SFD Report

Ratnanagar 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 Ratnanagar Municipality, Nepal, 2026

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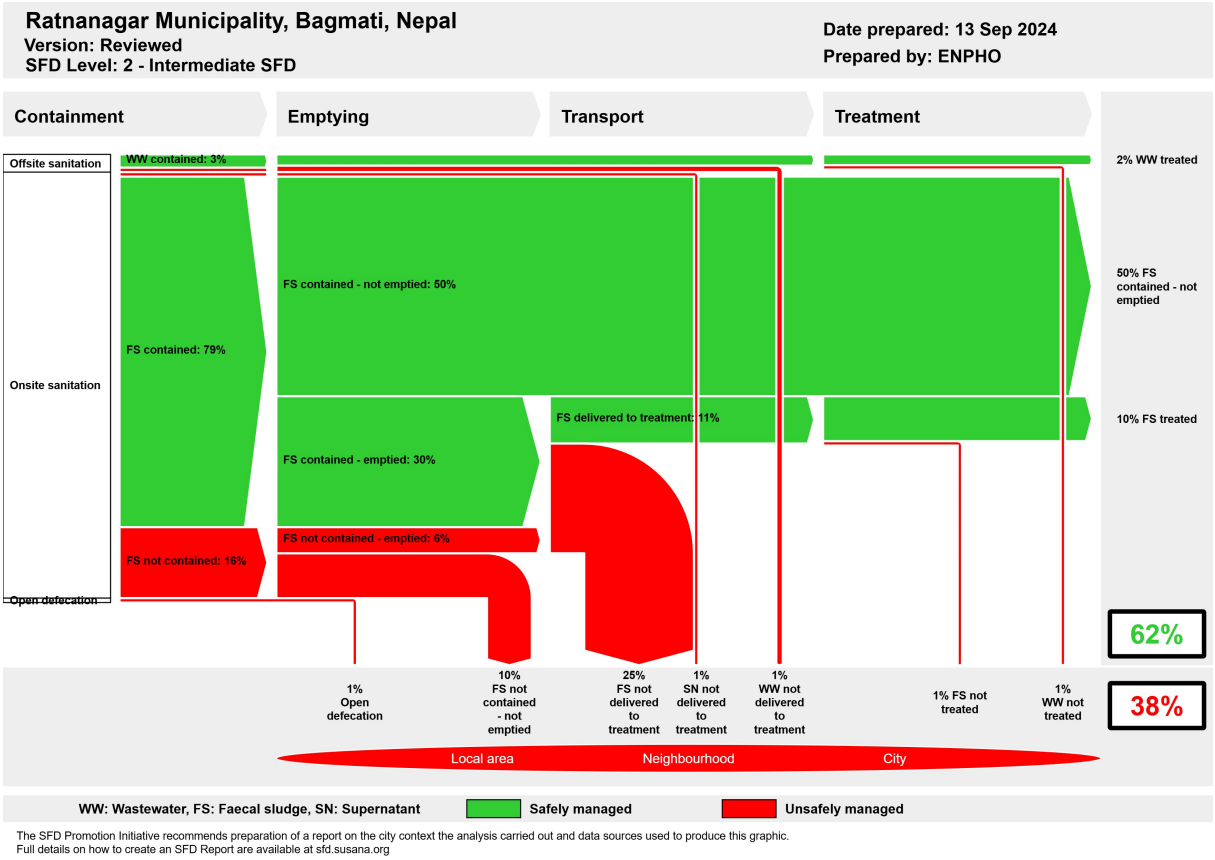
1. The SFD Graphic



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:

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

Status:

Final SFD report.

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3. General city information

Ratnanagar Municipality is situated in Chitwan District within Bagmati Province in the central region of Nepal. It is divided into 15 wards and covers an area of 3,117.54 sq. km. It was established on December 2, 2014 and was reformed on March 10, 2017. It is formed by merging 11 Village Development Committees (VDCs) namely Thankot, Dahachowk, Naikap Nayabhanjyang, Wodabhanjyang, Balambu, Mahadevsthan, Teenthana, Satungal, Matatirtha, Machhegaun and Naikap puranobhanjyang. It lies on 27°38'10" to 27°43'38" N latitude and 85°06'12" to 85°16'30" E longitude and the altitude ranges from 898 metres above sea level (masl) to 2525 masl (Ratnanagar Municipality, 2024).

The municipality has a population of 89,905 residing in 22,403 households (National Statistics Office, 2023). The annual population growth rate of the municipality is 3.77%. The municipality has a temperate climate (Cwb) with warm summers and dry winters. The annual average temperature of the municipality is 16.1°C and receives 2,812 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 (ENPHO, 2024). Chitwan district was declared Open Defecation Free (ODF) on 23 September 2011. 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 4% of households rely on an offsite sanitation system and 95% rely on onsite sanitation systems. In the municipality, scanty households have sewer network. The toilets with sewer network, outlet to an open environment and open/stormwater drain are considered as offsite sanitation systems. Households with onsite sanitation systems have different sanitation technologies. About 1% of households have septic tanks, 29% have fully lined tanks, 55% have lined tanks with impermeable walls with open bottom, 11% have lined pit with semi-permeable walls with open bottom and 1% have unlined pits.

All the institutional buildings have toilets with 93% having onsite sanitation systems and 7% having offsite sanitation systems. Among the institutional buildings with onsite sanitation systems, 47% have fully lined tanks, 42% have lined tanks with impermeable walls and open bottom and 4% have lined pits with semi-permeable walls and open bottom.

Ratnanagar municipality has four public toilets. Among which two were observed for the study. The toilets at *Nagdhunga Buspark,* was jointly constructed by Ratnanagar Municipality and Lumanti, and the toilet at *Naya Naikap* was constructed by Ratnanagar Municipality only. Almost 350 people use the toilet at *Nagdhunga Buspark*. The restrooms are mostly used by local bus passengers, temple visitors and city dwellers.

Emptying and Transport:
Among the buildings with onsite sanitation systems, about 33% of households and 21% 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 into stormwater drains during rainy season. Moreover, mechanical emptying is prevalent in the municipality.

The municipality has private desludging providers. Among them one service provider has a vehicle with a tank capacity of 4,000 litres. The service charge for each trip is NRs. 4,500 - NRs.5,000 (USD 33.8 - USD 37.6) to empty a containment.

Treatment and Disposal/Reuse:
Mechanically emptied faecal sludge (FS) is disposed of in privately owned land without treatment. The manually emptied FS is extracted and dumped in a pit on the compound, applied into farmlands, composted or released into stormwater drain/sewer. While, FS generated at households in Amarawati colony is being managed at FSTP owned by the colony. Apart from FSTP at the colony, all the emptied FS is disposed unsafely into an open environment or water bodies.

Approximately 86% of households have piped drinking water supply services in the municipality. Among other service providers, Matatirtha Mahadevsthan Water and Sanitation Users' Committee is one of the major drinking water services providers in Ratnanagar Municipality. It serves in wards 5, 6 and 7. It has distributed more than 4,500 taps to households and institutions. Also, Tinthana Water and Sanitation Users' Committee is another water supply service provider. It serves in ward 15 and has distributed 1,520 taps in the ward. Apart from private taps, 6% rely on community taps, 1% on groundwater, 1% on spring sources, 1% on tanker water and 5% on jar water for drinking water supply.

Spring sources are vulnerable of contamination. The vulnerability of sources depends on lateral spacing between sanitation systems and the sources. However, sample water from boring and reservoir tanks of Tinthana 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 62% of the population are safely managed, while 38% of the population are unsafely managed. Only 2% of FS generated in the municipality was treated, which is delivered to FSTP and biogas digester at household. While safely managed FS generated from 50% of population is, temporary as, the FS that has not been emptied. 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 a fundamental right 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. The law emphasises on a right to quality sanitation services and prohibites direct discharge of wastewater and sewage into water bodies or public places.

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

Ministry of Water Supply through its Department of Water Supply and Sewerage Management (DWSSM) articulated and endorsed Institutional and Regulatory Framework (IRF) for Faecal Sludge Management in Urban Areas of Nepal in 2017. The main objective of the IRF is to define the specific roles and responsibilities of key institutions for the effective management and regulation of Faecal Sludge Management (FSM).

6. Overview of stakeholders

Based on the regulatory framework for Faecal Sludge Management (FSM), the major stakeholders for effective and sustaining service delivery as presented in Table 1.

Table 1: Overview of Stakeholders

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

7. Process of SFD development

Data on sanitation situation was collected through household and institutional surveys (ENPHO, 2024) . Enumerators of the municipality were mobilised after orientating on sanitation technologies and proper use of mobile application (KOBOCOLLECT) to collect data for survey. The Key Informant Interviews (KIIs) were conducted with WASH focal person of the municipality, Water and Sanitation Users' Committee and caretakers of public toilets. Types of sanitation technologies used in various locations have been mapped using ARCGIS. For the Shit Flow Diagram (SFD) graphic production, initially, a relationship between sanitation technology used in questionnaire survey and Shit Flow Diagram Promotive Initiatives (SFD PI) methodology was made. Then, data were fed into SFD graphic generator to produce the SFD graphic.

8. Credibility of data

The major data were collected from random household sampling. Altogether, 586 households and 44 institutions were surveyed from 15 wards of Ratnanagar 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:

- Ratnanagar Municipality, 2024. *Ratnanagar Municipality.* [Online] Available at: https://www.Ratnanagarmun.gov.np/en.
- Climate-Data, 2021. *Climate-Data*. [Online] Available at: https://en.climate-data.org/asia/nepal/central-development-region/kathmandu-1137/.
- ENPHO, 2024. *Sanitation Situation Assessment of Ratnanagar Municipality*. *Unpublished*, s.l.: s.n.
- MoWS, 2020. *Open Defecation Free Nepal: Narration of the Journey*, Kathmandu: Secretariat of National Sanitation and Hygiene Coordination Committee, Nepal.
- National Statistics Office, 2023. *National Population and Housing Census 2021* National Report, Kathmandu: National Statistics Office.

SFD Bhojpur Municipality, Nepal, 2026

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Abbreviations

DWSSM	Department of Water Supply and Sewerage Management
DUDBC	Department of Urban Development and Building Construction
ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
GoN	Government of Nepal
HH	Household
IRF	Institutional and Regulatory Framework
KII	Key Informant Interview
KM	Kilometre
masl	metres above sea level
mm	Millimetre
MoWS	Ministry of Water Supply
MuAN	Municipal Association of Nepal
NPC	National Planning Commission
NSHMP	National Sanitation and Hygiene Master Plan
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
PPP	Public Private Partnership
RWSSNP	Rural Water Supply and Sanitation National Policy
SDG	Sustainable Development Goal
SDP	Sector Development Plan
SFD	Shit Flow Diagram
SFD PI	Shit Flow Diagram Promotion Initiative
SN	Supernatant
SuSanA	Sustainable Sanitation Alliance
UCLG ASPAC	United Cities and Local Governments Asia Pacific
VDC	Village Development Committees
WASH	Water, Sanitation and Hygiene
WSUC	Water and Sanitation Users Committee
WW	Wastewater
WWTP	Wastewater Treatment Plant

1 City context

Ratnanagar Municipality is situated in Chitwan District of Bagmati Province, Nepal. It was established on 24 January 1997 and was reformed on 2 December 2014. The municipality was formed by merging Unmukh and Panchakanya Village Development Committees (VDCs) and reformed by merging Pithuwa and Bachhauli Village Development Committees (VDCs) to previously formed Ratnanagar Municipality. It is divided into 16 wards. It shares its boundary with Khairahani Municipality on the east, Bharatpur Metropolitan City on the west, Kalika Municipality on the north and Chitwan National Park on the south (Ratnanagar Municipality, 2024). Figure 1 shows the ward boundary map of Ratnanagar Municipality.

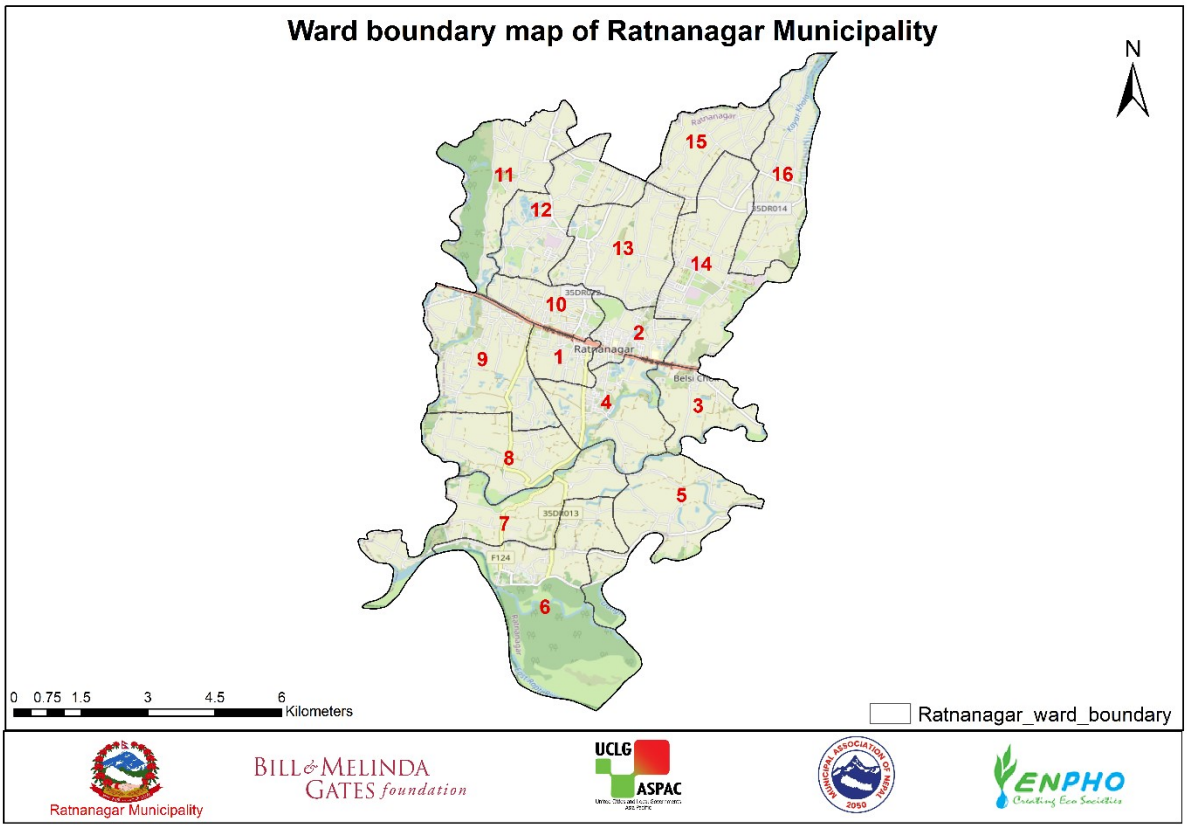

Figure 1: Ward boundary map of Ratnanagar Municipality.

1.1 Population

As per the national population and housing census conducted in 2021, Ratnanagar Municipality has a total population of 89,905 with 43,531 male and 46,374 female. There are altogether 22,403 households. The average household size is 4.01 (National Statistics Office, 2023) and population density is 1,309 per km^2. The annual population growth rate of the municipality is 2.87%. This shows that the municipality has increasing migration.

1.2 Topography and Geography

The elevation of Ratnanagar Municipality ranges from 185 metres above sea level (masl) to 213 masl. The municipality lies at 27°37'02" N latitude and 84°30'42" E longitude (Elevation API, 2024) . It covers a total area of 68.68 sq. km (Ratnanagar Municipality, 2024) . The municipality lies in the Dun Valley range based on the physiographic division of Nepal. Thus,

it has the topography based on the range. The region has a composition of alluvial sediments i.e. sand, silt and clay along with coarse gravels, along with sandstone, mudstone and traces of Siwalik Hills (Upreti, 1999).

1.3 Climate

Köppen–Geiger classification is one of the most used systems for climatic categorisation. This classification is a widely used method for portraying climates worldwide, based on monthly air temperature and precipitation. The climatic condition of Ratnanagar Municipality falls on temperate climate (Cwa) based on Köppen–Geiger classification. This climatic condition has hot summers and dry winters (Karki, et al., 2015). The warmest month of the year is June with an average temperature of 28.4°C and coldest month is January with average temperature of 15.6°C. The annual average temperature of the municipality is 23.9°C. It receives 1,726 mm rainfall on average annually. The most rainfall occurs in July and the least in November (Climate-Data, 2021). Figure 2 shows the graph of the monthly average for precipitation and temperature of Ratnanagar Municipality.

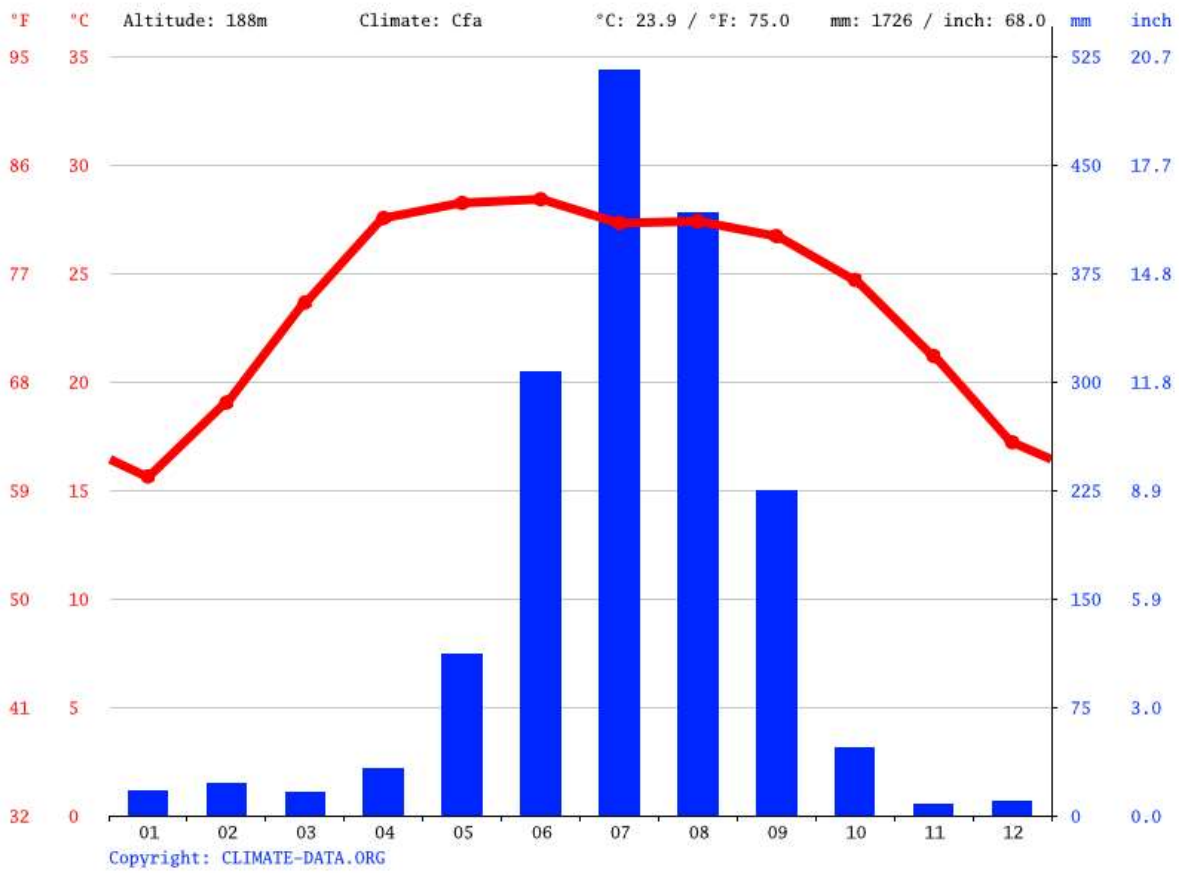

Figure 2: A graph showing the monthly average for precipitation and temperature of Ratnanagar Municipality.

2 Service Outcomes

2.1 Overview

Data on sanitation situation was collected through household and institutional surveys (ENPHO, 2024) . A total of 586 households were sampled from 22,403 households distributed in 16 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 infrastructure, facilities or services designed for the safe management of human excreta from toilets, including handling, storage, and treatment – either onsite or offsite – and its safe conveyance to a final point of use or disposal, in order to protect human health and the environment (Affam & Ezechi, 2021).

2.1.1 Sanitation System in Household Buildings

Chitwan district was declared Open Defecation Free (ODF) on 23 September 2011 (MoWS, 2020). The status of ODF indicates accessibility to basic sanitation for each household (HH). In Ratnanagar Municipality, still 1% of the households do not have toilets and practice open defecation. The households practising open defecation go to an open space or near water bodies. Figure 3 shows sanitation technologies present at households in Ratnanagar Municipality.

Figure 3: Sanitation technologies at households of Ratnanagar 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, stored and emptied from or treated on the plot where they are generated (SuSanA, 2018). In the municipality, 4% of the households have offsite sanitation systems, whereas 95% have onsite sanitation systems. Figure 4 presents the location map of households with status of access to improved sanitation.

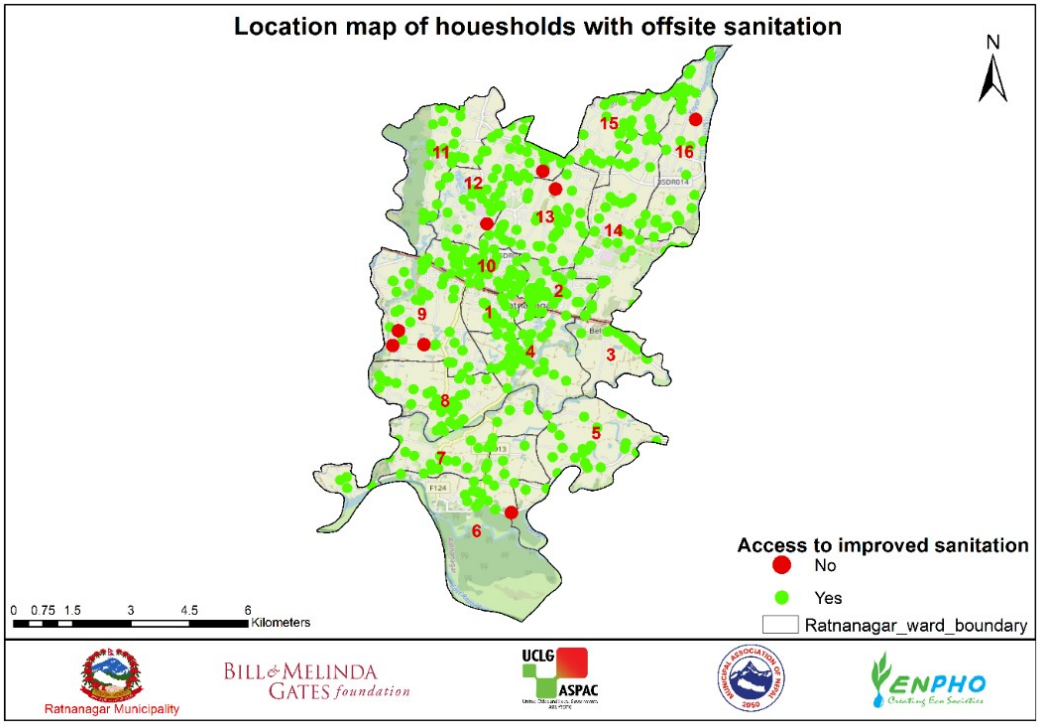

Figure 4: Location map of households with status of access to improved sanitation.

Types of Offsite Sanitation Systems

Ratnanagar Municipality has offsite sanitation systems with a centralised combined sewer network. The sewerage network is in the wards 1, 2, 4 and 10 of the municipality. The sewerage network covers almost 9,000 HHs in these wards. Further, the sewer lines are connected to decentralised wastewater treatment plants located in wards 4 and 12 (KII-1, 2023). Also, few households other than these wards have offsite sanitation systems, but with an outlet to an open environment. Thus, 4% of households in the municipality have offsite sanitation systems. In the SFD-PI methodology, households that have the outlet of toilet to a sewer line or to an open environment is considered as offsite sanitation systems. It is taken as toilet with no onsite container for the SFD graphic. Figure 5 shows offsite sanitation systems in Ratnanagar Municipality.

Figure 5: Offsite sanitation systems (Manhole of sewer network on left and discharge of sludge to an open environment on right) in Ratnanagar Municipality.

Types of Onsite Sanitation Systems

In the municipality, 95% of the households have onsite sanitation systems. Table 1 shows the types of onsite sanitation technologies and percentage of households using each in Ratnanagar Municipality.

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

Containment	Wall construction materials	Bottom of containment	Chamber	Number	Connected to	%
Septic tank	Concrete walls OR Cemented brick/stone walls	PCC or plastered	Two or more than two	NA	Soak pit Sewer Open drain/ open ground	1%
Biogas digester	NA	NA	NA	NA	No outlet/ overflow	7%
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	4%
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	15%
Twin pits	Concrete rings piled one after other	Soiling or Nothing	NA	Two	NA	4%
Single pit	Concrete rings piled one after other	Soiling or Nothing	NA	One	NA	63%
Unlined pit	Mud mortar brick wall/Mud mortar cement wall/No lining/Dry stone wall	Nothing	NA	NA	NA	1%

Septic tank is a watertight rectangular chamber with two or more than two compartments for better storage and stabilisation of faecal sludge (FS). The technology is properly sealed, and the effluent is discharged into soak pit (SuSanA, 2018). 1% of households in the municipality have septic tank.

Biogas Digester is a waste to energy conversion technology designed to treat household organic waste and faecal sludge (FS) to generate biogas. 7% 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 and sanitation in Nepal (AEPC, 2018). Figure 6 shows the types of biogas digesters in Ratnanagar Municipality.

Figure 6: Biogas digesters found at households in Ratnanagar Municipality.

Fully lined tank is a rectangular tank with impermeable walls and base to safely store FS. It does not have outlet for the discharge of effluent (Strande, et al., 2014) . Around 4% 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). About 15% of households have this type of containment in the municipality.

Single Pit is a circular onsite technology made from concrete rings. There is no lining between rings, and it allows infiltration of effluents from walls and as well as bottom of the pit. No outlet or overflow for effluent is observed in this type of containment (SuSanA, 2018). Around 63% of households have single pits in the municipality. Figure 7 shows pictures of single pits found in the municipality.

Figure 7: Single pits found in Ratnanagar Municipality

Twin Pit is also a circular onsite sanitation technology with two sets of concrete rings. It has semi-permeable walls and a permeable base (SuSanA, 2018). Each pit is used alternatively after filled. This technology is ideally designed to safely store and treat FS. It effectively treats FS if there is no exfiltration of water (Saxena & Den, 2022). The facility consists of two sets of pits with the minimum horizontal distance of 1.2m. Both the pits are connected from diversion box. However, most twin pits installed by the households are not as per the design.

About 4% of households have twin pits. Figure 8 shows the inappropriate design of twin pits in the municipality.

Figure 8: Inappropriate design of twin pits, the distance between two pits is less than 1.2m

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). About 1% of households have unlined pits. Figure 9 shows unlined pits found in Ratnanagar Municipality.

Figure 9: Unlined pit found at a household in Ratnanagar Municipality.

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

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

Sanitation System	Percentage
No toilet/Open defecation (T1B11 C7 TO C9)	1%
No onsite container (T1A1C3 and T1A1C8)	4%
Onsite Sanitation System	
Septic tank (T1A2C8)	1%
Fully lined tank (T1A3C8 and T1A3C10)	11%
Lined tank with impermeable walls and open bottom (T1A4C6, T1A4C8, T1A4C10 and T2A4C10)	15%
Lined pit with semi-permeable walls and open bottom (T1A5C10 and T2A5C10)	67%
Unlined pit (T1A6C10)	1%
Grand Total	**100%**

According to Shit Flow Diagram (SFD) Promotion Initiative (PI), biogas digester and fully lined tanks are recategorised as fully lined tanks and single pits and twin pits are recategorised as lined pits with semi-permeable walls and open bottom. Thus, 11% of households have fully lined tanks and 67% of households have lined pits with semi-permeable walls and open bottom. Figure 10 shows location map of households with different types of containment in Ratnanagar Municipality.

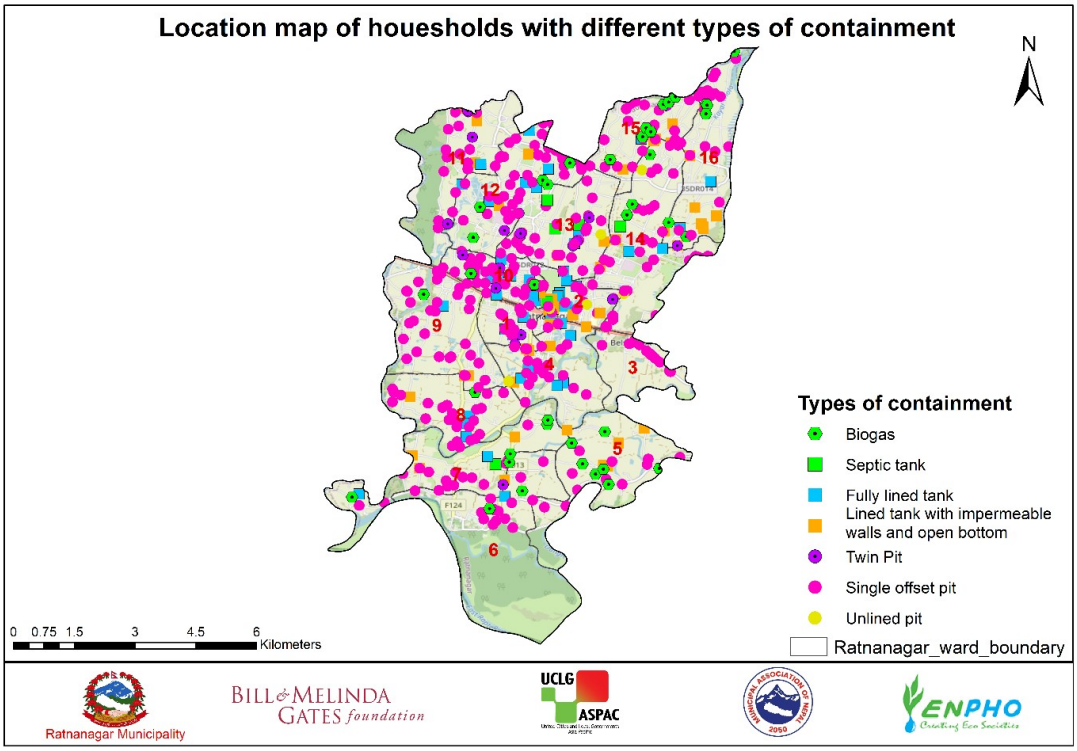

Figure 10: Location map of household with different types of containment.

2.1.2 Sanitation Systems in Institutional Buildings

Altogether 61 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	10
Government /Non-government Office	34
Health Care Centre	7
Hotel/Home Stay	10
Grand Total	**61**

All the institutional buildings in the municipality have toilets with 93% of institutional buildings with onsite sanitation systems and 7% have offsite sanitation systems. Various containment types are found in the institutional buildings. About 3% of the buildings have septic tanks,

38% have fully lined tanks, 25% have lined tanks with impermeable walls and open bottom, and 27% have lined pits with semi-permeable walls and open bottom (3% twin pits and 24% single pit). The data shows that only 6% of the institutional buildings have safe technologies, whereas 87% of the institutional buildings have improperly built containments that possess risk to groundwater contamination. Figure 11 shows the location map of institutional buildings with different types of containments in Ratnanagar Municipality.

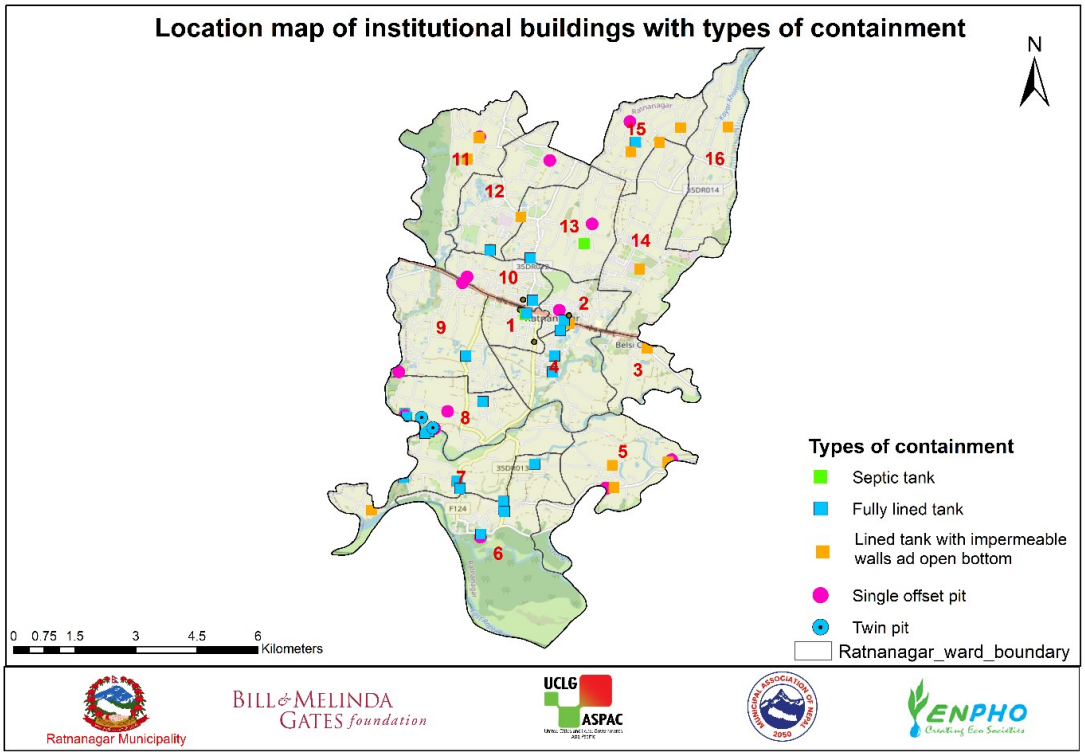

Figure 11: Location map of institutional buildings with different types of containment in Ratnanagar Municipality.

2.1.3 Public Toilets

There are six public toilets in Ratnanagar Municipality, located in bus park and bazaar areas (KII-1, 2023). Among which three were observed for the study. The information about public toilets obtained during KII and observation are fed in this report.

Public toilet at *Saurahachowk*

The toilet located at *Saurahachowk* in ward 1 was constructed by the Ratnanagar Municipality. It has separate male and female compartments. It serves 4 users at a time with 1 pan and 2 urinals in male compartment and 1 pan in female compartment. The local shopkeepers and local passers-by are the major service recipients of this toilet. About 150 users use the toilet per day. The users are charged NRP 5 (USD 0.04) for urination and 10 (USD 0.08) for defecation.

The outlet of the toilet is connected to a containment. The containment is about 10,000 litres and is emptied on demand basis by municipal desludging vehicle. 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. Handwashing basins

are placed outside the compartment for the handwashing facility. A caretaker is responsible for overall management of the toilet (KII-4, 2024).

Figure 12: Public toilet located at *Saurahachowk.*

Public toilet A at *Sauraha Bazaar*

The toilet A located at *Sauraha Bazar* was constructed by the local club. It has separate male and female compartments. The public visitors and city dewellers are the service recipients of the toilet. The toilet compartments have ventilation. Handwashing basin is placed outside the compartment for the handwashing facility. A caretaker is responsible for overall management of the toilet. The users are charged NRP 10 (USD 0.08) for urination and 20 (USD 0.16) for defecation.


Figure 13: Public toilet A and its status at *Sauraha Bazaar*.

Public toilet B at *Sauraha Bazaar*

The toilet B located at *Sauraha Bazar* was constructed by the Ratnanagar Municipality. It has separate male and female compartments. It serves 3 users at a time with 1 urinal and 1 pan for male and 1 pan for female users. The public visitors and city dewellers are the service recipients of the toilet. The toilet compartments have ventilation. Handwashing basin is placed outside the compartment for the handwashing facility.

Figure 14: Public toilet B located at *Sauraha Bazaar.*

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, about 44% of the households have emptied their containment, whereas 56% have not emptied yet. Similarly, about 39% of the institutional buildings have emptied their containments, while 61% have not emptied. The emptying ratio of lined tanks with impermeable walls and open bottom and unlined pits are more as compared to other containment types. The containment types with open bottom allow effluents to infiltrate (Peal, et al., 2020) , preventing them from filling up quickly. Furthermore, the emptying ratio of single pits and twin pits are greater than others as the sizes of containments are comparatively smaller. Thus, this has resulted in difference in the frequency of emptying of these containments. Figure 15 shows emptying status of different types of containment at households.

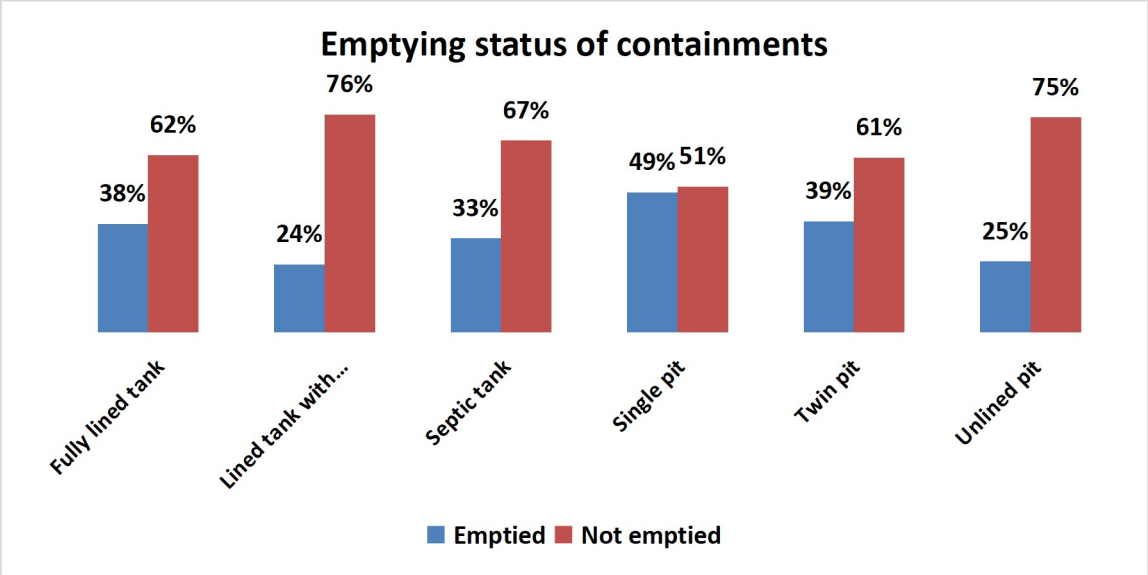

Figure 15: Status of emptying of different types of containment.

The municipality does not have scheduled containment emptying practice as most containments are with open bottom and do not get filled in standard time as per the containment size. Thus, on-demand emptying practice is found in the municipality (KII-2, 2023) . Both manual and mechanical emptying is practiced, while mechanical emptying is prevalent. In addition, households also practice open emptying. Open emptying method is the practice of discharging effluent into an open/stormwater drain during rainy season. Among the households that have emptied their containments, 26% of households emptied manually, 73% emptied mechanically and 1% practiced open emptying. Similarly, 4% of institutional buildings practiced manual emptying, 91% practiced mechanical emptying and 4% practiced open emptying (ENPHO, 2024) . The easy access of desludging service and availability of motorable road networks are the reasons for more mechanical emptying practice in the municipality.

The municipality has a desludging vehicle of capacity 3,500 litres. The service charge for each trip is NRP 3,500 (USD 26.3). It generally has an average of 7 trips per week. However, the service is generally not available at household level and commercial buildings. A driver and a helper are assigned for the desludging service (KII-1, 2023).

Ratnanagar Municipality has about 40 private desludging service providers (KII-1, 2023) . These service providers also serve in neighbouring municipalities. Each vehicle makes about

1 trip per day on an average during dry season, whereas the trips are more during rainy season. In addition, the private desludgers from Bharatpur Metropolitan City also serve in the municipality (KII-2, 2023) . The following table provides the details of studied private desludgers in the municipality:

Table 4: Details of private desludging service providers in Ratnanagar Municipality.

Service Provider	Registration	No. of vehicles	Capacity of vehicle (litres)	Average no. of trips per day per vehicle	Average service charge per trip (NPR)	Staff
Bakulahar Safety Tanki Safai	Not registered	1	3,500	1	1,500-2,500	1 (Helper)
New Manakamana Safety Tanki	Registered in ward office	2	6,000	2	1,500-3,500	2 (Driver) 2 (Helper)
Ratnanagar Safety Tanki	Not registered	18	3,500	1	1,500	NA
Sanjha Safety Tanki Safai	Not registered	2	4,500	1	3,500	2 (Driver) 2 (Helper)
Chitwan Safety Tanki Safai	Not registered	1	NA	1	NA	NA
Sena Chaudhary Safety Tanki	Not registered	1	6,000	1	NA	NA
Shanta Chaudhary Safety Tanki	Not registered	1	6,000	1	NA	NA
Tikauli Chaudhary Safety Tanki	Not registered	1	6,000	1	NA	NA

Figure 16: Municipal (left) and Private (right) desludging vehicles in Ratnanagar Municipality.

2.1.5 Treatment and Disposal/Reuse

Ratnanagar Municipality has 2 decentralised wastewater treatment plants (WWTPs) on the bank of Budhikhola. The wastewater from wards 1,2,4 and 10 is conveyed in these WWTPs which are estimated to treat approximately 1,424 m^3 of wastewater daily. Moreover, both WWTPs are only partially functional due to physical damage in the WWTPs. The FS collected by municipal desludging vehicle is only allowed to dispose in the WWTP (KII-1, 2023) . However, FS collected by private desludgers are not allowed to dispose in these WWTPs. Thus, private desludgers usually apply FS to their private farmlands or in other farmlands as per demand (KII-2, 2023).

Figure 17: FS disposal in WWTP by municipal desludging vehicle.

Currently, manually emptied FS is extracted and dumped on-site, applied into farmlands or composted (ENPHO, 2024) , while mechanically emptied FS is disposed of on privately owned land or in other farmlands as per demand (KII-2, 2023) . Though municipality has WWTPs, and biogas digester installed at households, the major portion of FS generated and collected is not treated or disposed safely.

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 in regard to lateral spacing between sanitation system and the sources.

a. Sources of drinking water and water production

Approximately 78.53% of households in the Ratnanagar Municipality have piped drinking water supply services while 0.34% of households get drinking water from community taps, 0.51% uses jar, 0.17% uses tanker water and 0.17% get drinking water from neighbour's tap. Moreover, 20.27% of households still rely on groundwater sources for drinking water. In the municipality, Water and Sanitation Users' Committees (WSUCs) are serving piped drinking water supply services. About 5 WSUCs are providing drinking water supply service at households and institutions (ENPHO, 2024) . Figure 18 shows groundwater and community taps in the municipality.


Figure 18: Picture showing groundwater and community tap in Ratnanagar Municipality.

Ratnanagar Water and Sanitation Users' Committee is one of the major water service providers in the municipality. It was established in 2001 A.D. and has been serving since 2007 A.D. It has been providing water supply services in wards 1 to 13. It serves drinking water services to more than 18,000 households. The scheme lifts water from 7 deep borings, 1 in Subba chowk, 1 in ward 12, 2 in Ghegauli and 3 in Bagdevi. The lifted water from sources is collected in reservoir tanks and chlorinated prior to distribution through pipeline to private taps in households and institutions. The water quality is tested every month in the laboratory at the office of Ratnanagar WSUC (KII-3, 2023).

Figure 19: Reservoir tank for drinking water of Ratnanagar WSUC.

Apart from this water service provider, Bachhauli, Pithuwa, Shubha chowk and Satkanya WSUCs are also serving in the municipality (ENPHO, 2024) (KII-3, 2023). The water supply service is not uniformly distributed in the municipality thus, locals are obliged to rely on groundwater sources for drinking water supply.

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

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, neutralisation, volatilisation, 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 (Foster, et al., 2013) . Among other anthropogenic activities, improperly designed and constructed, and unmanaged sanitation technologies also contribute to the groundwater contamination (EPA, 2015). In addition to it, the key factor to risk of groundwater pollution is the soil type and geological structure. According to WHO, 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. The size of pores in the soil determines the infiltration rate (Krishnan, 2011).

The soil composition of Ratnanagar Municipality consists of alluvial sediments i.e. sand, silt and clay along-with coarse gravels (Upreti, 1999) also known as sandy loam soil. In the sandy loam soil, the permeability is approximately 2.5 cm per hour (INREM, 2011). Thus, between 25 and 50 days the pollutant could travel to the depth of approximately 24 meters (78.74 feet) in the soil type of Ratnanagar Municipality and possess risk of groundwater pollution. Hence, the people using open bottom tanks and consuming water from the handpumps with the depth of up to 80 feet (24.38 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.

Figure 20 shows the depth of handpumps and horizontal distance of it from source of pollutant by lined tanks with impermeable walls and open bottoms. Almost 80% of the households (i.e.T2A4C10: 80%*3%=2% of the overall population, where 3% is the percentage of population using lined tanks with impermeable walls and open bottom with no outlet or overflow and groundwater as drinking water source) using this type of containment possess significant risk to groundwater contamination.

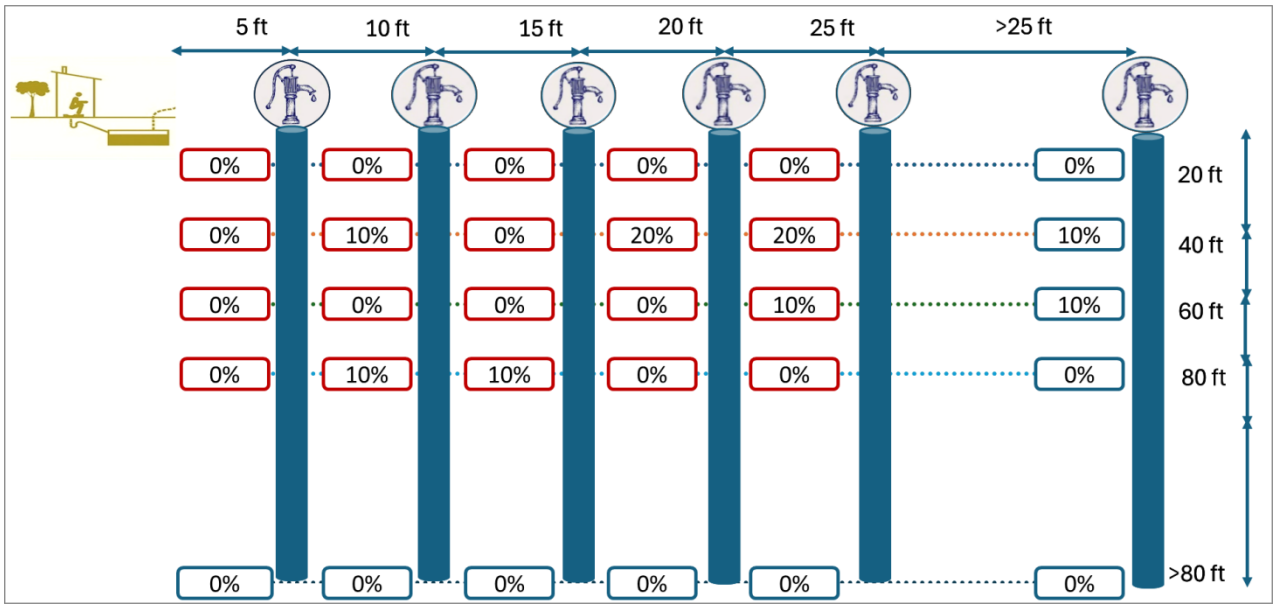

Figure 20: Depth of hand pumps and lateral spacing of it with containment type lined tank with impermeable walls and open bottom.

Figure 21 shows the depth of hand pumps and horizontal distance of it with the containment type lined pit with semi-permeable walls and open bottom. It shows that almost 83% of the households (i.e.T2A5C10: 83%*12%=10% of the overall population, where 10% is the percentage of population using lined pits with semi- permeable walls and open bottom with no outlet or overflow and using groundwater as drinking water source) using this type of containment possesses significant risk to groundwater contamination.

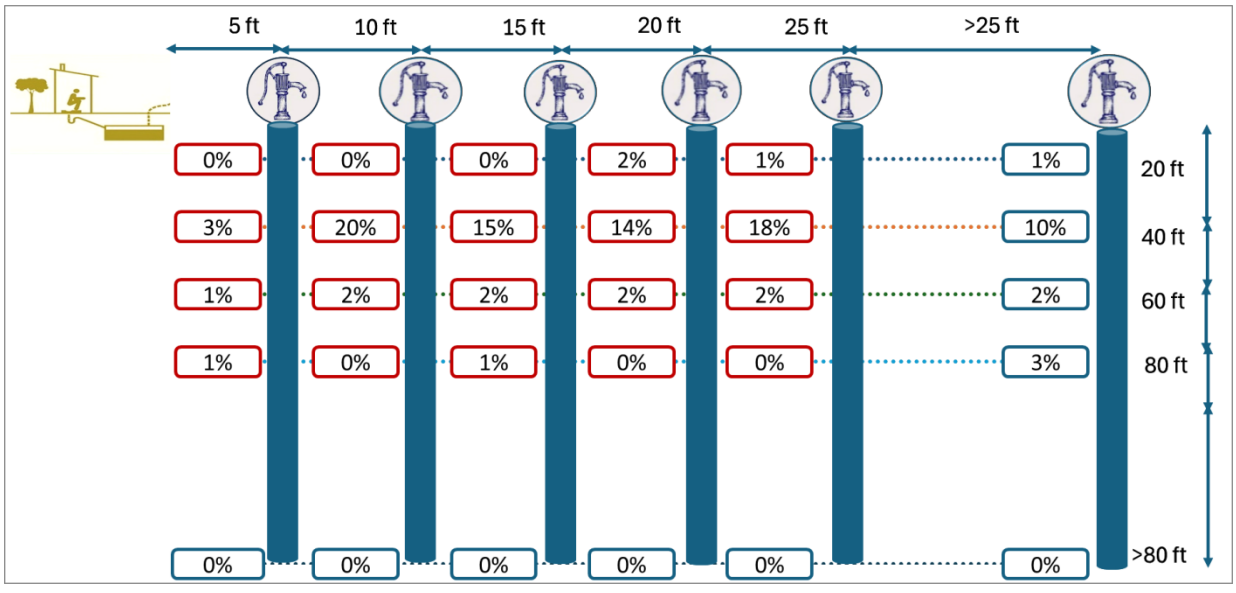

Figure 21: Depth of hand pumps and lateral spacing of it with containment type lined pit with semi-permeable walls and open bottom.

2.2 SFD Selection Grid

Figure 22 shows the types of sanitation technologies present in the Ratnanagar 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 biogas digesters and fully lined tanks are selected as fully lined tank, while single pit and twin pits are selected as lined pit with semipermeable walls and open bottom in this selection grid.

Figure 22: SFD selection grid for Ratnanagar Municipality.

The detail description of selected terms in the selection grid is provided in Table 5:

Table 5: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 22.

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 will contribute to variable W3.
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.
T1A2C8	A correctly designed, properly constructed, fully functioning septic tank with an outlet connected to open ground. The supernatant/effluent flowing from the tank is only partially treated and is still hazardous, therefore all the excreta in this system is considered NOT contained.
T1A3C8	A correctly designed, properly constructed and well maintained fully lined tank with impermeable walls and base. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are NOT performing as septic tanks,

	instead they are acting as sealed vaults. Since the tank is fitted with a supernatant/effluent overflow connected to open ground 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.
T1A4C6	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 an open drain or storm sewer, the excreta in this system is considered NOT 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.
T2A4C10	A correctly designed, properly constructed and well maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur - the excreta is therefore likely to be partially treated. It includes all lined but open bottomed tanks and containers which are sometimes mistakenly referred to as septic tanks (e.g. cubluks in Indonesia). The tank is NOT fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered NOT contained.
T1A5C10	A correctly designed, properly constructed and well-maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow, so this system is considered contained.
T2A5C10	A correctly designed, properly constructed and well maintained pit with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. The tank is NOT fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered NOT contained.
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 100%, as septic tanks are not connected to an open/stormwater drain or sewer.

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

iii. The proportion of FS from lined tanks with open bottom and all types of pit is 99%, as the percentage of lined tanks with impermeable walls and open bottom and any pits which are connected to an open/stormwater drain is only 1%.

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 23 shows the SFD matrix of Ratnanagar Municipality.

Ratnanagar Municipality, Bagmati, Nepal, 13 Sep 2024. SFD Level: 2 - Intermediate SFD
Population: 89905
Proportion of tanks: septic tanks: 100%, fully lined tanks: 100%, lined, open bottom tanks: 99%

Containment								
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment	SN transport	SN treatment
	Pop	W4b	W5b	F3	F4	F5	S4e	S5e
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	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C3 Toilet discharges directly to a decentralised combined sewer	3.0	85.0	95.0					
T1A1C8 Toilet discharges directly to open ground	1.0							
T1A2C8 Septic tank connected to open ground	1.0			26.0	0.0	0.0		
T1A3C10 Fully lined tank (sealed), no outlet or overflow	10.0			64.0	87.0	95.0		
T1A3C8 Fully lined tank (sealed) connected to open ground	1.0			0.0	0.0	0.0		
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	11.0			15.0	38.0	95.0		
T1A4C6 Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	1.0			54.0	95.0	95.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0			46.0	23.0	95.0		
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	57.0			38.0	18.0	95.0		
T1A6C10 Unlined pit, no outlet or overflow	1.0			2.0	0.0	0.0		
T1B11 C7 TO C9 Open defecation	1.0							
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	2.0			20.0	0.0	0.0		
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	10.0			43.0	0.0	0.0		

Figure 23: SFD Matrix of Ratnanagar 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, 2023) . The information on FS emptied from containment is obtained from the survey and from KII with desludging service providers. An average 20% of the FS in the containment which is very thick and does not dissolve in water, is not removed during emptying (KII-2, 2023). Hence, actual proportion of FS emptied from each containment is calculated as:

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

Table 6 shows the actual proportion of FS emptied from each containment.

Table 6: 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[1]	Actual Proportion of Empited FS (F3)[2]
Toilet discharges directly to a decentralised combined sewer	T1A1C3	3%	0%	0%	0%
Toilet discharges directly to open ground	T1A1C8	1%	0%	0%	0%
Septic tank connected to open ground	T1A2C8	1%	33%	80%	26%
Fully lined tank (sealed) connected to open ground	T1A3C8	1%	0%	80%	0%
Fully lined tank (sealed), no outlet or overflow	T1A3C10	10%	80%	80%	64%
Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	T1A4C6	1%	67%	80%	54%
Lined tank with impermeable walls and open bottom, connected to open ground	T1A4C8	1%	57%	80%	46%
Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	11%	19%	80%	15%
Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	57%	48%	80%	38%
Unlined pit, no outlet or overflow	T1A6C10	1%	2%	80%	2%
Open defecation	T1B11 C7 TO C9	1%	0%	0%	0%

Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A4C10	2%	25%	80%	20%
Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A5C10	10%	54%	80%	43%

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. However, based on the (KII-1, 2023), WW from wards with sewer networks are connected to wastewater treatment plant (WWTPs). Therefore, considering 85% of WW is transported to the treatment plant and 95% efficiency of the WWTPs, the value for variables W4b is 85% and W5b is 95%.

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

The variable F4 is the proportion of FS that is delivered to treatment plant and F5 is the proportion of FS that is treated. Around 87% of FS in fully lined tank with no outlet or overflow (T1A3C1) is either delivered to WWTP or connected to biogas digester. The biogas digester is reclassified as fully lined tanks with no outlet or overflow. In addition, 95% of FS in lined tank with impermeable walls and open bottom connected to an open/stormwater drain (T1A4C6), 23% of FS in lined tank with impermeable walls and open bottom connected to an open ground (T1A4C8), 38% of FS in in lined tank with impermeable walls and open bottom with no outlet or overflow (T1A4C10) and 18% of FS in lined pit with semi-permeable walls and open bottom with no outlet or overflow (T1A5C10) is delivered to WWTP. Thus, the emptying proportion of FS for these systems are taken as F4 = 87%, 95%, 23%, 38% and 18% and the capacity of fully functioning WWTP and biogas digester is taken to 95% (F5 = 95%). Apart from biogas digester and FS delivered to WWTP, FS emptied from other sanitation technologies are applied in farmlands without treatment or simply disposed of through digging and dumping. Hence, the portion of FS delivered to treatment plant for the remaining technologies (F4) and treated (F5) is 0%.

2.3.5 Proportion of Supernatant in Open drain or Storm sewer delivered to Treatment Plant (S4e and S5e)

The variable S4e is the proportion of supernatant disposed in an open drain or storm sewer that is delivered to treatment plant and S5e is the proportion of supernatant that is delivered to treatment plant that is treated. The actual proportion of supernatant from the containment to open drain and stormwater drain is not able to be observed. Thus, the proportion is estimated at 50% of the faecal sludge in the containment connected to open drain and storm

sewer. While the proportion delivered to treatment plant (S4e) and treated (S5e) is nil as there is no treatment facility.

2.4 SFD Graphic

Figure 24 shows the SFD graphic of Ratnanagar 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 is shown in red coloured arrowhead. It shows that excreta from 62% of the population is safely managed, while excreta from 38% of the population is unsafely managed. It also represents the sanitation value chain going from left to right.

Offsite Sanitation

Ratnanagar Municipality has sewer networks in the wards 1, 2, 4 and 10 that are connected to WWTPs. Thus, around 4% of households have offsite sanitation systems. Mostly, the wastewater generated from these households is disposed to WWTPs, while a small proportion is disposed of in an open environment. Therefore, wastewater from 2% of the population is not treated, while the remaining 1% (which is WW not delivered to treatment plant) is unsafely disposed in an open environment.

Onsite Sanitation

In the municipality, 95% of households rely on onsite sanitation systems. Of the total households having an onsite sanitation system, FS from 79% of the population is contained, while FS from 16% of population is not contained.

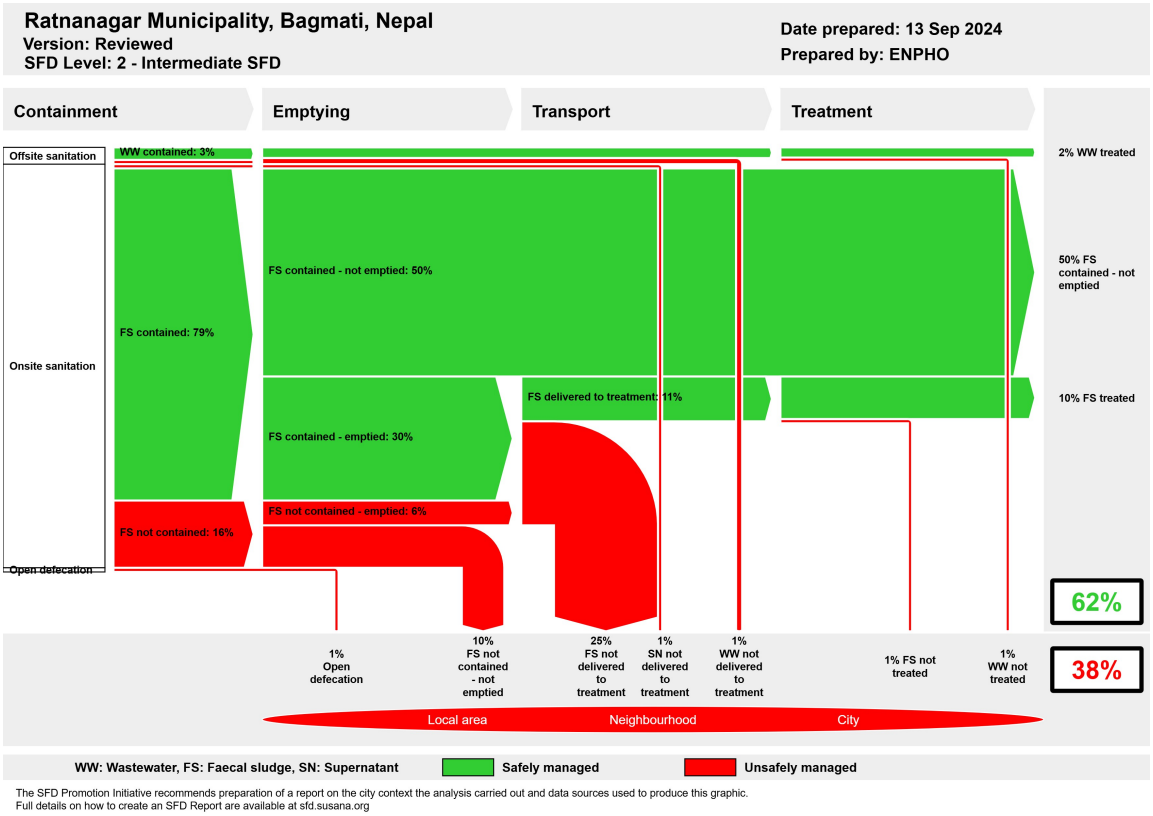

Figure 24: SFD Graphic of Ratnanagar Municipality.

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. 79%, 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), lined pits with semi-permeable walls and open with no outlet or overflow (T1A5C10) and unlined pit with no outlet or overflow (T1A6C10) without posing a significant risk to groundwater.

FS not Contained

The definition of 'FS not contained' is faecal sludge contained within an onsite sanitation technology which does not ensure safe level of protection from excreta i.e. pathogen transmission to the user or general public is likely. These are tanks or pits that are incorrectly designed, or poorly constructed, or poorly functioning, and/or are causing a 'significant' risk of polluting groundwater used for drinking (SuSanA, 2018).

The value of FS not contained i.e. 16% is obtained from the population using septic tanks connected to an open ground (T1A2C8), fully lined tanks connected to an open ground (T1A3C8), lined tanks with impermeable walls and open bottom connected to an open drain or storm sewer and open ground (T1A4C6 and T1A4C8), lined tank with impermeable walls and open bottom with no outlet or overflow with 'significant risk' to groundwater (T2A4C10), and lined pits with semi-permeable walls and open bottom with no outlet or overflow with 'significant risk' to groundwater (T2A5C10).

FS contained not Emptied

The value of 50% 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 30% is obtained from the proportion of population using sanitation systems where the FS is contained and have emptied their containment.

FS delivered to treatment

The proportion of FS delivered to treatment, i.e. 11%, is obtained from the FS contained that has been emptied and delivered to biogas digester and WWTP.

FS not contained emptied

The value of 6% is obtained from the proportion of the population using sanitation systems where the FS is not contained but have emptied their containment.

FS not contained not Emptied

The value of 10% 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. 25%, is obtained from the FS contained emptied and FS not contained emptied which have not been delivered to biogas digester and any treatment plants.

FS treated

In the municipality, 7% of households have biogas digester and HHs from wards 1, 2, 4 and 10 are connected to sewer network with WWTPs. Therefore, the amount of FS delivered to biogas digesters at households and the WWTP are treated. Thus, the proportion of FS treated i.e. 10% is obtained from fully lined tanks with no outlet or overflow (T1A3C10), lined tanks with impermeable walls and open bottom connected to an open/stormwater drain, to an open ground and with no outlet or overflow (T1A4C6, T1A4C8T and 1A4C10) and lined pits with semi-permeable walls and open with no outlet or overflow (T1A5C10) without posing a significant risk to groundwater.

FS not treated

The proportion of FS not treated, i.e. 1%, is obtained from the FS delivered to treatment plant but not treated.

Supernatant (SN) not delivered to treatment

The proportion of supernatant is obtained from containments connected to sewer networks, open drain or storm sewer. As all proportion of SN is not delivered to WWTP due to efficiency of the system, 1% of SN is not delivered to treatment.

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 and do not have toilet, or despite having toilets still lack in behaviour change have led to open defecation in the municipality.

3 Service delivery context

3.1 Policy, legislation, and regulation

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

Local Government Operation Act, 2017

Local Governance Operation Act 2017 was 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 was 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 to clean and quality drinking water, sanitation services and management of sewerage and wastewater. It defines sewerage and wastewater management as construction of sewer networks and treatment plants to preserve sources of water. It has entitled federal, provincial, and local level for the operation and management of water and sanitation services. The act also explicitly defines the responsibility of every citizen to preserve, conserve and maintain the sources of water and use responsibly.

Environment Friendly Local Governance Framework 2013

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

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

Institutional and Regulatory Framework for Faecal Sludge Management, 2017

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

Total Sanitation Guideline, 2017

Total Sanitation Guideline was promulgated by the Ministry of Water Supply in April 2017 after the successful implementation of National Sanitation and Hygiene master Plan (NSHMP) 2011. It provides guidelines for sustaining ODF outcomes and initiating post-ODF activities through an integrated water, sanitation and hygiene plan at municipalities and districts. The guideline redefined sanitation as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish a hygienic environment and promote public health. Indicators are set to guide total sanitation movement with an arrangement for resource management, monitoring and evaluation, capacity building.

3.2 Policies

Historically, the National Sanitation Policy (1994) was the guideline for the planning and implementation of sanitation programs. The policy had promoted sanitation issues together with issues on water supply in rural communities. Also, Rural Water Supply and Sanitation National Policy (RWSSNP) 2004, has set a new target to provide safe, reliable, and affordable water supply with basic sanitation facilities. The policy focused on delivering quality services on water and sanitation to the marginalised and vulnerable groups. However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery. Thus, the National Urban Water Supply and Sanitation Sector Policy (NUWSSSP) was formulated and enforced in 2009. It focused on achieving coherent, consistent, and uniform approaches of development in urban areas with the involvement of different agencies and institutions. Both these policies were limited to addressing emerging issues and challenges in the rural and urban areas. Thus, the National Water Supply and Sanitation Policy (NWSSP) was formulated in 2014 by GON to address the emerging challenges and issues with the adoption of new approaches and resolve the inconsistency in RWSSNP and NUWSSSP.

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

Nepal is a signatory of the historical resolution of 2010 United Nations General Assembly on the Human Right to Water and Sanitation. Nepal committed to Millennium Development Goals (MDGs) for 2000- 2015. The goal was accomplished through declaration of the country as free from open defecation on 30th September 2019. After the MDGs, United Nations General Assembly set 17 global goals as Sustainable Development Goals (SDGs). Sanitation is prioritised on SDG 6. The target 6.2 of SDG 6 majorly focuses on sanitation. It mentioned to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations by 2030. In line with SDG 6.2, Nepal has targeted to provide improved sanitation to 95% households that are not shared, and urban households with toilets connected to sewer system or proper FSM to 90% by 2030 (NPC, 2017). National Sanitation and Hygiene Master Plan, 2011 was developed for coordinated planning and implementation of National Sanitation Campaign. The campaign strengthened institutional setup tier of government in a participatory approach. In an alignment, total sanitation campaign was initiated formally to sustain ODF. The guideline set various indicators to assess the sustainability of sanitation services. Remarkably, it extended sanitation definition as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish the hygienic environment and promote public health (NPC, 2017).

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

3.3 Institutional roles

Federal, provincial, and local government are entitled for implementation of water and sanitation programs to ensure the rights on access to safe water and sanitation.

At Federal Government

National Planning Commission: At the federal government, the National Planning Commission is the specialised and apex advisory body for formulating a national vision, developing policy, periodic plans, and sectoral policies. The NPC assesses resource needs, identifies sources of funding, and allocates budget. It serves as a central agency for

monitoring and evaluating development policy, plans and programs. It supports, facilitates, and coordinates with federal, provincial, and local government for developing policy plans and implementation.

Ministry of Water Supply: Ministry of Water Supply is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015) . Under the MoWS, the Department of Water Supply and Sewerage Management (DWSSM) plans and implements water and sanitation projects funded by foreign donors or inter provincial projects or serves at least 15,000, 5,000 and 1,000 people in terai, hilly and mountain region respectively (GoN, 2015). The organisational structure of DWSSM is shown in Figure 25.

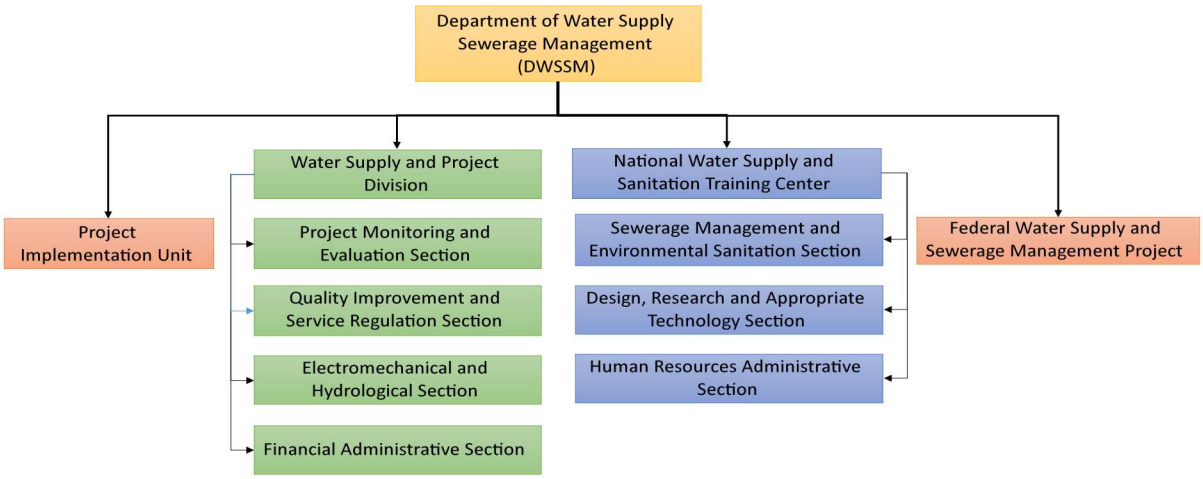

Figure 25: Organisational Structure Department of Water Supply and Sewerage Management (DWSSM).

Ministry of Urban Development: The Ministry of Urban Development (MoUD) works on integrated urban planning and development in municipalities, including faecal sludge management. Department of Urban Development and Building Construction (DUDBC) under MoUD is the implementing body and sets the standards for safe, affordable building construction and implementation for managed residential environment.

At Provincial Level

Ministry of Water Supply, Energy and Irrigation: Ministry of Water Supply, Energy and Irrigation of provincial government in Bagmati 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 Ratnanagar Municipality is executed through Water Supply and Sanitation Division (WSSD), Makawanpur. WSSD 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

The Forest, Environment Disaster Risk Management and Sanitation Section in the Ratnanagar Municipality is responsible for overall management of water supply and

sanitation. This section oversees all the planning and operation related to forest, environment, water supply, sanitation and disaster risk management.

3.4 Service provision

Urban Water Supply and Sanitation Policy 2009 has emphasised the Public-Private Partnership (PPP) in water supply and sanitation to improve service delivery (MoPIT, 2009). Also, Public-Private Partnership Policy, 2015 encourages private sector investment in the development and operation of public infrastructure services for comprehensive socioeconomic development. The policy has aimed to remedy challenges such as structuring of projects, land acquisition, coordination and approval, payments to private sector and approval for environment impact (MoF, 2015).

The toilet system is directly connected to open drain, water bodies or open ground. The toilets that are connected to containments are emptied mechanically by desludging suction truck from municipality or private service providers, whereas others are manually emptied by traditional desludgers.

3.5 Service standards

The sanitation service standards have been set by Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030). It classifies sanitation services as high, medium, and basic based on sanitation facilities in place. The sanitation service levels with indicators are shown in Table 7. However, FSM specific standards have yet to be developed and implemented.

Table 7: Sanitation Service Level and its Components.

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

4 Stakeholder Engagement

4.1 Key Informant Interviews

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 persons at the municipality were 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 the caretaker of public toilet along with observation to find sanitation status and management practice of public toilet. The list of stakeholders and pictures of KIIs are presented in the Table 8 and Figure 26.

Table 8: List of Key Informant Interviewed personnel.

S.N.	Name	Designation	Organisation/Company	Purpose of KII	Date
1.	Ram Rimal (KII-1)	Environment Section Coordinator	Ratnanagar Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	1 June, 2023
2.	Pankaj Giri (KII-1)	Engineer	Ratnanagar Municipality	Sanitation status, ongoing projects on sanitation, policies and plan for sanitation development	1 June, 2023
3.	Narayan Chaudhary (KII-2)	Owner	Private Desludging Service Provider	Emptying practices, finances requirement, disposal and treatment	1 June, 2023
4.	Jayram Chaudhary (KII-2)	Owner	Private Desludging Service Provider	Emptying practices, finances requirement, disposal and treatment	1 June, 2023
5.	Bisnu Prasad Ghimire (KII-2)	Owner	Private Desludging Service Provider	Emptying practices, finances requirement, disposal and treatment	2 June, 2023
6.	Kamal Khatiwada (KII-3)	Manager	Ratnanagar Water and Sanitation Users' Committee	Water supply services and water quality in Ratnanagar Municipality	1 June, 2023
7.	(KII-4)	Caretaker	Public toilet-Saurahachowk	Quantitative and qualitative management on public toilet and public toilet operation	2 June, 2023

Figure 26: KII with municipal representatives and representatives of Ratnanagar WSUC.

4.2 Household Survey

A random household survey was conducted in all wards of the municipality. The local enumerators selected from the municipality were oriented prior to the survey and were mobilised for data collection. A mobile application "KOBOCOLLECT" was used for data collection from the households. In the orientation, enumerators were clarified on survey objectives, technical terms concerning sanitation, use of the mobile application, and the procedure of random sampling survey based on the provided map (Figure 27).

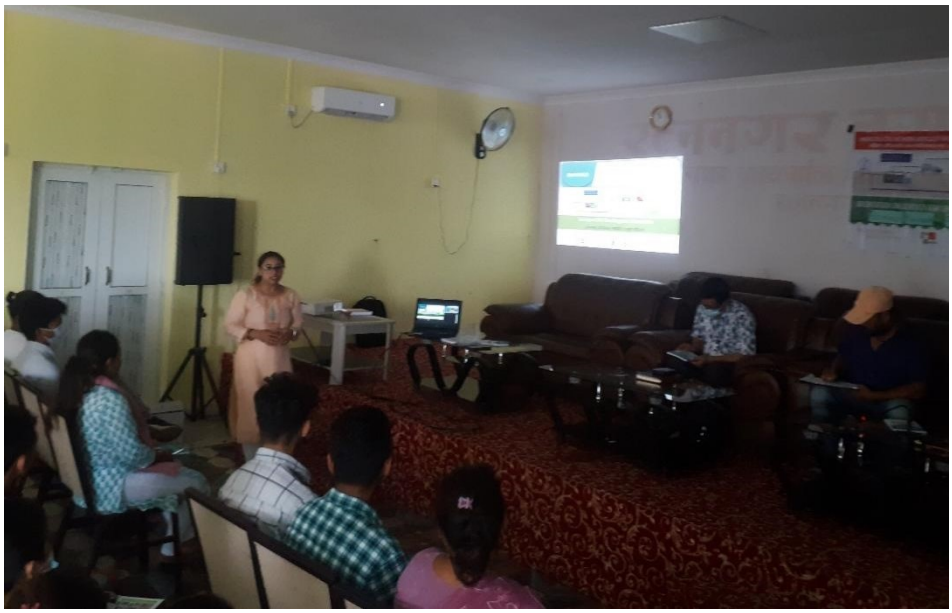

Figure 27: SFD orientation to local enumerators for data collection.

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	+/-3%	Level of precision or sampling error.
N		A total number of population (households in the municipality).

This was followed by proportionate stratification random sampling such that each ward in the municipality was considered as one stratum. The sample sized required in each ward was calculated as

$n_h = (N_h/N)*n$, where N_h is a total population in each stratum.

A total of 586 households were sampled from 22,403 households distributed in 16 wards with proportionate stratification random sampling. The household samples surveyed in the municipality is shown in Figure 28.

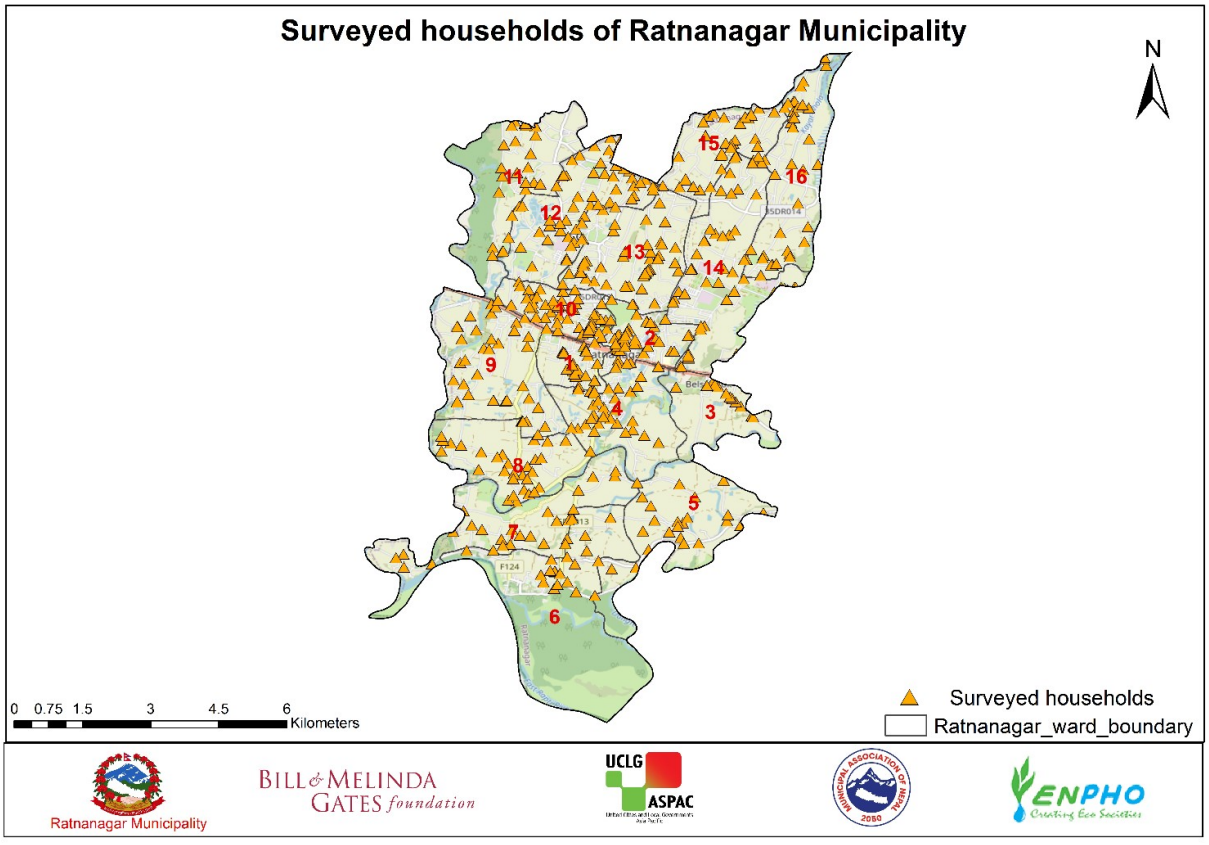

Figure 28: Location map of surveyed households.

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 transportation of faecal sludge were carried out. Figure 29 shows desludging of FS from manhole of sewer network using the municipal desludging vehicle in Ratnanagar Municipality.

Figure 29: Desludging from manhole by municipal desludging vehicle.

4.4 Sharing and Validation of Data

The Shit Flow Diagram Sharing and Validation Workshop was conducted at Ratnanagar Municipality to share the findings on sanitation situation survey and receive the suggestions from the municipal stakeholders. Altogether, 32 participants including Mayor, Deputy Mayor, CAO, ward chairpersons, municipal council members, sectoral staffs and other relevant stakeholders actively participated on the workshop and provided valuable suggestions. Participants recognised the pressing need on FSM in the municipality and agreed to keep it as an agenda for municipal planning meeting. Figure 30 shows the picture of SFD findings sharing to the participants. The list of participants with their designation is attached in Appendix 4.

Figure 30:Sharing of findings during validation workshop.

5 Acknowledgements

We would like to acknowledge the executing agency, United Cities and Local Governments 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. Pralhad Sapkota, Mayor, Mr. Yadav Prasad Pathak, Deputy Mayor, Mr. Chhabilal Subedi, CAO and Mr. Sujan Aryal, IT Officer of the Ratnanagar 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.

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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.

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7 Appendix Annexes

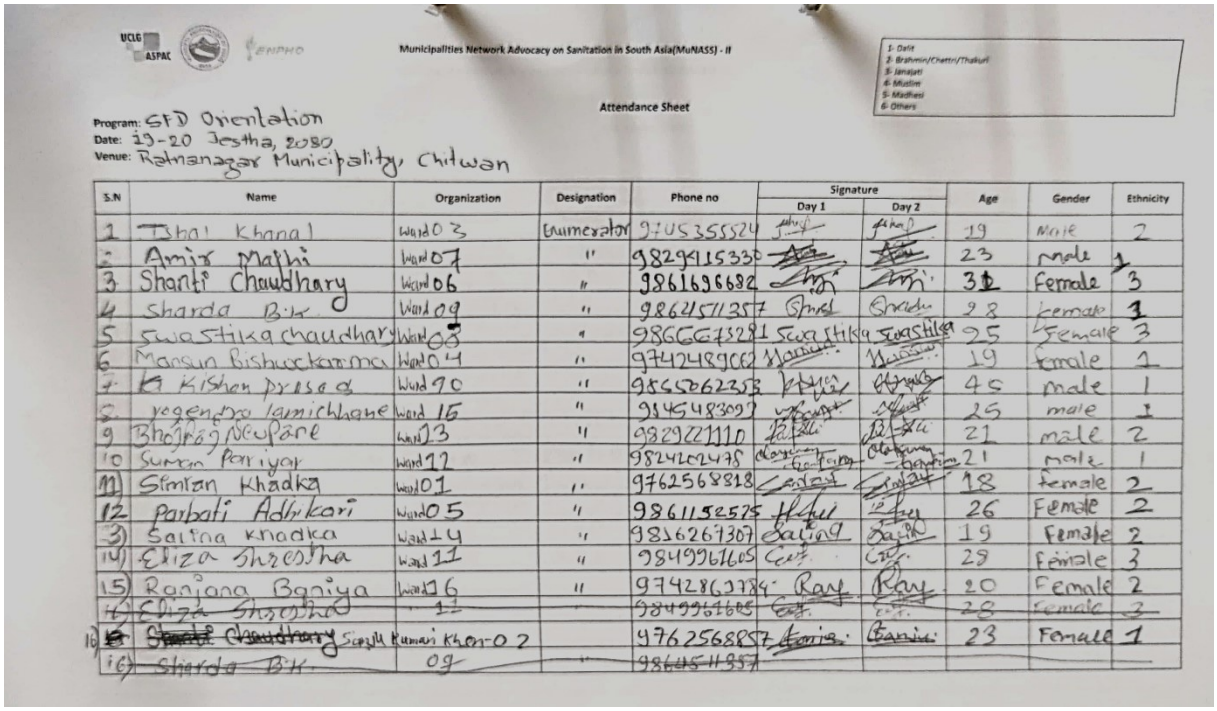
7.1 Appendix 1: Roles and Responsibility of Various Tiers of Governments Delineated in Drafted SDP 2016 – 2030

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	5,635	1,428	37
2	5,330	1,340	35
3	5,039	1,236	32
4	4,484	1,101	29
5	4,008	955	25
6	4,035	977	25
7	3,631	863	23
8	4,682	1,110	29
9	5,879	1,458	38
10	8,241	2,128	56
11	4,779	1,205	32
12	7,439	1,923	50
13	8,749	2,223	58
14	6,690	1,684	44
15	6,325	1,554	41
16	4,959	1,218	32
Total	**89,905**	**22,403**	**586**

7.3 Appendix 3: List of Participants on SFD Survey Orientation



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

Attendance Sheet

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

Program: SFD Orientation
Date: 19-20 Jestha, 2080
Venue: Ratnanagar Municipality, Chitwan

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Age	Gender	Ethnicity
1	Ishal Khanal	Ward 03	Enumerator	9705355524			19	Male	2
2	Amir Mathi	Ward 07	"	9829115330			23	male	1
3	Shanti Chaudhary	Ward 06	"	9861696682			31	Female	3
4	Sharda B.K	Ward 09	"	9862511357			28	Female	1
5	Swastika chaudhary	Ward 03	"	9866673281			25	Female	3
6	Mansun Bishwokarma	Ward 04	"	9742489662			19	female	1
7	Kishan prasad	Ward 10	"	9855862358			45	male	1
8	regendra lamichhane	Ward 16	"	9845483097			25	male	1
9	Bhojraj Neupane	Ward 13	"	9829221110			21	male	2
10	Suman Pariyar	Ward 12	"	9824202478			21	male	1
11	Simran Khadka	Ward 01	"	9762568818			18	female	2
12	Parbati Adhikari	Ward 05	"	9861152575			26	Female	2
13	Saina Khadka	Ward 14	"	9816267307			19	Female	2
14	Eliza Shrestha	Ward 11	"	9849961605			28	Female	3
15	Ranjana Baniya	Ward 16	"	9742861784			20	Female	2
16	~~Eliza Shrestha~~	~~11~~	~~"~~	~~9849961605~~			~~28~~	~~Female~~	~~3~~
17	~~Sharda Chaudhary~~ Sagun Kumari Khanal	02	"	9762568857			23	Female	1
18	~~Sharda B.K~~	~~09~~	~~"~~	~~9862511357~~					

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

आज मिति २०८० साल पौष १८ गतेका दिन रत्ननगर 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 छलफल र प्रमाणीकरण कार्यशाला कार्यक्रममा निम्न अनुसार मुख्य सरोकारवालाहरुको सहभागिता रह्यो ।

उपस्थिति :

क्र.सं.	नाम	कार्यालय	पद	फोन नं.	हस्ताक्षर
१.	प्रल्हाद सापकोटा	रत्ननगर नगरपालिका	नगर प्रमुख	९८५५०६२६५३	[illegible]
२.	यादव प्रसाद पाठक	रत्ननगर नगरपालिका	नगर उप-प्रमुख	९८५५०६६४१७	[illegible]
३.	सुकदेव लम्साल	रत्ननगर नगरपालिका	प्र. प्र. अ	९८५५०१४१११	[illegible]
४.	माधव प्रसाद पर्याल	रत्नागर खानेपानी	अध्यक्ष	९८५८०२६८२१	[illegible]
५)	डोमनाथ रानामगर	रत्ननगर १४	वडा अध्यक्ष	९८५५०६१८५१	[illegible]
६	कलाधर पौडेल	र.न. पा १०	" "	९८५५०६१८८८	[illegible]
७	अनन्त अधिकारी	र.न.पा ५	" "	९८४५०२६४८१	[illegible]
८)	राजेन्द्र थापा	र.न.पा. २	कार्यवाहक/वडा	९८४५०६८८२३	[illegible]
९)	धर्मेन्द्रराज बेरल	" ३	वडा अध्यक्ष	9845109223	[illegible]
१०	कुडन चौधरी	र.न पा ८	वडाअध्यक्ष	९८४५०४४४३	[illegible]
११.	शेर ब. श्रेष्ठ	र. न. पा. १३	वडा अध्यक्ष	९८५५०६६६१०	[illegible]
१२	माधव कडरिया	नारायणी मिडिया (कलेज ७३९४)	पत्रकार	9855049688	[illegible]
१३	सजना महतो	र.न.पा ६	वडा अध्यक्ष	९८४५०६४०५६	[illegible]
१४	बालकृष्ण बाँस्तोला	र.न.पा - ४	वडा अध्यक्ष	९८५५०६२६६३	[illegible]
१५	सुन्दरमणि दवाडी	र.न.पा १२	" "	९८५५०४९६९४	[illegible]
१७.	विश्वास पन्त	र.न.पा.	कार्यक्रम अधिकृत	९८४५१४०१२४	[illegible]
१८	विनय आचार्य	चितवन आवाज दैनिक भरतपुर चितवन	पत्रकार	9855077262	[illegible]

क्र.सं	नाम	कार्यालय	पद	फोन नं.	हस्ताक्षर
१९	पंकज तिवारी	र.न.पा.	इन्जिनियर	९८५५०१५०५६	[illegible]
२०	शानु भण्डारी (बल्ले)	र.नं.पा.	कार्यपालिका स	९८४१६१[illegible]	[illegible]
२१	चन्द्रकला परियार	र.न.पा.	कार्यपालिका	९८४४९८०९६३	[illegible]
२२	तुलमाया वि.क	र.न.पा	का.पा.स	९८४४४६५३६६	[illegible]
२३	ललिता चौधरी	र.न.पा.	का.पा.स	९८४५१६३१८३	[illegible]
२४	किरण महतो	र.न.पा-६	वडा अध्यक्ष	९८४५०४४२१४	[illegible]
२५	केशव प्र. भट्टराई	र.न.पा.	प्रेस संयोजक	९८४५०६४५६	[illegible]
२६	सबिता अर्याल	रनपा	अ. जाती	9855092202	Sabita
२७	रमामाया रेग्मी	र.न.पा.	अ: छोरी	984658382	Rama
२८	श्यामकुमार श्रेष्ठ	रत्ननगर-११	वडाध्यक्ष	९८५५०८०६६	[illegible]
२९	कृष्णप्रसाद खापकोटा	र.न.पा.७	वडा अध्यक्ष	९८५५०६३२८६	[illegible]
३०	सुरी ब० तमाङ	र.न.पा-८	वडा सदस्य	९८५५०८६६४३	[illegible]
३१	यशोदा अधिकारी	र.न.पा. ११	कार्यपालिका सदस्य	९८५५०६११००	[illegible]
३२	खड्ग ब० बस्नेत	र.नपा - १०	नगर प्रहरी	९८६५४५८६६१	[illegible]
३३	अनिता भुजु	ENPHO	A.P.O.		[illegible]
३४	बुद्ध वज्राचार्य	एन्फो	PC		[illegible]

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