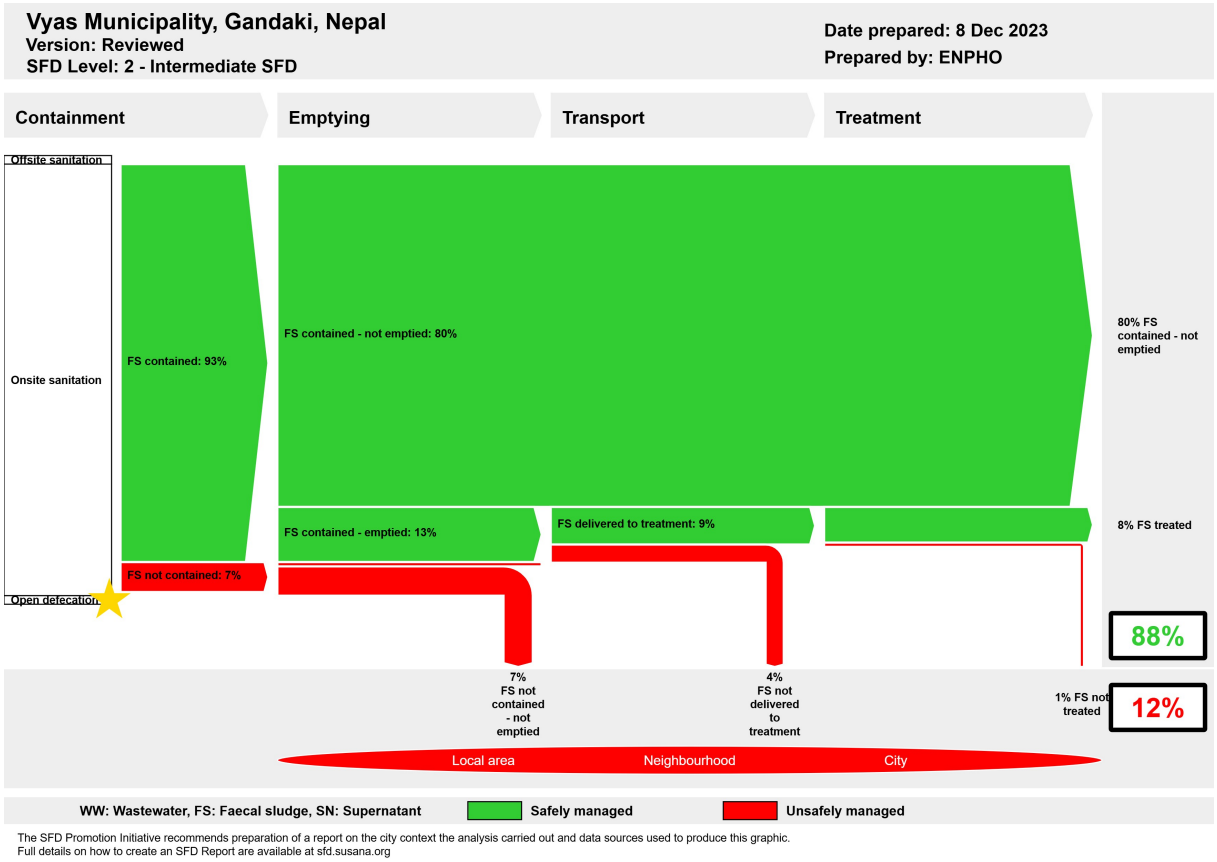

Figure 18: SFD graphic of Vyas Municipality.

The FS that is unsafely managed is divided into two categories: as 4% of FS is unsafely collected which is emptied and 7% of FS is unsafely managed as it has not been emptied, both having a risk of groundwater contamination through seepage. A further 1% corresponds to FS not treated from the biogas digester.

Lack of FSTP and WWTP in the Municipality leads to disposal of FS and WW in farmland and water bodies. Considering the SFD graphics, FS management is a concern for the municipality even through FS which is safely collected but emptied will eventually be emptied in future and requires safe management.

2.4.1 Offsite Sanitation

Nepal Multiple Indicator Survey (MICS) reported that among the total households in Nepal, 10% of households has a toilet connected to sewer network and in Gandaki province it is only 3% (CBS, 2020) whereas in Vyas Municipality its 0%.

2.4.2 Onsite Sanitation

100% of the population in the municipality relies on the onsite sanitation system. Among them, 93% are using technically effective containment that safely stores faeces and 7% with unsafe containment. Vyas Municipality does not have treatment plant or land separated for disposal of FS, which was confirmed by the information collected during KII with the

municipal officer (KII-1, 2023) . The description on flow of FS from the onsite sanitation system as shown in the SFD graphic is explained in Table 8.

Table 8: Description of the percentages of the SFD graphic (Susana, 2018).

Variables	Description	Percent
FS contained	Faecal sludge that is contained within an onsite sanitation technology which is technically effective.	93%
FS not contained	Faecal sludge that is stored in an unsafe onsite sanitation technology.	7%
FS contained not emptied	FS that is contained within an onsite sanitation technology and not removed where there is no significant risk to groundwater pollution. These containments are fully lined tanks with impermeable walls and open bottom without outlet or overflow (T1A4C10), lined pit with semi-permeable walls and open bottom without outlet or overflow (T1A5C10) and unlined pits (T1A6C10) without significant risk to groundwater.	80%
FS contained – emptied	FS that is contained in onsite sanitation technology and emptied either mechanically or manually.	13%
FS not contained – not emptied.	FS that is not contained within an onsite sanitation technology and not removed which may either remain in the containment or infiltrate to ground polluting groundwater.	7%
FS - treated	FS treated in a well functioned anaerobic biogas digester.	8%
FS not delivered to treatment	FS emptied from an onsite sanitation system is either FS contained or not but is not delivered to the treatment plant.	4%
FS not treated	FS emptied from an onsite sanitation system but is not delivered to the treatment plant.	1%

2.4.3 Open Defecation

Nepal Multiple Indicator Survey (MICS) reported that among the total households in Nepal, 5% of households still practices open defecation and only in Gandaki Province it is 1% (CBS, 2020). The sanitation situation assessment conducted by ENPHO in 2023 showed that 100% of surveyed households in the municipality have access to basic sanitation coverage. (ENPHO, 2023).

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 the promotion of safe sanitation services is discussed here.

Local Government Operation Act, 2017

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

Environment Protection Act, 2019

Environment protection act 2019 is promulgated to prevent and control pollution from different development activities. It defines "Pollution" as the activities that significantly degrade, damage the environment, or harm the beneficial or useful purpose of the environment, by changing the environment directly or indirectly because of wastes, chemical, heat, noise, electrical, electro-magnetic wave, or radioactive ray. It provides the mechanism for appointing an 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 citizens to easy access on clean and quality drinking water, sanitation services and management of sewage 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 environmentally 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 tanks in the households is sufficient for treating faecal sludge.

Institutional and Regulatory Framework for Faecal Sludge Management, 2017

Ministry of Water Supply through its Department of Water Supply and Sewerage Management (DWSSM) articulated and endorsed Institutional and Regulatory Framework (IRF) for Faecal Sludge Management in Urban Areas of Nepal in 2017. The main objective of the IRF is to define the specific roles and responsibilities of key institutions for the effective management and regulation of 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 the National Sanitation and Hygiene Master Plan (NSHMP) 2011. It provides guidelines for sustaining ODF outcomes and initiating post-ODF activities through an integrated water, sanitation and hygiene plan at municipalities and districts. The guideline redefined sanitation as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish a hygienic environment and promote public health. Indicators are set to guide total sanitation movement with an arrangement for resource management, monitoring and evaluation, capacity building.

3.2 Policies

Historically, the National Sanitation Policy (1994) was the guideline for the planning and implementation of sanitation programs. The policy had promoted sanitation issues together with issues on water supply in rural communities. Also, Rural Water Supply and Sanitation National Policy (RWSSNP) 2004, has set a new target to provide safe, reliable, and affordable water supply with basic sanitation facilities. The policy focused on delivering quality services on water and sanitation to the marginalized and vulnerable groups. However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery (DWSSM, 2009).Thus, 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 (UNGA, 2010) . 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.

3.2.1 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 Level

National Planning Commission: At the federal government, the National Planning Commission is the specialized and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs, identifies sources of funding, and allocates budget. It serves as a central agency for monitoring and evaluating development policies, plans and programs. It supports, facilitates and coordinates with federal, provincial, and local government for developing policy plans and 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 19.

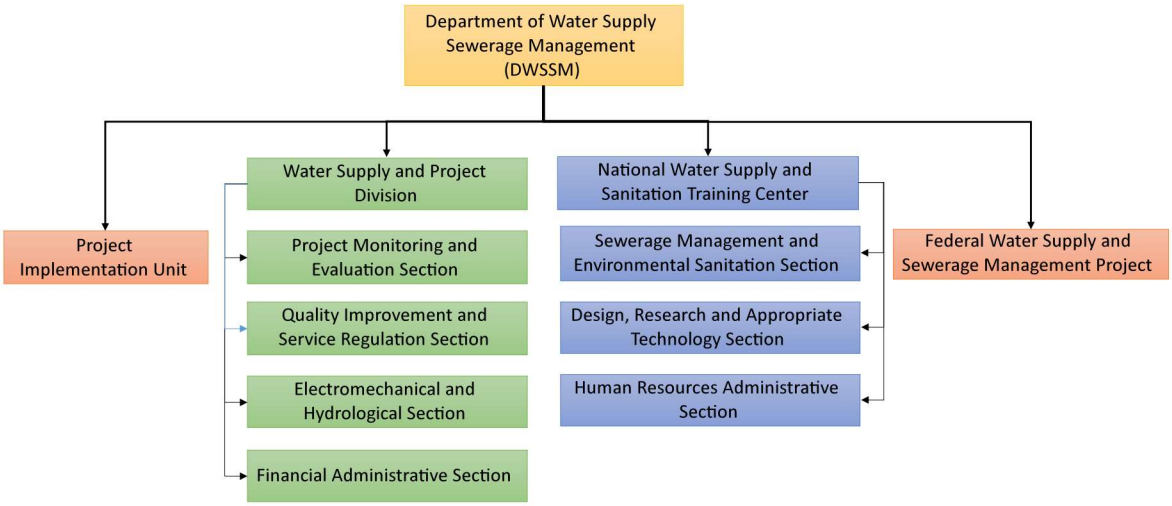

Figure 19: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).

At Provincial Level

Ministry of Physical Infrastructure: Ministry of physical infrastructure of provincial government in Madesh Province is major executing body in the province. Planning and implementation of water supply and sanitation infrastructure is the province that is executed through Water supply and Sanitation Divisional Office (WSSDO). WSSDO implements the water and sanitation programs meeting the following criteria:

i. Inter local government projects

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

3.2.2 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).

3.2.3 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 9. However, FSM specific standards have yet to be developed and implemented.

Table 9: Sanitation Service Level and its Components.

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

3.3 Planning

3.3.1 Service Targets

The plans and programs for development in Nepal is guided by a national development framework formulated by the national planning commission in coordination with sectoral ministries. The ministry of finance allocates budgets and releases them to executing agencies and coordinates with development partners to address resource gaps. Nepal is committed to the SDGs which has been reaffirmed in key documents such as the current 15th development plan and the 25-year long-term vision 2100 that internalizes the sustainable development goals (NPC, 2020). The SDGs codes are assigned for all national development programs through the Medium-Term Expenditure Framework (MTEF). The MTEF sets out three-year spending plans of the national and provincial governments which aims to ensure that budgets reflect social and economic priorities and give substance to

reconstruction and development commitments (NPC, 2020). Further, Nepal has prepared the SDG status and roadmap to localize the SDG indicators with baselines and targets for 2030. Nepal has set the following target and indicator focused on sanitation based on global SDGs as shown in Table 10.

Table 10: National SDG target and indicator on sanitation.

National SDG Target and Indicator		2015	2019	2022	2025	2030
Target 6.2 By 2030, 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						
6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water						
1	Households using improved sanitation facilities which are not shared (%)	60	69.3	78.7	85.7	95
2	Proportion of population using latrine (%)	67.6	75.7	83.8	90	98
3	Sanitation coverage (%)	82	86.5	89.9	93.3	99
4	Urban households with toilets connected to sewer systems/ proper FSM (%)	30	46	62	74	90

4 Stakeholder Engagement

4.1 Key Informant Interview

KII and objective sharing of the study were conducted with the major stakeholders of the sanitation sector of the municipality. An interview was conducted with Dr. Raju Paudel, Senior Engineer of Vyas Municipality, for the planning and the activity that is going on in the sanitation sector and Mr. Amar Giri and Mr. Ishwor Shrestha, Manager of Vyas Drinking Water Uses Committee. Table 11 shows the KII with the Municipal officers, Water Users Committee and Public Toilet Operators. (Figure 20).

Table 11: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organization	Purpose of KII	Date
1.	Dr. Raju Paudel (KII-1)	Senior, Engineer	Vyas Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development	9th Oct 2023
2.	Mr. Bhagyasali Dhungana and Mr. Kishan (KII-2)	Officers and Driver of Desludging Vehicle	Vyas Municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development and Emptying practices, finances, requirements, disposal and treatment	9th Oct 2023
3.	Dr. Amar Giri (KII-3)	Manager	Damauli Drinking Water and Sanitation Users Committee	Supply and demand of water, water sources, groundwater contamination risk	9th Oct 2023
4.	Mr. Ishwor Shrestha (KII-4)	Manager	Bhadgaun Drinking Water and Sanitation Users Committee	Supply and demand of water, water sources, groundwater contamination risk	9th Oct 2023
5.	Mr. Bhanu Uparkoti (KII-5)	Manager	Public Toilet	Quantitative and management data on public toilet and public toilet operation	10th Oct 2023

Figure 20 : KII with Municipal officers of Vyas Municipality.

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 and methods for conducting HH survey. The household survey was conducted using mobile application "KOBOCOLLECT" after orientation. SFD team members along with municipal focal person went on field visits in households to encourage enumerators and observe household sanitation status.

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= no/(1+ (no-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 size required in each ward is calculated as

nh= (Nh/N)*n, where Nh is the total population in each stratum.

Thus, a total of 359 households were sampled from 50,792 households distributed in 14 wards with proportionate stratification random sampling which is shown in Figure 21.

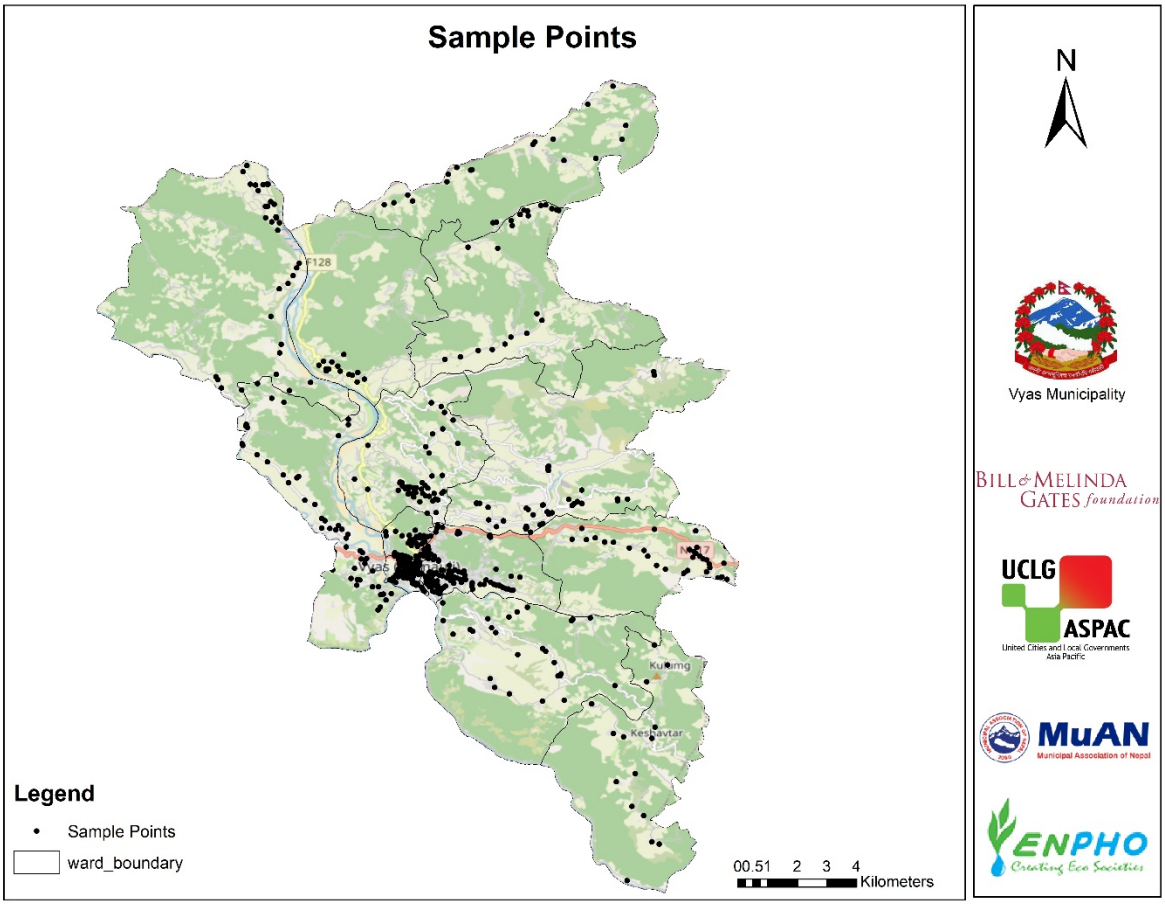

Figure 21: Distribution of sampling points in different wards of Vyas Municipality.

4.2.2 Direct Observation

Various sanitation technologies in the households in all the wards were observed, and visual references were kept in Figure 22. Also, observation of the toilet, water source, containments and transportation of faecal sludge were carried out.

Figure 22: Storm Water Drain during direct observation survey in the Municipality.

4.3 Sharing and Validation of Data:

The sharing and validation of findings on sanitation status were conducted in the municipality hall in participation of Mayor, Deputy Mayor, Chief Administrative Officer (CAO), Ward Chairpersons, Municipal Officers, General members of the municipal council and other relevant stakeholders. The participants agreed upon the findings of this study that showed the current sanitation status of the municipality (Figure 23).

Figure 23: Sharing and Validation at Vyas Municipality.

5 Acknowledgements

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

We offer our sincere gratitude to Mr. Vaikuntha Neupane, Mayor, Mrs. Indira Darai, Deputy Mayor, Mr. Ganga lal Subedi, Chief Administrative Officer of Vyas Municipality. We would also like to thank Dr. Raju Paudel, Senior Engineer of Vyas Municipality, for their remarkable support during the study.

We would like appreciate Dr. Roshan Raj Shrestha, Deputy Director of Bill and Melinda Gates Foundation (BMGF), Dr. Bernadia Irawati Tjandradewi, Secretary General, and Mr. Satish Jung Shah, Knowledge Management ASPAC. Similarly, we are very much obliged to Mr. Ashok Kumar Byanju Shrestha, President and Mr. Kalanidhi Devkota, Executive Director, Mr. Muskan Shrestha, Sanitation Advocacy Specialist, MuAN for their gracious support during the study.

We are very grateful to Ms. Bhawana Sharma, Executive Director and Mr. Rajendra Shrestha, Program Director in Environment and Public Health Organization (ENPHO), for tremendous support and guidance during the whole process of the study. Together, we would like to thank all ENPHO colleagues for their support in the development of questionnaire for the survey and uploading data in KOBOCOLLECT tool.

We are grateful to the enumerators, Mrs. Sancheeta Gharti, Mrs. Sadhana Shrestha, Mrs. Sumina Shrestha, Mrs. Jyoti Gurung, Mr. Raju thapa magar, Mr. Sabir miya, Mr. Kamal pariyar, Murari Poudel, Mr. Yujan Gurung, Mr. Rupesh Gurung, Mr. Sojit Dura, Mrs. Parbati Rijal, Mrs. Mandira Sidhain Kandel and Mr. Santosh Thapa.

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(2023). KII-4. (Rupak Shrestha, Interviewer) Jayanagar Municipality.

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7 Appendix

Appendix 1: List of participants on Orientation on survey for Shit Flow Diagram

UCLG ASPAC

Municipalities Network Advocacy on Sanitation in South Asia(MuNASS)

Attendance Sheet

Program: SFD orientation
Date: 2080/06/25
Venue: Vyas Municipality Hall

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1.	Sujit Darai	Vyas Municipality	Vyas-11	9816696155	[illegible]	[illegible]	20	Male	3
2.	Jyoti Gurung	Vyas Municipality	Vyas-4	9824131713	[illegible]	[illegible]	21	Female	3
3.	Rupesh Gurung	Vyas municipality	Vyas-10	[illegible]	[illegible]	[illegible]	20	Male	3
4.	Sabir Miya	Vyas Municipality	Vyas-6	9846346658	[illegible]	[illegible]	32	Male	4
5.	Sucheeta Ghasti	Vyas Municipality	Vyas-1	9815163689	[illegible]	[illegible]	21	Female	3
6.	Parbati Ryal	Vyas Municipality	Vyas-12	9864435115	[illegible]	[illegible]	21	Female	2
7.	Kamal Pariyar	Vyas Municipality	Vyas-7	9806614752	[illegible]	[illegible]	32	Male	1
8.	Anju Thapa Magar	Vyas municipality	Vyas-15	9810059383	[illegible]	[illegible]	42	Male	3
9.	Sadhana Shrestha	Vyas-11	Vyas-2	[illegible]	[illegible]	[illegible]	45	Female	3
10.	[illegible] Shrestha	Vyas-3	Vyas-3	[illegible]	[illegible]	[illegible]	23	Female	3
11.	Santosh Thapa	Vyas-Hud	Vyas-14	[illegible]	[illegible]	[illegible]	38	Male	3
12.	[illegible] Gurung	Vyas-9	Vyas-9	[illegible]	[illegible]	[illegible]	19	Female	
13.	Mandira Sedhain Kandel	Vyas-13	Vyas-13	[illegible]	[illegible]	[illegible]	24	Female	2
14.	Manasi Pande	Vyas municipality	Vyas-2	[illegible]	[illegible]	[illegible]	46	Male	4
15.	[illegible] Shrestha	Vyas-3	Vyas-3	[illegible]					

Attendance Sheet

Program: SFD orientation
Date: 2080/06/25
Venue: Vyas Municipality Hall

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1.	Baikuntha Neupane	Vyas M.P	Mayor	[illegible]	[illegible]	[illegible]		M	2
2.	Indira Darai	"	D. Mayor	[illegible]	[illegible]	[illegible]		F	1
3.	Gangalal Subedi	"	CAO	[illegible]			48	M	2
4.	Bishal Paudel	Vyas M.P	IT officer	9856010109	[illegible]		28	M	2
5	Amal K C	Vyas M P	Engineer	9846054011	[illegible]		36	M	2
6.	Bhagyashali Dhungana	"	"	9846069087	[illegible]				?
7.	Li. Raju Paudel	Vyas Municipality	Senior Eng.	[illegible]	[illegible]			M	2
8	Nabin Parajuli	vyas	officer	9856063577	[illegible]		3		2
9.	Anita Bhuju	ENPHO	A.P.O.	[illegible]	[illegible]	[illegible]			
10.	Rupak Shrestha	(Engineer) ENPHO	Engineer	[illegible]	[illegible]	[illegible]			

Appendix 2: List of Participants in Sharing and Validation Workshop

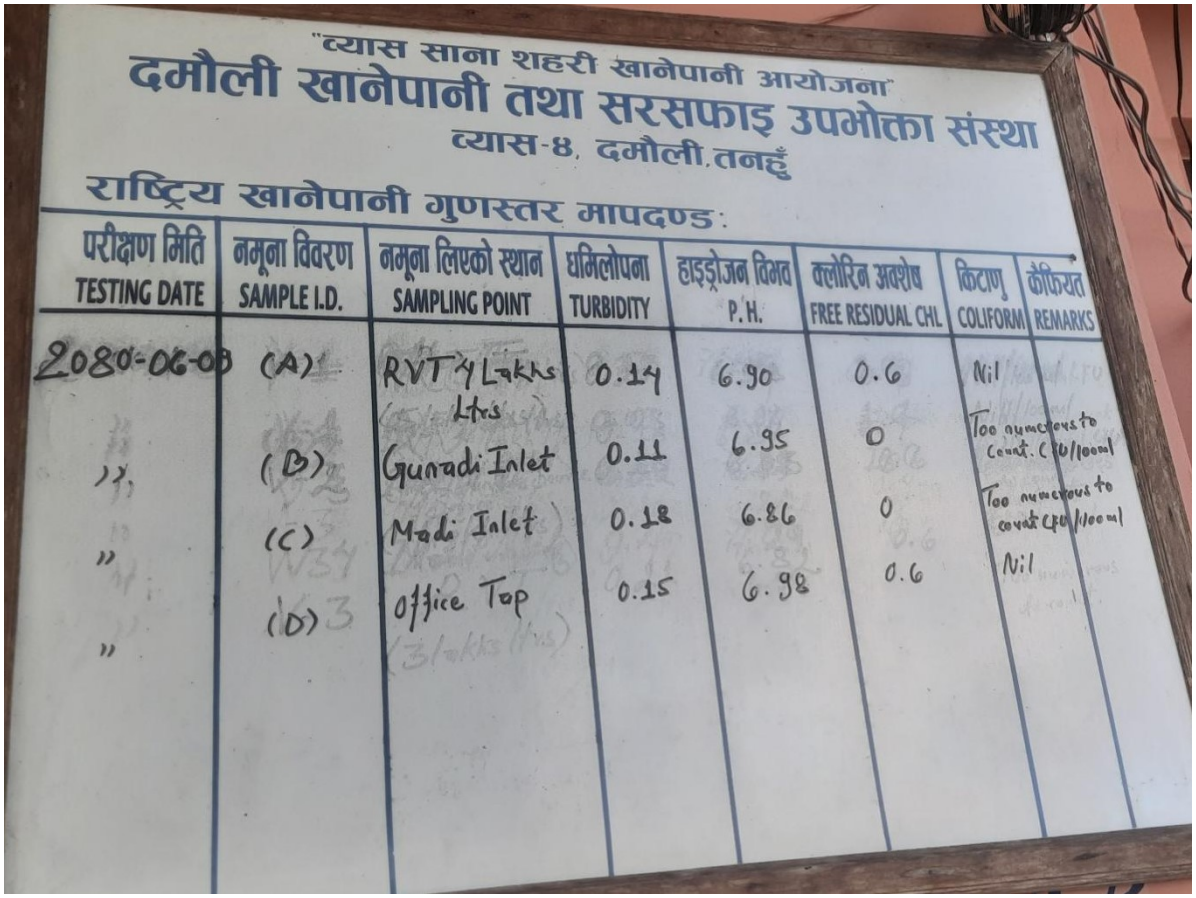
आज मिति २०८० साल माघ २४ गतेका दिन व्यास नगरपालीकामा नेपाल नगरपालीका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (इन्फो)को प्राविधीक सहयोग, The United cities and Local Government Asia Pacific (UCLG-ASPAC) को सहकार्यमा र Bill and Mellanda Gates Foundation (BMGF) का आर्थिक सहयोगमा मानव मलमुत्र प्रवाह रेखाचित्र (Shit flow Diagram SFD) सम्बन्धित छलफल तथा प्रमाणिकरण कार्यक्रममा निम्न अनुसार सरोकारवालाहरुको उपस्थिती रहेको छ ।

उपस्थिति :

क्र.सं	नाम	पद	कार्यालय	फोन नं.	हस्ताक्षर
१.	वैकुण्ठ न्यौपाने	नगर प्रमुख	व्यास नगरपालिका	9856061162	[illegible]
२.	इन्दिरा घेरै	नगर उप-प्रमुख	व्यास नगरपालिका	9856061163	[illegible]
३.	गंगालाल सुवेदी	प्रमुख प्रशासकीय अधिकृत	व्यास नगरपालिका	985600२111	[illegible]
४	काशीराम तिवारी	वडा अध्यक्ष	व्यास २.	985606084[illegible]	[illegible]
५	मन ब० [illegible]	"	— ४-	98065903[illegible]	[illegible]
६	खेमराज पोखरेल	वडा अध्यक्ष व्यास - १०	व्यास - १०	98465525[illegible]	[illegible]
७	रमेश चन्द्र हडखले	[illegible] 9	[illegible] 9.	98463469[illegible]	[illegible]
८	काजी मान श्रेष्ठ	अध्यक्ष -१४	१४ नं. वडा कार्यालय	98960495[illegible]	[illegible]
९.	बिज्ञान कैनी	सदस्य - १२	व्या. न.पा. -१२	[illegible]	[illegible]
१०	नरी माया थापा	कार्यपालिका सदस्य	व्यास १५	9846[illegible]	[illegible]
११	कमला देवि घर्ति	क.का. [illegible]	व्यास १३	[illegible]	[illegible]
१२	आहर के सी.	ईन्जिनियर	व्यास न.पा.	[illegible]	[illegible]
१३	चन्द्रमाया परियार	का.पा. सदस्य	व्यास न.पा.	[illegible]	[illegible]
१४	[illegible]	का.पा. [illegible]	"	[illegible]	[illegible]
१५.	अनुप राना	वडा अध्यक्ष-३	" - ३	9856024065	[illegible]
१६.	विष्णु कुमार श्रेष्ठ	वडा अध्यक्ष-५	" " - ५	9856060496	[illegible]
१७.	जीवन गुरुङ	वडा अध्यक्ष	" " - ६	985606025[illegible]	[illegible]
१८	बसन्त आले	वडा अध्यक्ष	" "-१२	98412[illegible]091	[illegible]

क्र.सं	नाम	पद	कार्यालय	फोन नं.	हस्ताक्षर
१९	कुमार कंचन गिरी	प्र. आ. ले. प. अ.	व्या. न. पा.	9850606517	
२०	गोकर्ण राज बाग्ले	कृ. अधिकृत	,,	9846037270	
२१	भोषराज तिवारी	अधिकृत	,,	984646097	
२२	डा. राजु पौडेल	पिसिय इन्जिनियर	,,	9846050376	
२३	रामचन्द्र हड्खोले	प्रशासकीय अधिकृत	,,	९८२६०६००८६	
२४	हेमन्त गुरुङ	लेखा अधिकृत	व्यास न.पा.का	९८२६०००३०६	
२५	बिशाल कुमाल			९८०१९८५५	
२६	युवा प्रसाद शर्मा	वडा सदस्य	व्या. न. वडा नं. १०	९८४६०५५४५५	
२७	प्रमोद खाती	जनस्वास्थ्य अधिकृत	व्यास न.पा	९८२६०६४६५५	
२८	डा. मनोज विश्वकर्मा	प. चि. प्र	व्यास न.पा	९८६०३८०४०६	
२९	राजकुमार थापा	का. स.	व्यास न.पा.	९८४६५०२८२६	
३०	हरि कु. थापा	,,	,,	९८०६२५५९९३	
३१	प्रतिक्षा लोहनी	,,	,,	९८१५१०८६२३	
३२	बिन्दु पौडेल	अ. सा.	,,	९८४६०४०३६२	

Appendix 3: Water Quality Report



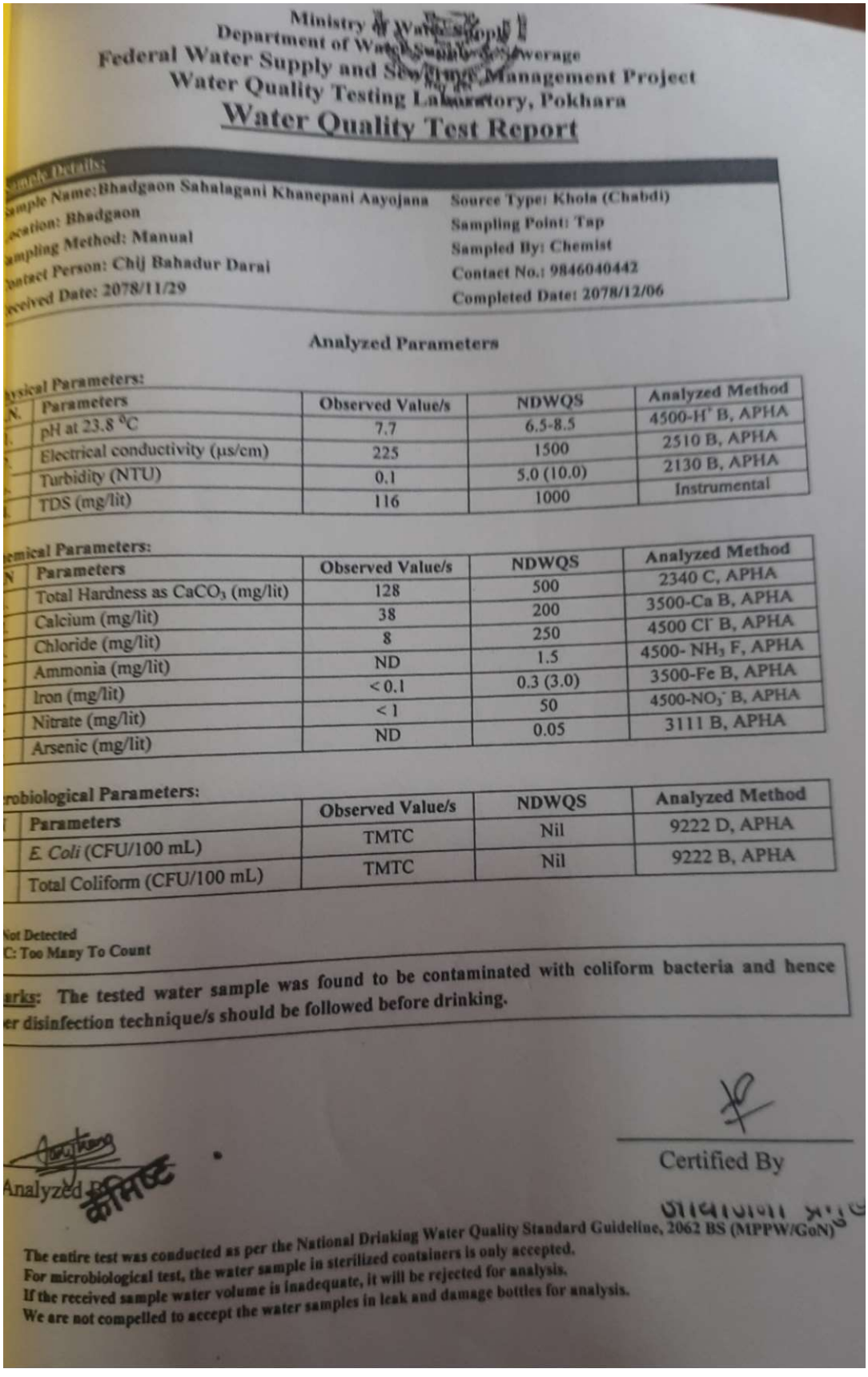
"व्यास साना शहरी खानेपानी आयोजना"

दमौली खानेपानी तथा सरसफाइ उपभोक्ता संस्था

व्यास-४, दमौली, तनहुँ

राष्ट्रिय खानेपानी गुणस्तर मापदण्ड:

परीक्षण मिति TESTING DATE	नमूना विवरण SAMPLE I.D.	नमूना लिएको स्थान SAMPLING POINT	धमिलोपना TURBIDITY	हाइड्रोजन विभव P.H.	क्लोरिन अवशेष FREE RESIDUAL CHL	किटाणु COLIFORM	कैफियत REMARKS
2080-06-03	(A)	RVT 4 Lakhs Ltrs	0.14	6.90	0.6	Nil	
"	(B)	Gunadi Inlet	0.11	6.95	0	Too numerous to count. CFU/100ml	
"	(C)	Madi Inlet	0.18	6.86	0	Too numerous to count CFU/100ml	
"	(D)	Office Top	0.15	6.98	0.6	Nil	



Ministry of Water Supply
Department of Water Supply and Sewerage
Federal Water Supply and Sewerage Management Project
Water Quality Testing Laboratory, Pokhara

Water Quality Test Report

Sample Details:

Sample Name: Bhadgaon Sahalagani Khanepani Aayojana — Source Type: Khola (Chabdi)
Location: Bhadgaon — Sampling Point: Tap
Sampling Method: Manual — Sampled By: Chemist
Contact Person: Chij Bahadur Darai — Contact No.: 9846040442
Received Date: 2078/11/29 — Completed Date: 2078/12/06

Analyzed Parameters

Physical Parameters:

S.N.	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	pH at 23.8 °C	7.7	6.5-8.5	4500-H^+ B, APHA
2.	Electrical conductivity (µs/cm)	225	1500	2510 B, APHA
3.	Turbidity (NTU)	0.1	5.0 (10.0)	2130 B, APHA
4.	TDS (mg/lit)	116	1000	Instrumental

Chemical Parameters:

SN	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	Total Hardness as $CaCO_3$ (mg/lit)	128	500	2340 C, APHA
2.	Calcium (mg/lit)	38	200	3500-Ca B, APHA
3.	Chloride (mg/lit)	8	250	4500 Cl^- B, APHA
4.	Ammonia (mg/lit)	ND	1.5	4500- NH_3 F, APHA
5.	Iron (mg/lit)	< 0.1	0.3 (3.0)	3500-Fe B, APHA
6.	Nitrate (mg/lit)	< 1	50	4500-NO_3^- B, APHA
7.	Arsenic (mg/lit)	ND	0.05	3111 B, APHA

Microbiological Parameters:

	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	*E. Coli* (CFU/100 mL)	TMTC	Nil	9222 D, APHA
2.	Total Coliform (CFU/100 mL)	TMTC	Nil	9222 B, APHA

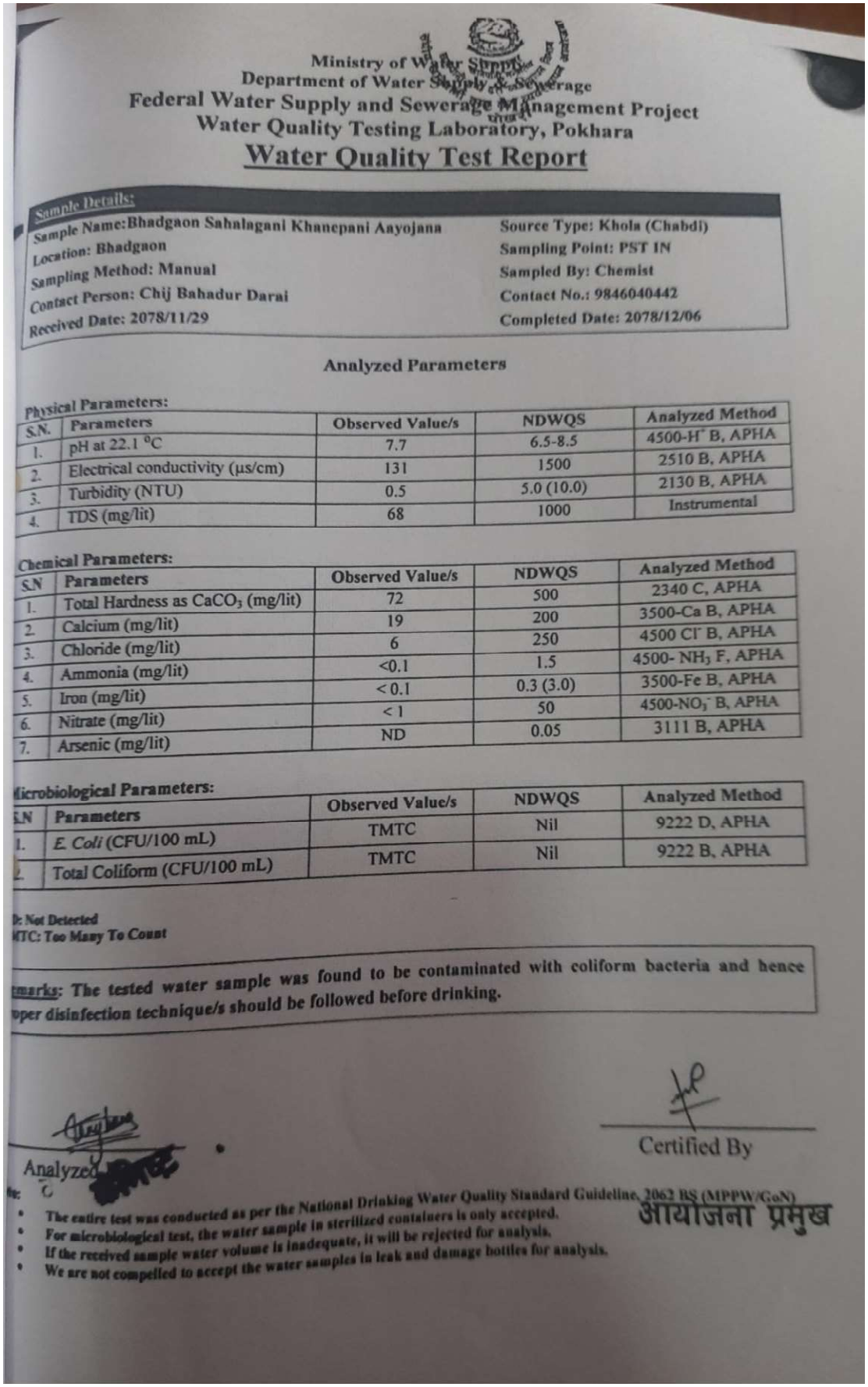
Not Detected
TMTC: Too Many To Count

Remarks: The tested water sample was found to be contaminated with coliform bacteria and hence proper disinfection technique/s should be followed before drinking.

Analyzed By

Certified By

The entire test was conducted as per the National Drinking Water Quality Standard Guideline, 2062 BS (MPPW/GoN)
For microbiological test, the water sample in sterilized containers is only accepted.
If the received sample water volume is inadequate, it will be rejected for analysis.
We are not compelled to accept the water samples in leak and damage bottles for analysis.



Ministry of Water Supply
Department of Water Supply & Sewerage
Federal Water Supply and Sewerage Management Project
Water Quality Testing Laboratory, Pokhara

Water Quality Test Report

Sample Details:

Sample Name: Bhadgaon Sahalagani Khanepani Aayojana
Location: Bhadgaon
Sampling Method: Manual
Contact Person: Chij Bahadur Darai
Received Date: 2078/11/29
Source Type: Khola (Chabdi)
Sampling Point: PST IN
Sampled By: Chemist
Contact No.: 9846040442
Completed Date: 2078/12/06

Analyzed Parameters

Physical Parameters:

S.N.	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	pH at 22.1 °C	7.7	6.5-8.5	4500-H^+ B, APHA
2.	Electrical conductivity (µs/cm)	131	1500	2510 B, APHA
3.	Turbidity (NTU)	0.5	5.0 (10.0)	2130 B, APHA
4.	TDS (mg/lit)	68	1000	Instrumental

Chemical Parameters:

S.N	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	Total Hardness as $CaCO_3$ (mg/lit)	72	500	2340 C, APHA
2.	Calcium (mg/lit)	19	200	3500-Ca B, APHA
3.	Chloride (mg/lit)	6	250	4500 Cl^- B, APHA
4.	Ammonia (mg/lit)	<0.1	1.5	4500- NH_3 F, APHA
5.	Iron (mg/lit)	< 0.1	0.3 (3.0)	3500-Fe B, APHA
6.	Nitrate (mg/lit)	< 1	50	4500-NO_3^- B, APHA
7.	Arsenic (mg/lit)	ND	0.05	3111 B, APHA

Microbiological Parameters:

S.N	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	*E. Coli* (CFU/100 mL)	TMTC	Nil	9222 D, APHA
2.	Total Coliform (CFU/100 mL)	TMTC	Nil	9222 B, APHA

ND: Not Detected
TMTC: Too Many To Count

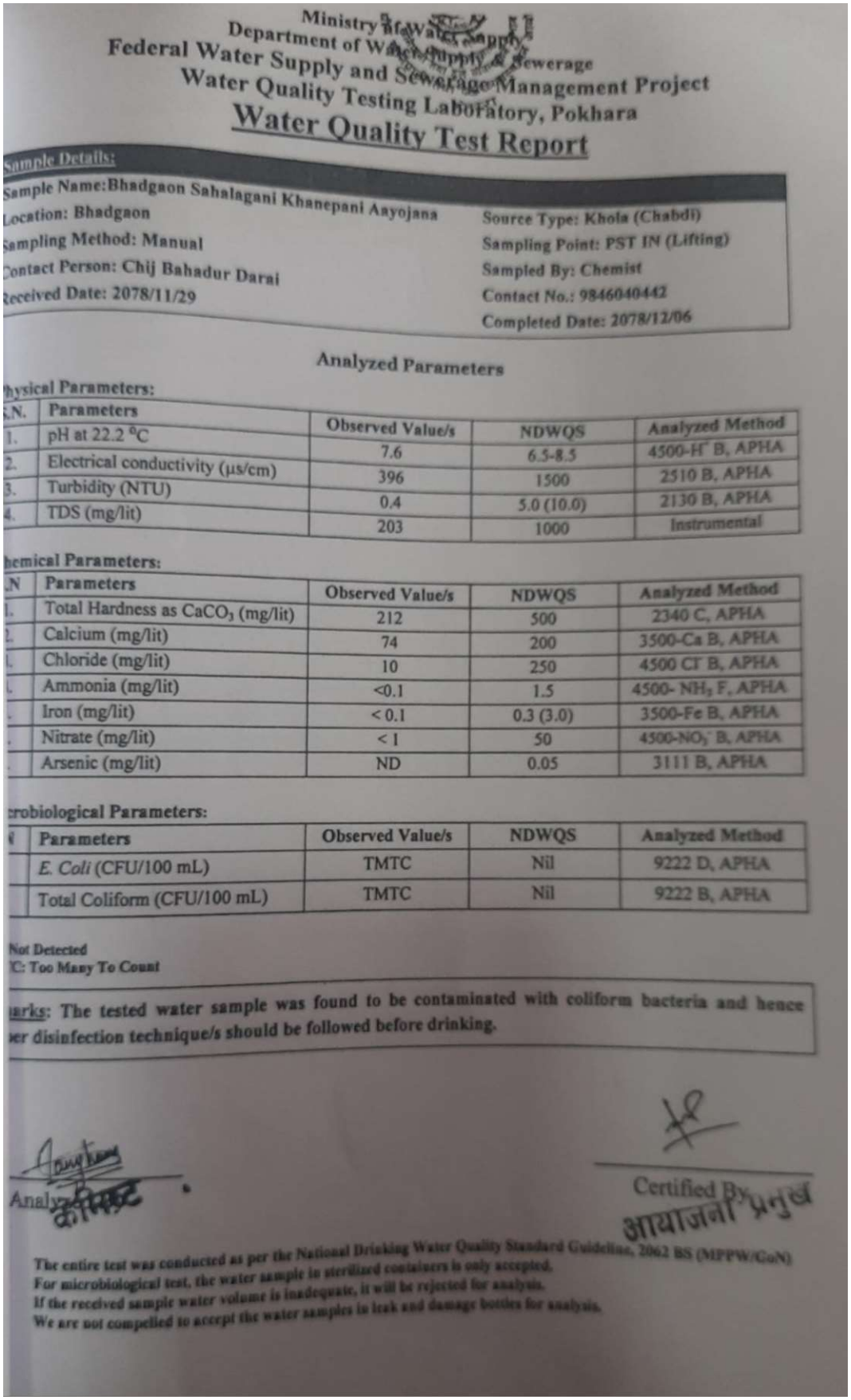
Remarks: The tested water sample was found to be contaminated with coliform bacteria and hence proper disinfection technique/s should be followed before drinking.

Analyzed By

Certified By

आयोजना प्रमुख

Note:
- The entire test was conducted as per the National Drinking Water Quality Standard Guideline, 2062 BS (MPPW/GoN)
- The water sample in sterilized containers is only accepted.
- For microbiological test, the water volume is inadequate, it will be rejected for analysis.
- If the received sample water volume is inadequate, it will be rejected for analysis.
- We are not compelled to accept the water samples in leak and damage bottles for analysis.



Ministry of Water Supply
Department of Water Supply & Sewerage
Federal Water Supply and Sewerage Management Project
Water Quality Testing Laboratory, Pokhara

Water Quality Test Report

Sample Details:

Sample Name: Bhadgaon Sahalagani Khanepani Aayojana
Location: Bhadgaon
Sampling Method: Manual
Contact Person: Chij Bahadur Darai
Received Date: 2078/11/29
Source Type: Khola (Chabdi)
Sampling Point: PST IN (Lifting)
Sampled By: Chemist
Contact No.: 9846040442
Completed Date: 2078/12/06

Analyzed Parameters

Physical Parameters:

S.N.	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	pH at 22.2 °C	7.6	6.5-8.5	4500-H^+ B, APHA
2.	Electrical conductivity (µs/cm)	396	1500	2510 B, APHA
3.	Turbidity (NTU)	0.4	5.0 (10.0)	2130 B, APHA
4.	TDS (mg/lit)	203	1000	Instrumental

Chemical Parameters:

S.N	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	Total Hardness as $CaCO_3$ (mg/lit)	212	500	2340 C, APHA
2.	Calcium (mg/lit)	74	200	3500-Ca B, APHA
3.	Chloride (mg/lit)	10	250	4500 Cl^- B, APHA
4.	Ammonia (mg/lit)	<0.1	1.5	4500- NH_3 F, APHA
5.	Iron (mg/lit)	< 0.1	0.3 (3.0)	3500-Fe B, APHA
6.	Nitrate (mg/lit)	< 1	50	4500-NO_3^- B, APHA
7.	Arsenic (mg/lit)	ND	0.05	3111 B, APHA

Microbiological Parameters:

S.N	Parameters	Observed Value/s	NDWQS	Analyzed Method
1.	*E. Coli* (CFU/100 mL)	TMTC	Nil	9222 D, APHA
2.	Total Coliform (CFU/100 mL)	TMTC	Nil	9222 B, APHA

ND: Not Detected
TMTC: Too Many To Count

Remarks: The tested water sample was found to be contaminated with coliform bacteria and hence proper disinfection technique/s should be followed before drinking.

Analyst

Certified By

The entire test was conducted as per the National Drinking Water Quality Standard Guideline, 2062 BS (MPPW/GoN).
For microbiological test, the water sample in sterilized containers is only accepted.
If the received sample water volume is inadequate, it will be rejected for analysis.
We are not compelled to accept the water samples in leak and damage bottles for analysis.

SFD Vyas Municipality, Nepal, 2025

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