SFD Report

Birgunj Metropolitan City
Nepal

Final Report

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

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SFD Report Birgunj Metropolitan City, Nepal, 2023

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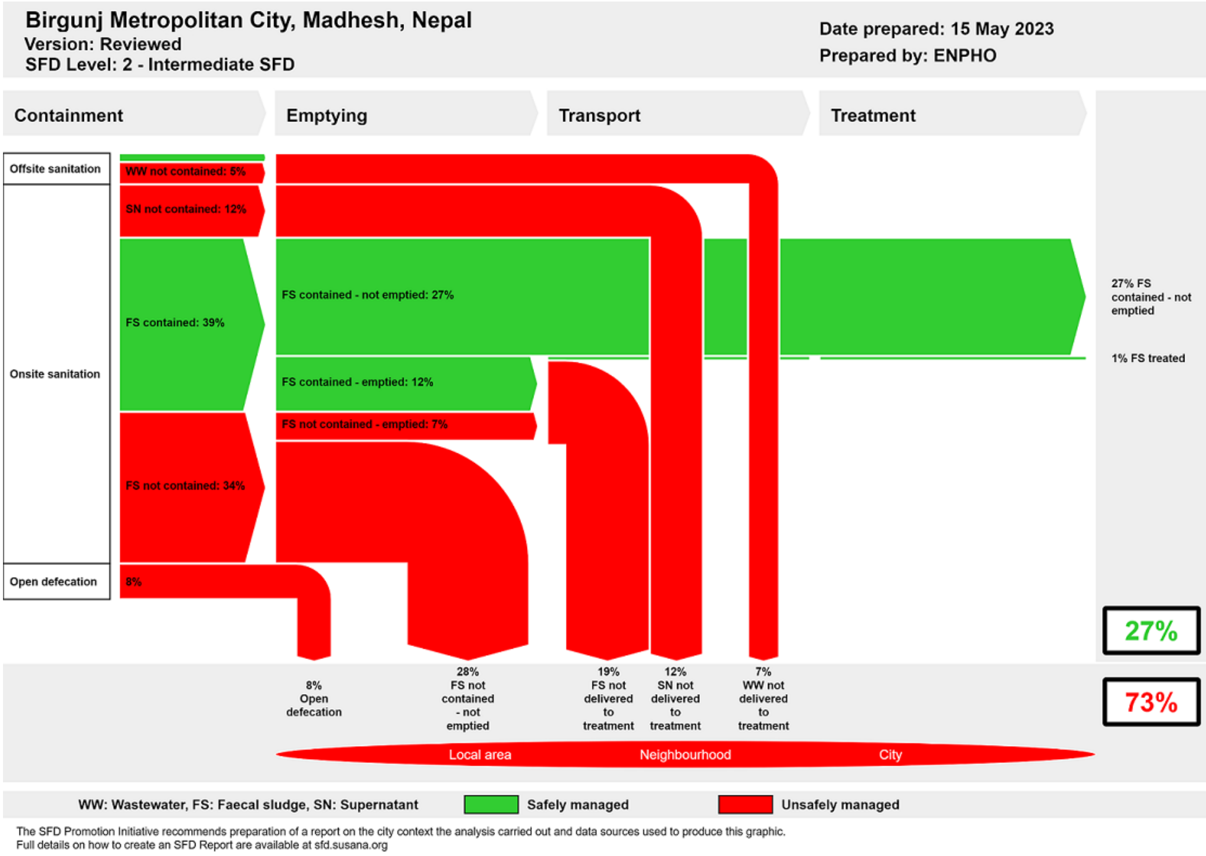
1. The SFD Graphic



2. Diagram information

SFD Level:

This SFD is a level 2 - Intermediate report.

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Birgunj Metropolitan City, Municipal Association of Nepal (MuAN), United Cities and Local Government – Asia Pacific (UCLG-ASPAC).

Status:

Final SFD Report.

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3. General city information

Birgunj Metropolitan City is located in the Parsa District, Madhesh Province of Nepal, near the southern border with India. The metropolitan city was formed on 14 April 2017 by merging several local administrative units, including Birgunj Municipality, Pokhariya Municipality, and Adarsh Kotwal Rural (Birgunj Metropolitan City, 2023).

Birgunj has a total population of 272,382 with 47,114 households and a family size of 5.7. The average monthly temperature remains above 18°C (64°F) throughout the year. Summers are typically hot and humid, while winters are milder. The average annual precipitation in Birgunj is reported to be around 1,200 to 1,500 mm (47 to 59 inches) (Climate Data, s.f.).

The geographical coordinates of the metropolitan city are approximately 27.0130° N, 84.8776E. The city's elevation is 85 metres (280 feet) above sea level (Birgunj Metropolitan City, 2023).

4. Service outcomes

This section provides a quick summary of the various sanitation systems used across the metropolitan sanitation value chain (ENPHO, 2023). Despite the metropolitan city was declared as an open defecation free zone, still 8% of the total population are deprived from access to basic sanitation facilities and defecate in open places.

Families with access to sanitary facilities rely on both offsite and onsite sanitation. In Birgunj, 85% of the households have a connection to an onsite sanitation system, 7% of the households have connection to offsite sanitation, among which only 2% have connection to the sewerage network while the remaining have connection to stormwater or open drainage. Despite the presence of a Wastewater Treatment Plant (WWTP) in the metropolitan city, the sewerage network is not connected to it. Instead, wastewater from the sewerage network is discharged untreated into two rivers – Sirsiya in the west and Singha in the east.

Containment:

Population residing in 23% of households use septic tanks, 35% have fully lined tanks (with an small percentage using biogas digesters modelled as fully lined tanks), 9% of people utilize lined tanks with impermeable walls and open bottom, 17% use lined pits with semi-permeable walls and open bottom and 1% use unlined pits. Since installation, only 33.3% of containments have been emptied at least once.

Emptying and Transportation:

Mechanical emptying is most popular in the metropolitan area, while manual emptying is still in practice. For mechanical emptying, both municipal and private desludgers are readily available to provide the service.

Treatment and Disposal:

The WWTP in the metropolitan city is not functional as connections have not been established from sewerage networks and stormwater drainages to the WWTP. There is practice of emptying the transported and untreated FS on agricultural land on demand or barren land near the river.

In the metropolitan city, groundwater is major source of drinking water. However, small percentage of population also depends of water service providers for drinking water. Nepal Water Supply Corporation (NWSC) Birgunj Branch provides piped drinking water supply in the majority of wards within the metropolitan.

People who use open-bottom tanks and handpumps with a horizontal distance of less than 25 feet (7 m) from the source of pollutants and a depth of up to 100 feet (30 m) are thought to be at significant risk of groundwater pollution. 1% of the households who have installed lined pits with semi permeable walls and open bottom are at high risk of ground water contamination as they pumped through handpump for water consumption.

Public Toilets (PTs) are installed for commuters to achieve and sustain open defecation-free status in the metropolitan. There are more than six public toilets installed to serve the floating population and travellers of the metropolitan. Some are well maintained and functional, while some are poorly managed.

Overall, the SFD graphic shows that 27% of the excreta generated are safely managed while 73% of the excreta generated are unsafely managed. The safely managed percentage of FS generated by 27% of the population is temporary until the tanks and pits become full and FS from the containment is emptied.

5. Service delivery context

The Constitution of Nepal 2015 in Article 35 related to right to health recognizes citizen's rights to 'access to clean drinking water and sanitation'. In addition, the Right to Clean Environment, Article 30 recognizes that every person shall have the right to live in a healthy and clean environment. (GoN, 2015) To respect, promote and fulfil the provisions related to right on water and sanitation, Government of Nepal has billed Drinking Water and Sanitation Act, 2019 through Ministry of Water Supply. The act elaborates the right to clean water as to receive affordable, sufficient, and quality drinking water regularly as well as access to sanitation as affordable access to quality sanitation services. (MoWS, 2017)

Several policies have been in place to accomplish the sanitation needs of people. Particularly, the National Sanitation and Hygiene Master Plan (NSHMP) 2011 has proved as an important strategic document for all stakeholders to develop uniform programs and implementation mechanism at all levels. It strengthens institutional set up with the formation of water and sanitation coordination committee at every tier of government to actively engage in sanitation campaigns. The document adopted sanitation facilities as improved, basic, and limited in line with WHO/UNICEF guidelines. The sanitation campaign throughout the country focused on achieving universal access to improved sanitation (NPC, 2020).

The draft Sector Development Plan (SDP) has envisioned the delineation of roles and responsibility of federal, provincial, and local government in an aim to initiate sustainability of Open Defecation Free (ODF) outcomes.

It is the duty and responsibility of the Birgunj Metropolitan City to improve access to accessible, safe and sustainable drinking water and sanitation services to the people of the municipal area as mentioned in chapter 3 of the Local Government Operation Act 2074 under the title of municipal work, duties and rights; the policy, laws, standards, plan implementation and regulation related to local water supply mentioned in sub-section D of section 11. In order to implement this responsibility, water supply, sanitation and hygiene plan and policy has become essential. Development without planning and estimation will not lead to the expected success in the areas of access to water and sanitation (UNICEF, 2020).

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 / Organizations
Public Institutions at Local Government	Birgunj Metropolitan City.
Non-governmental Organizations	Environment and Public Health Organization (ENPHO).
Private Sector	NWSC, Private FS Emptying and Desludging facility providers, public toilet operators.
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC.

7. Credibility of data

Primary data were collected from random household sampling. Altogether, 1044 households and 123 institutions were surveyed from thirty-two wards of the metropolitan area (ENPHO, 2023). Primary data on emptying, transportation and current sanitation practices in the metropolitan city were validated from Key Informant Interviews (KIIs) with private desludgers, public toilet management, sanitation, and environmental section. The overall data and findings were shared with the stakeholders of the metropolitan area and validated through a sharing program.

8. Process of SFD development

Data on sanitation situation were collected through household and institutional surveys. Enumerators from the metropolitan city were mobilized after providing orientation on sanitation technologies, objectives of the survey and proper use of mobile application, KOBOCOLLECT for collection of data for the survey. Along with this, KIIs were conducted with officers of municipality, private desludging service providers and engineer of International non-governmental organizations (INGO) to understand the situation practices across the service chain. Data were entered into the SFD graphic generator to produce the SFD graphic.

8. List of data sources

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

- Climate Data. (s.f.). Obtenido de Climate-Data.org: https://en.climate-data.org/asia/nepal/far-western-development-region/dipayal-silgadhi-1025266/
- ENPHO. (2023). Assessment of Sanitation status of Birgunj Metropolitan City.
- GoN. (2015, September 30). Constitution of Nepal: Goverment of Nepal. Retrieved from https://lawcommission.gov.np/en/wp-content/uploads/2021/01/Constitution-of-Nepal.pdf
- 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/
- MoWS. (2017). Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030). Ministry of Water Supply.

- City, B. M. (May de 2023). Birgunj Metropolitan City. Obtenido de birgunjmun.gov.np: https://birgunjmun.gov.np/en/content/brief-introduction
- NPC. (2020). National Review of Sustainable Development Goal. Kathmandu Nepal: National Planning Commission.

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Abbreviations

BMGF	Bill and Melinda Gates Foundation
CAO	Chief Administrative Officer
DUDBC	Department of Urban Development and Building Construction
DWSSM	Department of Water Supply and Sewerage Management
ENPHO	Environment and Public Health Organization
FS	Faecal Sludge
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
GDP	Gross Domestic Product
GON	Government of Nepal
HH	Household
IRF	Institutional and Regulatory Framework
JMP	Joint Monitoring Programme
KII	Key Informant Interview
KM	Kilometres
MM	Milometers
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
MoUD	Ministry of Urban Development
MTEF	Medium-Term Expenditure Framework
MuNASS-II	Municipalities Advocacy on Sanitation in South Asia – II
NGO	Non-Governmental Organization
NRS	Nepali Rupees
NWSC	Nepal Water Supply Corporation
NSHMP	Nepal Sanitation and Hygiene Master Plan
NUWSSSP	National Urban Water Supply and Sanitation Sector Policy
NWSSP	National Water Supply and Sanitation Policy
ODF	Open Defecation Free
RCC	Reinforced Cement Concrete
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
SMC	Sub-metropolitan City
UCLG ASPAC	United Cities Local Government – Asia Pacific
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

WSP	Water Service Providers
WSSDO	Water Supply and Sanitation Divisional Office
WSUC	Water and Sanitation Supply and User's Committee
WW	Wastewater

1. City context

Birgunj Metropolitan City is located in the Parsa District, Madhesh Province of Nepal, near the southern border with India. Birgunj Metropolitan City was officially formed on 14 April 2017. It was created by merging several local administrative units, including Birgunj Municipality, Pokhariya Municipality, and Adarsh Kotwal Rural Municipality. The total area of Birgunj Metropolitan City is approximately 44.56 square kilometres (17.21 square miles). This area includes urban, suburban, and rural areas that were part of the merged local administrative units (Birgunj Metropolitan City, 2023). Figure 1 shows the ward boundary map of Birgunj Metropolitan City.

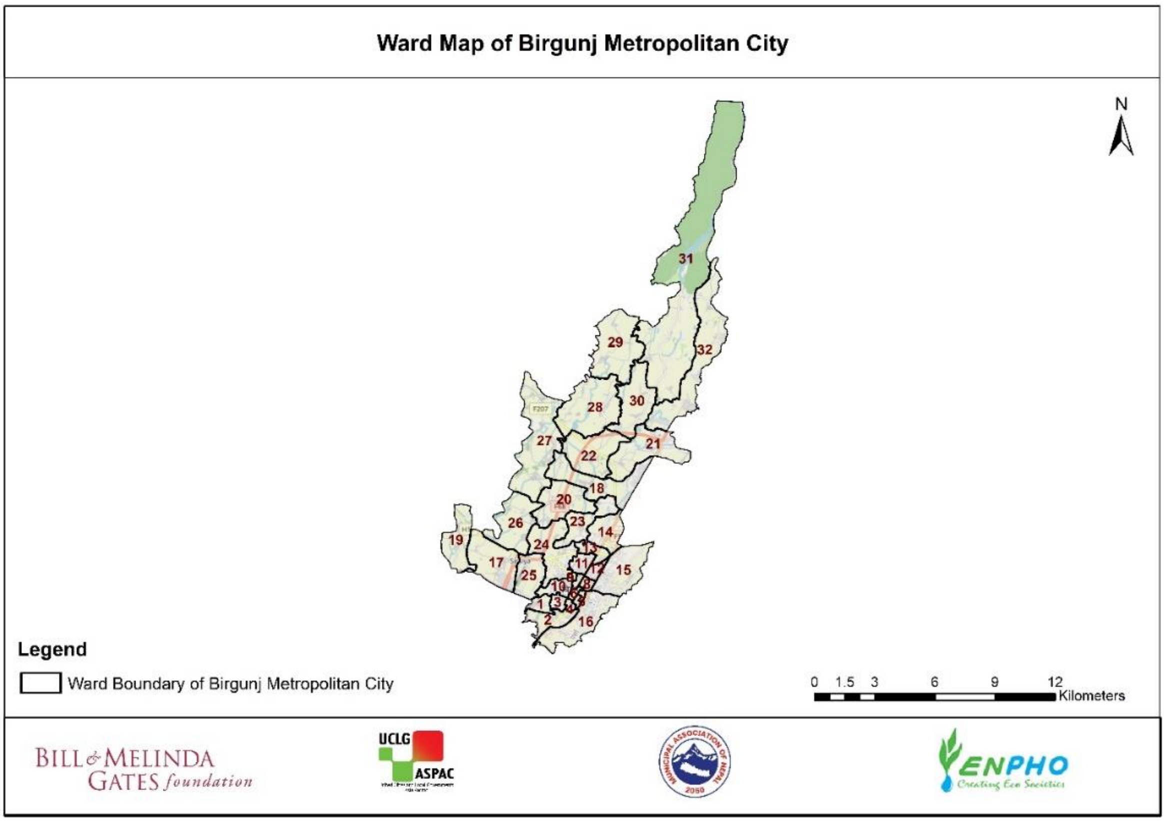

Figure 1: Map of Birgunj Metropolitan City with ward boundaries.

1.1 Population

The total population of the metropolitan city is 272,382 living in 47,114 households, with male and female population percentage of 52.2% and 47.8%, respectively. With the population density of 2,062, the family size of the city is 5.7 (Statistics, 2021). Ward-wise population distribution in the metropolitan city is shown in Table 1 (Statistics, 2021).

Table 1: Ward wise population of Birgunj Metropolitan City.

Ward	Population 2021	Male	Female
1	8,841	4,551	4,290
2	9,281	4,728	4,553
3	7,604	3,976	3,628
4	3,288	1,649	1,639
5	4,440	2,295	2,145
6	3,564	1,843	1,721
7	4,141	2,197	1,944
8	5,008	2,559	2,449
9	4,133	2,202	1,931
10	14,943	7,990	6,953
11	14,718	7,757	6,961
12	9,499	4,924	4,575
13	12,193	6,343	5,850
14	12,667	6,539	6,128
15	15,768	8,364	7,404
16	21,375	11,340	10,035
17	9,765	5,081	4,684
18	8,198	4,362	3,836
19	5,971	3,094	2,877
20	7,648	3,999	3,649
21	8,426	4,410	4,016
22	4,797	2,485	2,312
23	5,343	2,809	2,,534
24	10,277	5,488	4,789
25	4,362	2,320	2,042
26	6,509	3,262	3,247
27	7,400	3,885	3,515
28	7,380	3,843	3,537
29	7,858	4,052	3,806
30	5,138	2,637	2,501
31	1,0444	5,367	5,077
32	11,403	5,847	5,556
Total	**272,382**	**142,198**	**130,184**

Table Source: (Statistics, 2021)

Figure 2 shows the population density in different wards of Birgunj where it can be observed that wards number 3, 4, 5, 6, 7, 8, 9, 10 and 11 have high population density as compared to other wards of the city.

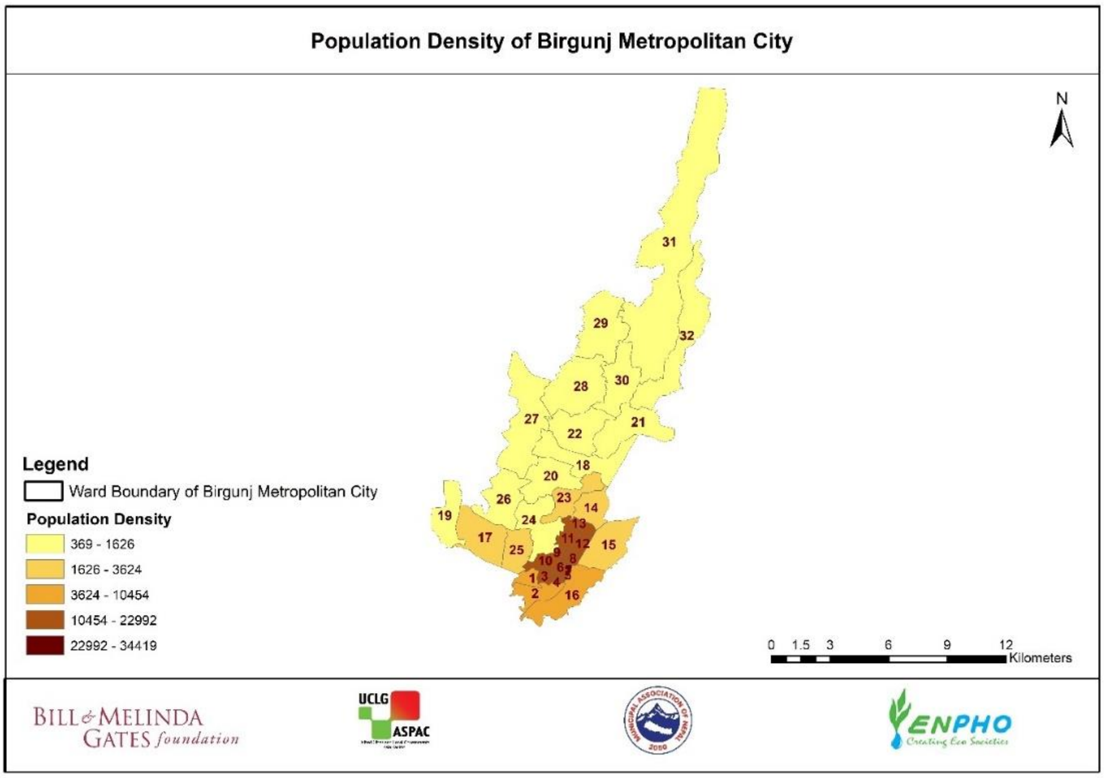

Figure 2: Population Density Map of Birgunj Metropolitan City.

1.2 Climate

Birgunj experiences high temperatures throughout the year, with relatively small variations. The average monthly temperature remains above 18°C (64°F) throughout the year. Summers are typically hot and humid, while winters are milder. Birgunj has a distinct wet and dry season. The majority of the rainfall occurs during the monsoon season, which typically spans from June to September. During this period, heavy rainfall and thunderstorms are common. The remaining months, especially the winter months, experience significantly less precipitation. The city receives most of its annual rainfall during the months of June, July, and August. The average annual precipitation in Birgunj is reported to be around 1,200 to 1,500 mm (47 to 59 inches) (Climate Data, s.f.).

1.3 Topography

The city is in the flat plains of Southern Terai Region of the country, which are formed by alluvial deposits brought by rivers. These plains are generally level and suitable for agriculture. The geographical coordinates of the metropolitan city are approximately 27.0130° N, 84.8776° E. Birgunj has a relatively low elevation compared to the mountainous regions of Nepal. The city's elevation is reported to be around 85 metres (280 feet) above sea level (Birgunj Metropolitan City, 2023).

2 Service Outcomes

2.1 Overview

The Joint Monitoring Programme (JMP) defines improved sanitation facilities as those designed to hygienically separate excreta from human contact (WHO, s.f.).In Birgunj Metropolitan City, people residing in 92.2% of households have access to a toilet. In the present context, the category of sanitation provision has seemingly improved from not having toilets in houses through to building a storage facility to contain Faecal Sludge (FS) produced at household level. Birgunj Metropolitan City achieved Open Defecation Free (ODF) status on 26th September 2019. Despite being declared as ODF city, people residing in 7.8% of households in wards number 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 29, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27 and 29 do not have access to basic sanitation facilities and defecate openly.

Data on sanitation situation were collected through household and institutional surveys (ENPHO, 2023). A total of 1,044 households were sampled from 47,144 households distributed in 32 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 reviews, Key Informant Interviews (KIIs) and a validation workshop is presented in this section.

2.2 Household Level Sanitation System

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). An offsite sanitation system relies on sewer technology for conveyance (Tilley, s.f.). In Birgunj, 85% of the households have connection to onsite sanitation system, 7% of the households have connection to offsite sanitation, among which, 2% have connection to sewerage networks and 5% have connection to stormwater/open drainage. 8% households do not have access to toilet and go for open defecation.

Types of Offsite Sanitation Systems

2.2.1 Sewerage Networks

The combined sewerage systems in Birgunj mainly consist of a network with a main trunk sewer that has a main, branch and lateral sewers. There are two major sewerage catchments divided by the Tribhuvan Highway, one is western part of Birgunj city under Sirsiya catchment and other one is eastern part under Singha River catchment. Major core area falls under western part (Sirsiya) catchment. The total length of sewerage network is 15.3 kilometres (km) which serves approximately 2% of total population in the Metropolitan City ((STIUEIP), Final Report of Sewerage Drainage, 2013).

Despite the presence of a Wastewater Treatment Plant (WWTP) in the metropolitan city, sewerage networks are not connected to it. Instead, wastewater (WW) from the sewerage network is discharged into two rivers – Sirsiya in the west and Singha in the east. Figure 3 below shows the distribution of households connected to the sewerage network as observed during the household survey.

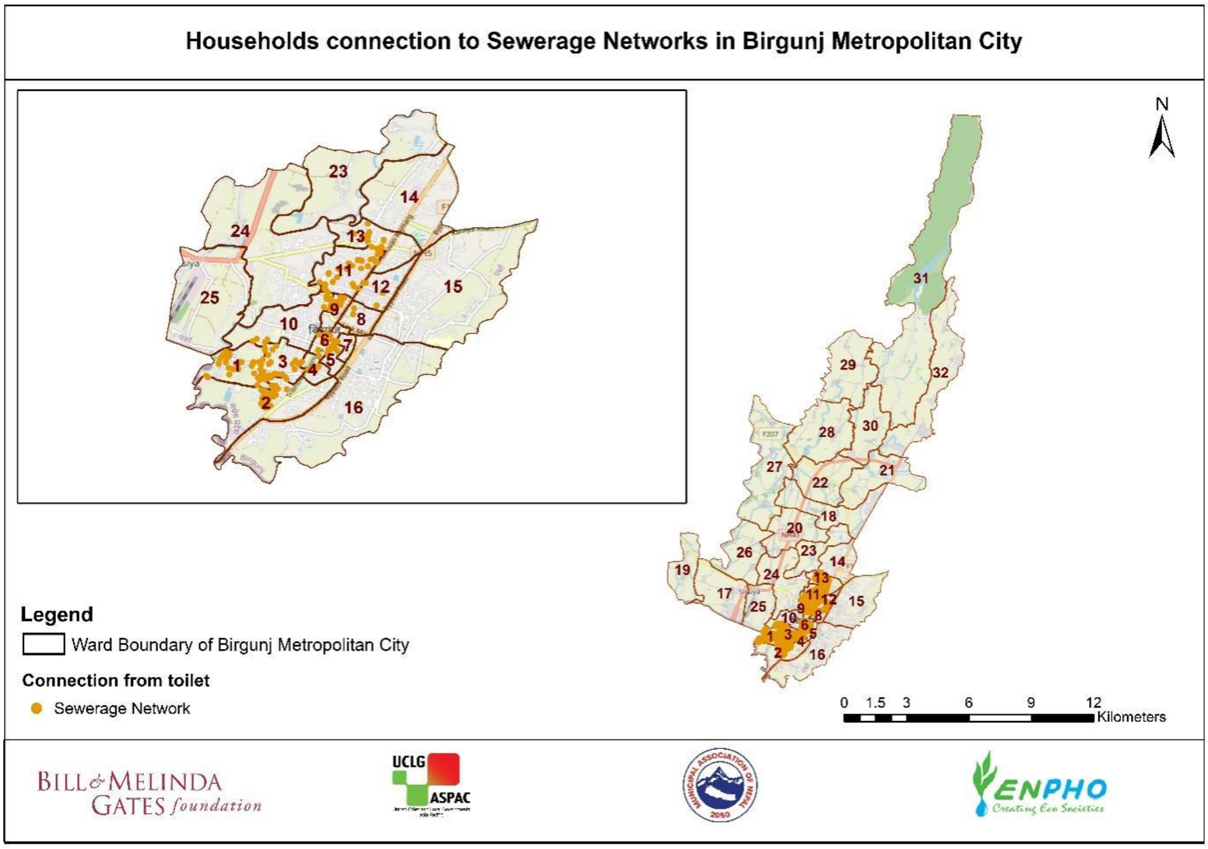

Figure 3: Households connection to Sewerage Networks in Birgunj Metropolitan City.

2.2.2 Stormwater Drainage Network

The total length of a properly built stormwater drainage system in Birgunj is 71.3 km. The length of brick masonry drains, Reinforced Cement Concrete (RCC) drains and main drains are 56.5 km, 9.9 km and 4.9 km, respectively (STIUEIP, 2013). The stormwater drainage is found in core area of the metropolitan city. Besides that, open drainage is built in different wards of the metropolitan city for precipitation runoff which is illegally used for drainage of Faecal Sludge (FS) from toilets and containment. The wastewater and runoff generated from sewerage and open drainage within the different catchments of Birgunj is drained to two rivers – Sirsiya in the west and Singha in the east. These drainage networks do not function properly due to the lack of maintenance and misuse by the locals resulting in inadequate hydraulic capacity to drain surface runoff and wastewater. As a result, water accumulates in low-lying areas due to poor drainage or high-water tables mostly during monsoon seasons. Most open drains in Birgunj do not function properly due to the lack of maintenance as well as their misuse by the local people as waste dump sites (STIUEIP, 2013). Stormwater drainage is not connected to the WWTP in the metropolitan city.

Out of the 7% households having connection of toilet to offsite sanitation system, 5% have connection to stormwater drainage. Similarly, out of the 85% onsite sanitation system, 38% have connection of containments to stormwater or open drainage. The location of such households within different wards of the metropolitan city are projected in the GIS (Geographical Information System) map which is shown in Figure 4.

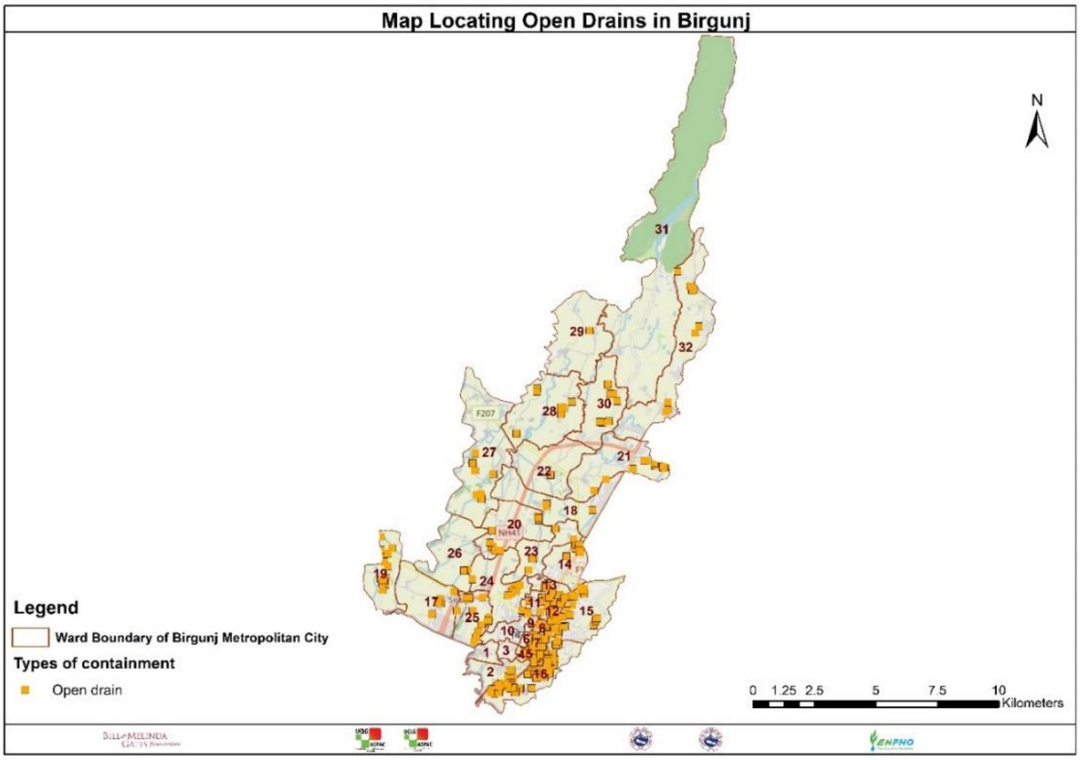

Figure 4: Households having connections of toilet and containment to stormwater drainage.

The condition of Sirsiya River due to disposal of effluent from toilets and containments can be highlighted in Figure 5.

Figure 5: Sirsiya River in Birgunj Metropolitan City.

2.2.3 Wastewater Treatment Plant

A Wastewater Treatment Plant with capacity to treat up to 10,000 m^3 of wastewater per day is located in Chapkaiya, Ward number 2 of Birgunj Metropolitan City. However, despite the presence of the treatment plant, the sewer networks and stormwater drainage in Birgunj are not connected to it. The treatment plant includes various major units, including an inlet diversion chamber, screen chamber, sump well for pumping units and ductile iron pumping main, receiving chamber, grit chamber, flow control channel/parshall flume, distribution chamber, anaerobic pond, facultative pond, inlet and outlet structures (weir type) for the ponds, outlet collection chambers, treated effluent pipe/channel, sludge drying bed, administration building, security cabin, toilet block, generator room and others (STIUEIP, 2013).

Within the treatment plant, a sludge drying bed is present which serves as a disposal site for the faecal sludge collected by the municipality's faecal sludge trucks. Although the drying bed aids in the management of the collected faecal sludge, this cannot be perceived as an ideal way to treat the faecal sludge. Figure 6 shows the location of the WWTP in Birgunj Metropolitan City.

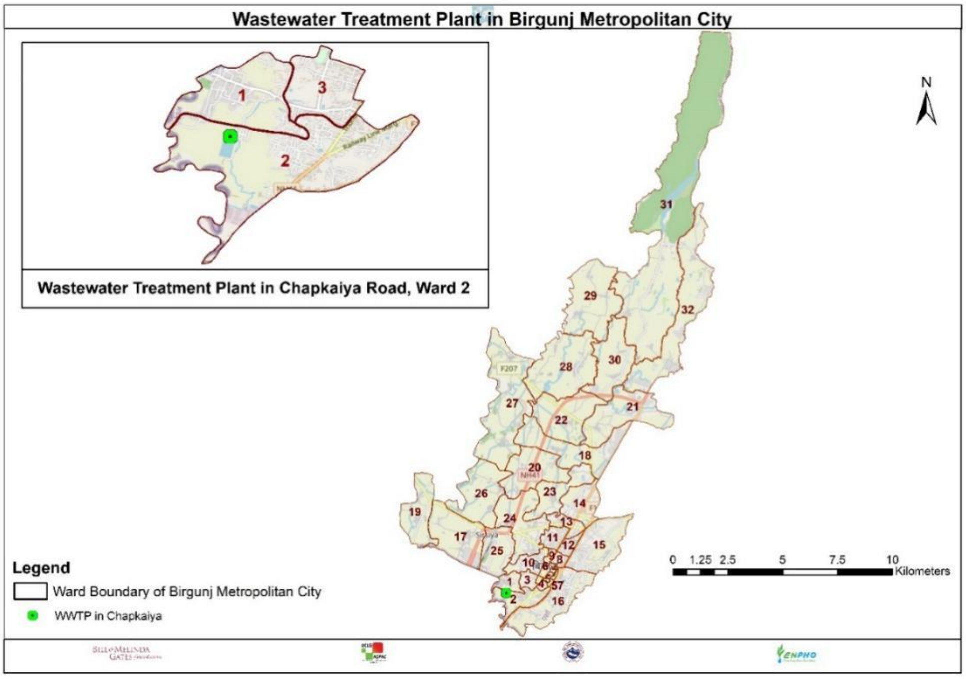

Figure 6: Locating of the Wastewater Treatment Plant.

Types of Onsite Sanitation Systems

Table 2 demonstrates the type of containments used in the household level in Birgunj along with its distribution according to the SFD methodology. Column 2 in the table shows the percentage of people using sanitation system as obtained from the household survey. Column 4 and 5 demonstrates the same system and its percentage according to the SFD methodology.

In column 3, the sum of types of containments only contributing to onsite sanitation systems (85%) excluding households without toilet and offsite sanitation is shown.

Table 2: Types of containment used in the household level in Birgunj Metropolitan City.

<table>
<tr><th>Containment used at household level</th><th>% of population using such containment</th><th>Contributing to 85% Onsite Sanitation</th><th>Distribution of the sanitation systems according to the SFD methodology</th><th>Percentage</th></tr>
<tr><td>Septic Tank</td><td>23.4%</td><td>27.3%</td><td>Septic Tank</td><td>23%</td></tr>
<tr><td>Biogas Digester</td><td>0.1%</td><td>0.1%</td><td>Fully Lined Tank without Outlet</td><td rowspan="2">35%</td></tr>
<tr><td>Fully Lined Tank</td><td>34.5%</td><td>40.1%</td><td>Fully Lined Tank</td></tr>
<tr><td>Lined Tank with Impermeable Walls and Open Bottom</td><td>9.4%</td><td>11.8%</td><td>Lined Tank with Impermeable Walls and Open Bottom</td><td>9%</td></tr>
<tr><td>Single Pit</td><td>12.9%</td><td>15.0%</td><td rowspan="3">Lined Pit with Semi-permeable Walls and Open Bottom (High and Low Risk)</td><td rowspan="3">17%</td></tr>
<tr><td>Twin Pit</td><td>2.1%</td><td>2.4%</td></tr>
<tr><td>Direct Pit</td><td>2.0%</td><td>2.3%</td></tr>
<tr><td>Unlined Pit</td><td>0.8%</td><td>1.0%</td><td>Unlined pit</td><td>1%</td></tr>
</table>

Different types of onsite sanitation systems used in households in the metropolitan city are described below:

Septic tank: Septic tank is a properly sealed watertight tank with at least two chambers. Most of the solids settle out in the first chamber. A correctly designed septic tank has an outlet from the second chamber to a sub-surface infiltration system (such as a soak pit) or to a sewer for further management of the liquid effluent. People residing in 27.3% of the households have access to a correctly built septic tank. Figure 7 shows the top view of septic tank built in a household of Birgunj.

Figure 7: Top view of a septic tank in a household of Birgunj.

Fully lined tank: Fully lined tank is a rectangular onsite sanitation technology which is used to safely store faecal sludge. There is no outlet or overflow to discharge effluent. The walls and bottom of tank is totally lined and sealed (Linda Strande, 2014). People residing in 40.1% of households with access to toilet in their houses in the city having onsite sanitation technology use fully lined tanks. Figure 8 shows the top view of a fully lined tank built in a house in a rural area of the metropolitan city.

Figure 8: Top view of a fully lined tank in Birgunj.

Biogas Digester: Biogas digester is a waste to energy conversion technology designed to treat household faecal sludge and organic matter and is proved to be a beneficial method of stabilising FS. Here, faecal sludge is converted into biogas and slurry. The slurry is relatively biologically stable and can be used as a soil conditioner (Linda Strande, 2014). In Birgunj, only 0.1% households use a biogas digester to store and treat the FS generated in their houses. Figure 9 shows the top view of biogas built in a household of Birgunj.

Figure 9: Biogas Digester in a household of Birgunj Metropolitan City.

Lined tank with impermeable walls and open bottom: Population residing in 11.8% of households with a toilet in their houses in the metropolitan city have built a lined tank with impermeable walls and open bottom, which are rectangular onsite system where the walls of the tank are lined and the bottom of tank is not lined and allows infiltration of effluents which could contaminate groundwater. Figure 10 shows the top view of a lined tank with impermeable walls and open bottom built in a house in a rural area of the metropolitan city.

Figure 10: Top view of Lined tank with impermeable walls and open bottom

Single pit: Single pits are properly constructed and well-maintained pits with semi-permeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur (Susana, 2018). Generally, single pits are circular in shape and do not have designed outlet. The population residing in 15.0% of households having access to basic sanitation in the metropolitan city use single pit as onsite sanitation technology. Such type of pits is considered as lined pit with semi-permeable walls and open bottom in the SFD graphic. Figure 11 shows the top view of a single pit built in a house in a rural area of the metropolitan city.

Figure 11: Top View of Single Pit in Birgunj.

Twin Pits Population residing in 2.4% of households with access to a toilet in their houses use twin pits as an onsite sanitation technology in Birgunj. Twin pits are two sets of properly constructed and well-maintained pits with semipermeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur. Each pit is used alternatively after one is filled. FS is left to decompose after the pit is filled. Twin pits effectively treat FS if there is no exfiltration of water. Figure 12 shows the top view of a twin pits built in a house in a rural area of the metropolitan city.

Figure 12: Top view of Twin Pits in Birgunj.

Unlined Pit: Unlined pits have permeable walls and open/permeable base to store FS onsite and contributes to groundwater pollution. Population residing in in 1.0% of households with access to toilet in their houses have built such type of onsite sanitation technology. Figure 13 shows connection of toilet to unlined pit.

Figure 13: Unlined pit used in a household of Birgunj Metropolitan City.

Direct Pit: Direct pits are a hole dug into the ground just beneath the toilet to store FS onsite. Population residing in 2.3% of households with access to toilet in their houses have built such type of onsite sanitation technology. There are no lining and the walls and bottom of such type of pits. Figure 14 shows toilet connected to direct pit in a household of Birgunj Metropolitan City.

Figure 14: Direct Pit used in a household of Birgunj Metropolitan City.

Figure 15 shows the distribution of various types of sanitation technologies in different wards of Birgunj Metropolitan City.

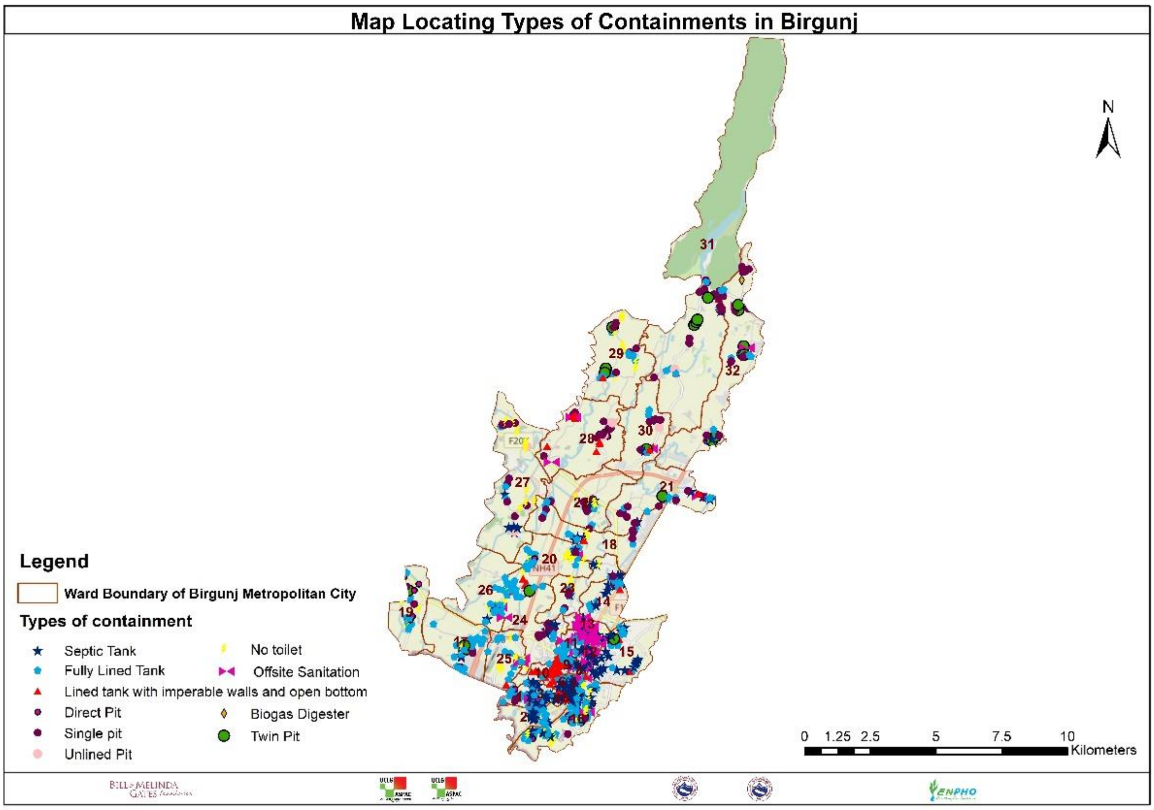

Figure 15: Sanitation technologies installed at household level.

2.2.4 Percentage of FS emptied from onsite sanitation technologies

Emptying is one of the major components of the sanitation value chain. It ensures the proper functioning of containment basically for the septic tanks which functioned well until the volume of sludge is one-third of the total volume of the tanks. Also, in other containments, regular emptying prevents overflow of the sludge and blockages (Linda Strande, 2014). 33.3% of the households have emptied their containment due to overflow of faecal sludge. Moreover, fully lined tanks are emptied more than other types of containment in the household buildings.

The final values used for the proportion of faecal sludge emptied from each sanitation system (which accounts for variable F3 in the SFD matrix and shown in Figure 21) are derived from the data obtained in the household survey and consider all sanitation systems that have been emptied at least once. In the SFD graphic generation process, 0.3% of households using biogas digesters are considered as fully lined tanks which are emptied, and the FS is the delivered to the treatment plant and treated.

Emptying rate of the containment is determined by the number of users, duration of use, types, and size of the containment. Among the households that have emptied their containment at least once, manual emptying, involving labours or household members to manually remove the faecal sludge from the containment and transport it for disposal in farmlands, is practised in 10.4% of the households within the metropolitan city. Likewise, 89.6% of households use mechanical emptying. Desludging services in the municipality are only provided by both the municipal authorities and private desludgers operating in the area. The emptying status of containments throughout different wards of Birgunj is shown in Figure 16. Blue circles in the figure represent the containments that have not been emptied and the red circles represent the containments that have been emptied at least once after construction.

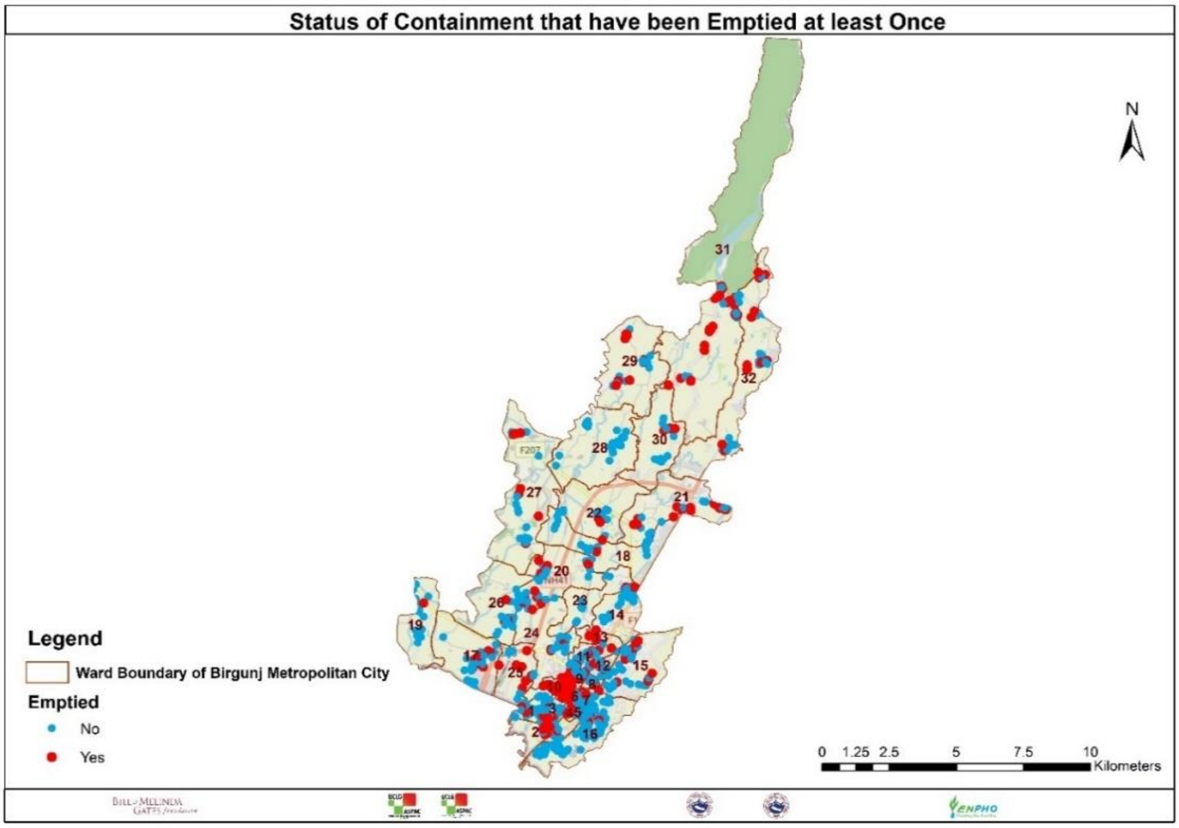

Figure 16: Status of onsite sanitation technologies that have been emptied at least once.

Table 3 shows the average emptying frequency of different types of onsite sanitation technologies in the metropolitan city. Frequency of emptying of pits is higher than sealed tanks and lined tanks with open bottom, which can be justified by the volume of onsite containments, which shows that the size of sealed containments is greater than the size of pits The types of soil found in Birgunj are sandy, sandy loamy and clay loam soils having average permeability of 5 cm/hr, 2.5 cm/hr and 0.8 cm/hr respectively (FAO, s.f.). Thus, groundwater or surface water can infiltrate into the pit, increasing its liquid volume which requires frequent emptying of pits to prevent from overflow. Several other factors including volume of containment and number of users can also attribute to the differences in emptying frequency among the types of containments.

Table 3: Average emptying frequency of different types of onsite sanitation technologies in Birgunj Metropolitan City.

Onsite Sanitation Technology	Average Emptying Frequency	Average Volume (m^3)
Septic Tank	Once every four years and seven months	18.2
Fully Lined Tank	Once every three years and five months	16.1
Lined Tank with Impermeable Walls and Open Bottom	Once every three years	8.2
Single Pit	Once every one year and two months	2.1
Twin Pits	Once every eight months	2.8
Direct Pit	Once every one year	2.5

2.2.2 *Treatment and Disposal/Reuse*

Birgunj Metropolitan City lacks a proper treatment facility for managing faecal sludge. However, the city has a wastewater treatment plant located in ward number 2, as represented in Figure 6. Currently, the faecal sludge collected by the municipal truck is directly disposed of in a sludge drying bed at the WWTP without any treatment, but private desludgers find this location inconvenient. As a result, there is practice of disposing faecal sludge untreated in water resources and open drains, regardless of whether it was collected by a mechanical desludging truck or emptied manually. The majority of the emptied faecal sludge is used as fertilizer in farmlands (without any treatment), while a small percentage is dumped in forest areas and nearby water bodies, also without any treatment. Thus, both procedures are considered to be an unsafely disposal of the faecal sludge. Therefore, for systems T1A1C1 and T1A1C6, values for variables W4a, W4c, W5a and W5c were all set to 0% in the SFD matrix.

Institutional Level Sanitation Systems

97.56% of the surveyed institutions have access to a safely managed sanitation systems in the municipality. The remaining 2.4% of institutions do not have a toilet and people defecate in open environment. 4.1% of the institutions have a connection of a toilet to an offsite sanitation system while 83.5% of the institutions use an onsite sanitation system.

37% of the institutions having an onsite sanitation system use a septic tank in their institutions, 39% have a fully lined tank, while 1% use a twin pit, which are safely managed sanitation systems. 11% use lined tanks with semipermeable wall and open bottom, 3% use a single offset pit and 2% use unlined pits, posing risk to groundwater pollution.

The percentage of types of sanitation technologies in these buildings is shown in Figure 17.

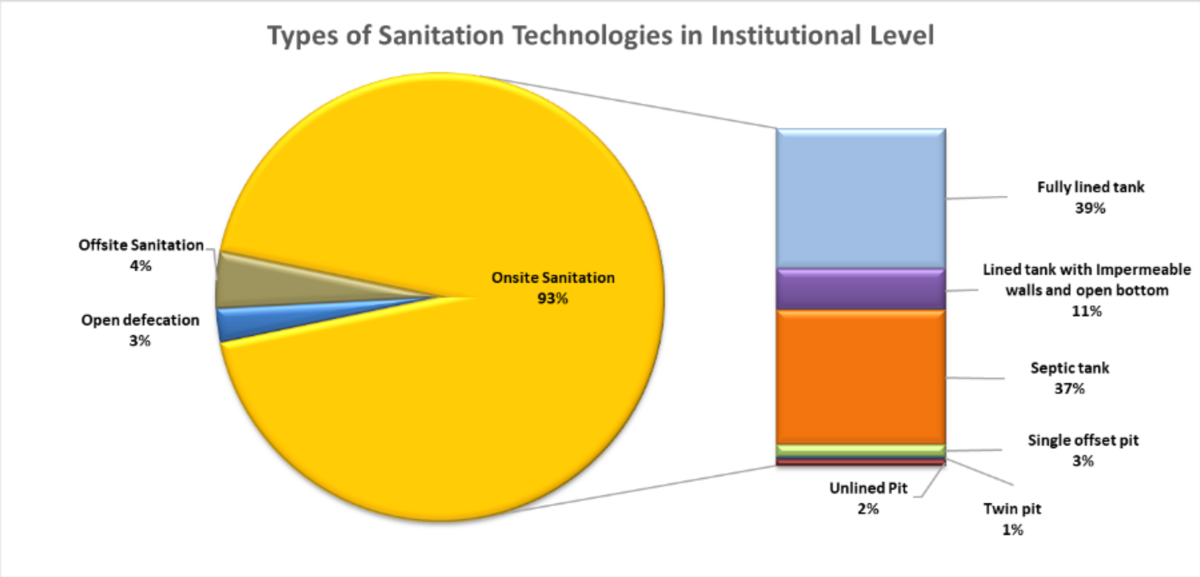

Figure 17: Types of sanitation technologies in institutions in Birgunj Metropolitan City.

32.2% of the surveyed institutions have emptied their containment at least once after construction. The rest of the institutions have never emptied their containment because it has never been filled. Distribution of different types of sanitation technologies of institutions in various wards of Birgunj Metropolitan city is shown in Figure 18.

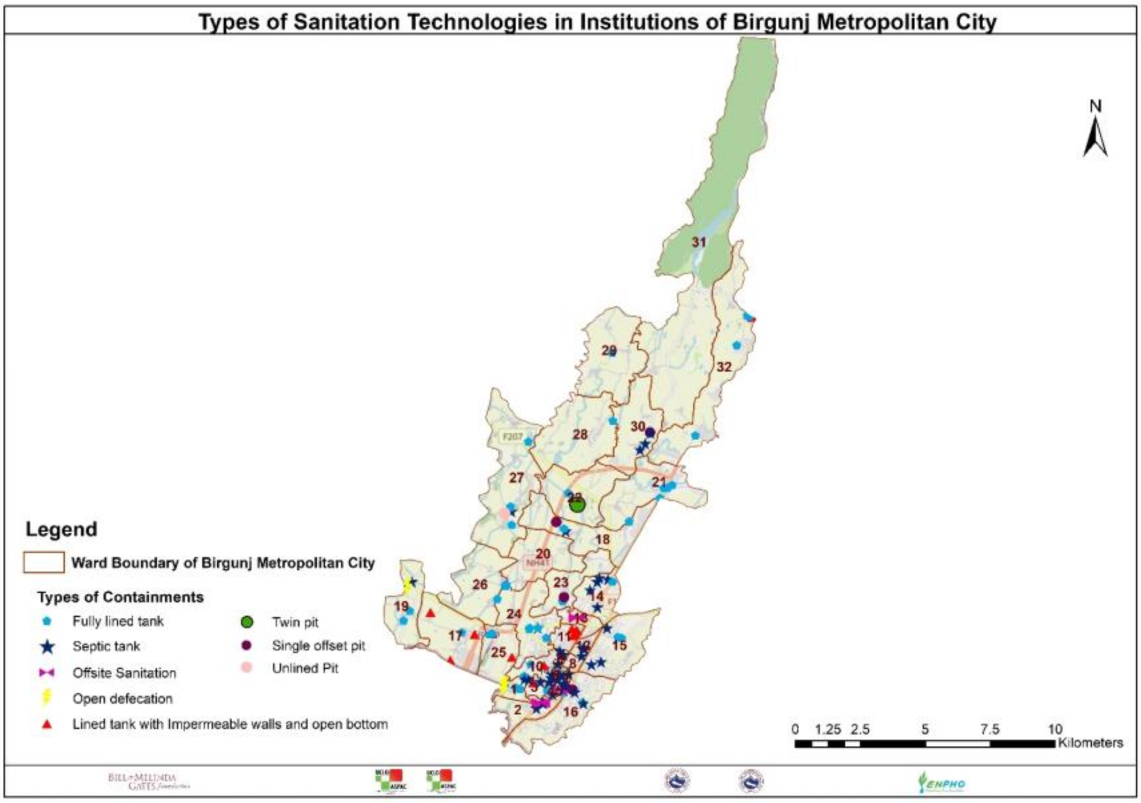

Figure 18: Types of onsite sanitation systems in institutions of Birgunj Metropolitan City.

2.2.3 *Public Toilets*

Public Toilets (PTs) are installed for commuters to achieve and sustain open defecation-free status in the metropolitan city. There are a number of toilets installed to serve the floating population and travellers of the metropolitan city. Public toilet E, although located near a college and the hospital, having high number of commuters, is in the worst condition. There is no proper lighting, locks, cleansing materials and it is in physically poor state with foul smell. The functionality of this toilet is solely dependent on the hard work of the operator. Other public toilets near Ghantaghar, the Bus Park and temple areas are functional. Some toilets are in good maintenance and functions well, while some are in very poor state with overflow and a foul smell, as it can be seen in pictures in Table 4.

Table 4: List of Public Toilets in Birgunj Metropolitan City.

	
Public Toilet (Near Ghantaghar)	
	
Public Toilet C (In Buspark Area)	

Public Toilet D (Ghadiarwa Pokhari)

Public Toilet E (Near Hospital Road)

Public toilet F (Aadarsnagar)

2.3 Risk of Groundwater Pollution

The risk of groundwater pollution is assessed based on the source of drinking water and the vulnerability of the aquifer with regards to lateral spacing between the sanitation system and the 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, as a result 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).Groundwater vulnerability is specific to containment type and pollution scenarios (Andreo, 2013).

98.1% of the households use groundwater as the major source of drinking water in the city. Among the various types of containments, lined tanks with impermeable walls and open bottom and lined pits are more prone to contribute to groundwater pollution as the seepage from such types of containments can readily infiltrate the surrounding soil and cause groundwater contamination. In the SFD graphic, the 1.4% (rounded off to 2.0%) of lined pits with semi-permeable walls and open bottom are considered to be located in areas of high risk of groundwater pollution (T2A5C10 = 1%). In case of lined tanks, no outlet or overflow, all of them (6%) are located in areas of low risk of groundwater contamination and hence T1A4C10 = 6%.

Figure 19 demonstrates the percentage of risk from the depth of hand pumps and horizontal distance of it with lined pits with semi-permeable walls and open bottom. According to WHO criteria, if the travel time of seepage 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 types of soil found in Birgunj are sandy, sandy loamy and clay loam soils having average permeability of 5 cm/hr, 2.5 cm/hr and 0.8 cm/hr respectively (FAO, s.f.). Thus, households having groundwater depth up to 100 feet (30 m) and distance of containment and groundwater below 25 feet (7 m) are considered to possess significant risk of groundwater contamination.

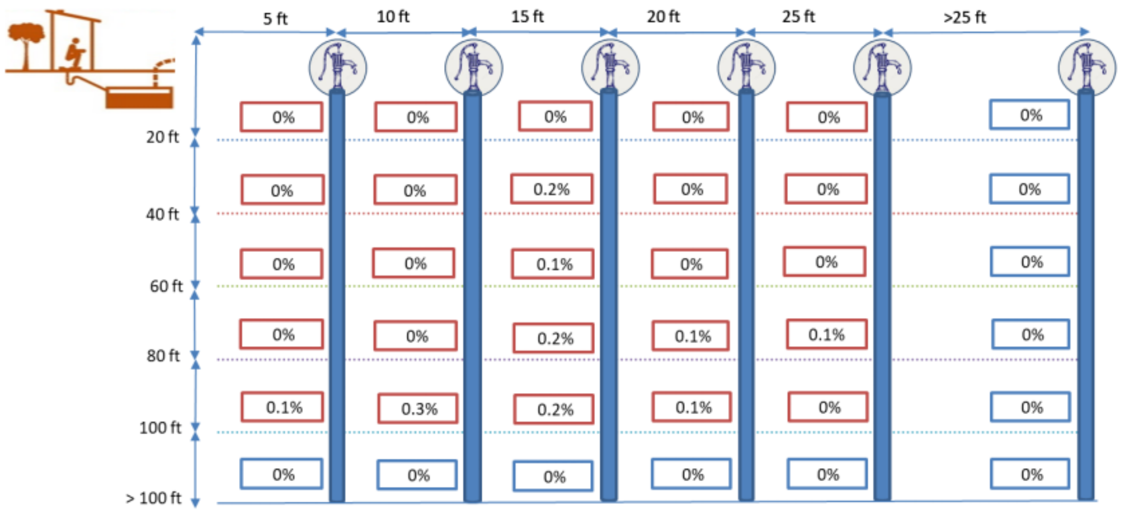

Figure 19: Groundwater contamination risk from lined pits with semi-permeable walls and open bottom.

2.4 SFD Selection Grid

Sanitation technologies selected in the SFD grid in Birgunj Metropolitan City are shown in Figure 20. 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 toilet. Similarly, horizontal row at the top of the selection grid shows options for connection for the outlet or overflow discharge from the toilet. Twin pits, direct pits and single pits observed in the household survey are selected as lined pits with semi-permeable walls and open bottom in the SFD grid.

Thus, different types of sanitation systems in Birgunj Metropolitan City and their outlet are selected in the selection grid and the proportion of population using such type of systems is calculated further 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	T1A1C1				Significant risk of GW pollution Low risk of GW pollution	T1A1C6				Not Applicable
Septic tank					Significant risk of GW pollution T1A2C5	T1A2C6		T1A2C8		
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution	T1A3C6		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	T1A4C6		T1A4C8		Significant risk of GW pollution T1A4C10
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A5C10 T1A5C10
Unlined pit										Significant risk of GW pollution T1A6C10
Pit (all types), never emptied but abandoned when full and covered with soil										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable						T1B11 C7 TO C9			Not Applicable

Figure 20: SFD selection grid for Birgunj Metropolitan City.

Sanitation technologies and/or systems which ensure safe level of protection from excreta i.e., pathogen transmission to the user or general public is limited, are considered to contain the FS. Similarly, sanitation technologies and/or sanitation systems which do not ensure safe level of protection from excreta. I.e., pathogen transmission to the user or general public, do not to contain FS (Susana, 2018).

Brief explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 20 is explained in Table 5.

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

T1A1C1	A fully functioning toilet discharging directly to a correctly designed, properly constructed, fully functioning centralised combined sewer. The excreta are raw, untreated and hazardous, but since it is captured in the sewer, all the excreta in this system will contribute to wastewater contained centralised.
T1A1C6	A fully functioning toilet discharging directly to an open drain or storm sewer. The excreta is raw, untreated and hazardous and since it discharges directly to an open drain or storm sewer, all the excreta in this system is considered not contained.
T1A2C5	A correctly designed, properly constructed, fully functioning septic tank with an effluent outlet connected to a soak pit. The supernatant/effluent flowing from the tank is only partially treated and is still hazardous, but since it is captured in the soak pit, all the excreta in this system is considered contained.
T1A2C6	A correctly designed, properly constructed, fully functioning septic tank with an outlet connected to an open drain or storm sewer. 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.
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.
T1A3C6	A correctly designed, properly constructed, and well maintained fully lined tank with impermeable walls and base. Since the tank is fitted with a supernatant/effluent overflow connected to an open drain or storm sewer the excreta in this system are considered not contained.
T1A3C8	A correctly designed, properly constructed and well-maintained fully lined tank with impermeable walls and open bottom. 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. 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. 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. 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. However, since the tank is not fitted with a supernatant/effluent overflow this system is considered contained.
T2A5C10 (High 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 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.
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.

2.5 SFD matrix

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. A detailed instruction on how to calculate SFD proportion in SFD PI was used as guide to calculate SFD proportion. It stated that the default "100%" value is used where onsite containers are connected to soak pits, to 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.

Where onsite containers are connected to a sewer network or to open drains, a value of "50%" is used which means that half the contents are modelled as faecal sludge; 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 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 as per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website is:

i. The proportion of FS in septic tanks is 60%, as 78% of the septic tanks are connected to stormwater drain or open drain in the municipality. This implies that almost 50% of FS from such types of containment is discharged into open or stormwater in the form of supernatant. Rest of the septic tanks are connected to either open ground or a soak pit.

ii. The proportion of FS in fully lined tanks is 74%.

iii. The proportion of FS from lined tanks with open bottom and all types of pits is 96%, as the proportion of lined tanks with impermeable walls and open bottom connected to open drain is only 2%.

Upon calculation of proportion of FS in each type of sanitation technologies, the proportion of population using the technology selected in the SFD selection grid is fed in. Figure 21 shows the SFD matrix of Birgunj Metropolitan City.

Birgunj Metropolitan City, Madhesh, Nepal, 15 May 2023. SFD Level: 2 - Intermediate SFD
Population: 272382
Proportion of tanks: septic tanks: 60%, fully lined tanks: 74%, lined, open bottom tanks: 96%

Containment										
System type	Population	WW transport	WW treatment	WW transport	WW treatment	FS emptying	FS transport	FS treatment	SN transport	SN treatment
	Pop	**W4a**	**W5a**	**W4c**	**W5c**	**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 centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of wastewater in open sewer or storm drain system, which is delivered to treatment plants	Proportion of wastewater delivered to 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
T1A1C1 Toilet discharges directly to a centralised combined sewer	2.0	0.0	0.0							
T1A1C6 Toilet discharges directly to open drain or storm sewer	5.0			0.0	0.0					
T1A2C5 Septic tank connected to soak pit	1.0					34.0	0.0	0.0		
T1A2C6 Septic tank connected to open drain or storm sewer	18.0					22.0	0.0	0.0	0.0	0.0
T1A2C8 Septic tank connected to open ground	4.0					17.0	0.0	0.0		
T1A3C10 Fully lined tank (sealed), no outlet or overflow	15.0					21.0	1.0	90.0		
T1A3C6 Fully lined tank (sealed) connected to an open drain or storm sewer	18.0					17.0	0.0	0.0	0.0	0.0
T1A3C8 Fully lined tank (sealed) connected to open ground	2.0					14.0	0.0	0.0		
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	6.0					68.0	0.0	0.0		
T1A4C6 Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	2.0					28.0	0.0	0.0	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	1.0					17.0	0.0	0.0		
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	16.0					34.0	0.0	0.0		
T1A6C10 Unlined pit, no outlet or overflow	1.0					0.0	0.0	0.0		
T1B11 C7 TO C9 Open defecation	8.0									
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	1.0					58.0	0.0	0.0		

Figure 21: SFD Matrix of Birgunj Metropolitan City.

2.2.4 *Proportion of Faecal Sludge Emptied (F3)*

The proportion of faecal sludge emptied (F3) is calculated based on the percentage containment emptied (ENPHO, 2023) and the amount of FS emptied during the process (KII-2, 2022). The information on FS emptied from containment is obtained from Key Informant Interviews (KIIs) with desludging service providers. It is revealed that most of the containment gets filled due to intrusion of the groundwater into the containment. Thus, the portion of liquid in the FS is high which can be easily pumped out by the desludging vehicle. So, almost 80% of the FS content in the containment is removed during emptying. Hence, actual proportion of FS emptied from each containment is calculated as:

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

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

Table 6: Sanitation technologies and proportion of emptied faecal sludge (ENPHO, 2023[1]; KII-2, 2022[2]).

SN	Sanitation Technologies	SFD Reference Variable	Percentage of Emptied Containment (1)	Emptied Proportion of FS (2)	Actual Proportion of Emptied FS (F3)
1	Septic tank connected to soak pit	T1A2C5	43%	80%	34%
2	Septic tank connected to open drain or storm sewer	T1A2C6	28%	80%	22%
3	Septic tank connected to open ground	T1A2C8	21%	80%	17%
4	Fully lined tank (sealed), no outlet or overflow	T1A3C10	26%	80%	21%
5	Fully lined tank (sealed) connected to an open drain or storm sewer	T1A3C6	21%	80%	17%
6	Fully lined tank (sealed) connected to open ground	T1A3C8	17%	80%	14%
7	Lined tank with impermeable walls and open bottom, no outlet or overflow	T1A4C10	85%	80%	68%
8	Lined tank with impermeable walls and open bottom, connected to an open drain or storm sewer	T1A4C6	35%	80%	28%
9	Lined tank with impermeable walls and open bottom, connected to open ground	T1A4C8	21%	80%	17%
10	Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	42%	80%	34%
11	Unlined pit, no outlet or overflow	T1A6C10	0%	80%	0%
12	Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	T2A5C10	73%	80%	58%

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

Variables F4 and F5 for all onsite sanitation systems were derived from the household survey and cross-checked with the KIIs conducted. The metropolitan city does not have any form of treatment plant to treat faecal sludge. Also, the people using twin pits reclassified the lined pits with semi-permeable walls and open bottoms are not using them properly. Thus, the percentage of FS emptied from such containment is not considered as treated. The FS emptied from the containments is dumped openly in farmlands or water bodies. Thus, variables F4 and F5 for all sanitation systems except T1A3C10 are set to 0%.

As shown in Figure 21 of SFD matrix, fully lined tanks (sealed) no outlet or overflow (15%), are comprised of two types of containments; biogas digesters (0.1%) and fully lined tanks without outlet (14.9%). Moreover, 21% (80% proportion of 26% FS emptied) of T1A3C10 emptied that is shown in F3 is 1% from biogas digesters and 20% from fully lined tanks without outlet. 1% of T1A3C10 in variable F4 pertains to biogas digesters, which is considered as FS transported to treatment plant (F4 = 1%). It is considered that the efficiency of the biogas digesters is 90% and thus, F5 = 90% for these systems (T1A3C10).

2.2.6 *Proportion of supernatant in open drain/storm sewer delivered to treatment (S4e)*

The actual proportion of supernatant from the containment to open drain and storm water drain is not able to observe. Thus, the proportion is estimated at 50% of the faecal sludge in the containment connected to open drain and storm water drain. Since the supernatant does not reach any treatment, the proportion delivered to treatment plant and treated is 0% (S4e and S5e both set to 0%).

2.6 Summary of Assumptions

Offsite Sanitation Systems

- ✓ There is a WWTP in the city but the wastewater or the supernatant generated do not reach the WWTP. Therefore, for systems T1A1C1 and T1A1C6, values for variables W4a, W4c, W5a and W5c were all set to 0% in the SFD matrix.

Onsite Sanitation Systems

- ✓ The proportion of FS in septic tanks was set to 60%, the proportion of FS in fully lined tanks was set to 74% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 96% 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 household survey and cross-checked with KIIs conducted.
- ✓ The city does not have any form of treatment plant to treat faecal sludge. The FS emptied from the containments is dumped openly in farmlands or water bodies. Thus, variables F4 and F5 for all sanitation systems are set to 0%. Values for supernatant (S4e and S5e) are also set to 0% in septic tanks and fully lined tanks connected to drains (T1A2C6 and T1A3C6). However, FS from anaerobic biogas digesters,

classified as fully lined tanks (system T1A3C10), is considered as transported (F4 = 1%) and treated with a treatment efficiency estimated at 90% (F5 = 90%).

2.7 SFD Graphic

Figure 22 represents the SFD graphic which demonstrates the fate and flow of faecal sludge and wastewater of Birgunj through each step of the sanitation service chain. It shows that FS and WW generated from 27% of the population is safely managed represented by “Green” colour arrowhead. However, 27% of the safely managed FS resembles the FS stored in the containments without significant risk to groundwater. Thus, the safely managed percentage of FS generated by 27% of the population is temporary until the FS from the containment is emptied. 1% of the FS safely managed corresponds to FS treated by the population using biogas digesters.

The WW, FS and supernatant from 73% of the population is unsafely managed, represented by “RED” arrow heads. The percentage of unsafely managed excreta is generated from containments where FS is not contained - not emptied (28%), FS emptied but not delivered to treatment (19%) which is disposed of untreated in the environment, supernatant not delivered to treatment (12%), wastewater not delivered to treatment (7%) and people practising open defecation (8%).

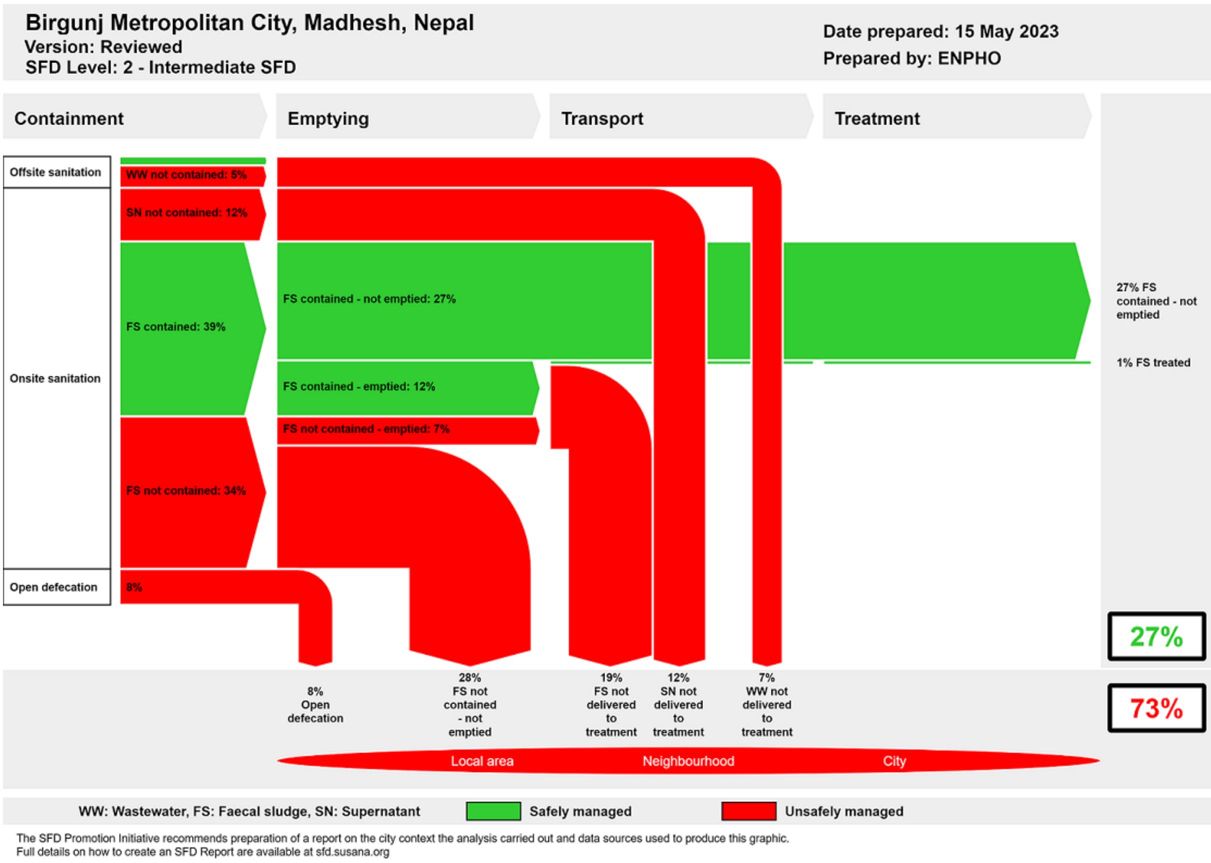

Figure 22: SFD graphic of Birgunj Metropolitan City.

Offsite Sanitation

WW contained

2% of WW proportion from a fully functioning toilet discharging directly to a correctly designed, properly constructed, fully functioning centralised combined sewer is considered as WW contained. WW is raw, untreated and hazardous, but since it is captured in the sewer, all the excreta in this system will contribute to wastewater contained.

WW not contained

5% proportion of WW from a fully functioning toilet is discharging directly to an open drain or storm sewer. The WW is raw, untreated and hazardous and since it discharges directly to an open drain or storm sewer. Thus, the proportion of WW in this system is considered not contained.

WW not delivered to treatment

Since WW contained and not contained are not connected to a WWTP, it is disposed directly into water bodies. Hence, the proportion of WW not delivered to treatment plant is 7%.

Onsite Sanitation

85% population in the metropolitan city relies on onsite sanitation systems.

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 FS generated by 39% of the population is considered as FS contained.

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 FS generated by 34% of the population is considered FS not contained.

FS contained – emptied and FS contained – not emptied

The proportion of FS which are at safe level of protection from excreta i.e., pathogen transmission to the user or public is considered as FS contained – emptied. Such proportion of FS is 12% in Birgunj Metropolitan City. This proportion of FS is considered as safely stored while it is contained, but it becomes unsafe once it is emptied and disposed of in open areas, forests or water resources.

27% of FS contained – not emptied is the proportion of FS which are at safe level of protection from excreta i.e., pathogen transmission to the user or public, which is not emptied. This percentage of FS is regarded as safely stored only because most of the pits and tanks have not yet filled up yet and the FS generated remains ‘not emptied’. Therefore, these systems will require emptying services in the short and medium term as they fill up.

FS not contained – emptied and FS not contained – not emptied

The proportion of FS not contained – emptied is the summation of the proportion of FS emptied from either technically appropriate or inappropriate containments with potential risk on direct contact with human or contamination of groundwater. The percentage of FS not contained – emptied is 7%.

28% of FS not contained – not emptied is FS kept in containment which has never been emptied and possess risk to human health through groundwater contamination or human contact

FS not delivered to treatment

The city does not have a treatment facility to treat faecal sludge. So, all the FS emptied from contained and not contained containments is disposed of into farmlands, riverbanks, and the jungle. The proportion of FS not delivered to treatment (19%) is the summation of FS contained – emptied and FS not contained – emptied.

Supernatant (SN) not delivered to treatment

The proportion of supernatant obtained from containments connected to open drain or storm water or sewer is calculated as 50% of FS contained in each containment. The total proportion of supernatant (SN) is 12% of FS generated by the total population. Since the municipality lacks proper sewer network and treatment plant, the supernatant is disposed of directly into water bodies. Hence the proportion of SN not delivered to treatment is 12%.

Open Defecation

Despite Open Defecation Free (ODF) status, people residing in 8% of households still go for open defecation. The people living in poverty and those who do not own land mostly do not have toilets.

3. Service Delivery Context

3.1 Policy, legislation, and regulation

3.1.1 *Policy*

The Constitution of Nepal 2015 in Article 35 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 recognizes that every person shall have the right to live in a healthy and clean environment (GoN, 2015). To respect, promote and fulfil the provisions related to right on water and sanitation, Government of Nepal has billed Drinking Water and Sanitation Act, 2019 through Ministry of Water Supply. The act elaborates right to clean water as to receive affordable, sufficient, and quality drinking water regularly as well as access to sanitation as affordable access to quality sanitation services (MoWS, 2019).

Historically, 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 in the marginalized and vulnerable groups. Participatory approach, community leadership project development, optimization of local resources and installation of locally appropriate technologies were major principles in the policy (DWSSM, 2004). However, it was unable to address the complex operational issue of urban water supply and sanitation service delivery (DWSSM, 2009). Thus, 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. Cost recovery principles, public private partnership, and sector effectiveness for improved service delivery are key principles of the policy (DWSSM, 2009). Both these policies were limited to address emerging issues and challenges in the rural and urban areas. Thus, the National Water Supply and Sanitation Policy (NWSSP) was formulated in 2014 by the Government of Nepal (GON) to address the emerging challenges and issues with the adoption of innovative 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.

Recently, National Water, Sanitation and Hygiene Policy, 2022 has been drafted and undergone the process for endorsement. The draft policy is updated till date, including the wide range of sanitation services including treatment, reuse/safe disposal of faecal sludge/wastewater. It emphasizes on the preparation of the municipal level WASH plan with the local leadership to ensure the WASH services for all (MoWS, 2022).

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 institutional setup tier of government in a participatory approach. In an alignment total sanitation campaign was initiated formally to sustain ODF. The guideline set various indicators to assess the sustainability of sanitation services. Remarkably, it extended sanitation definition as management of services and facilities to safely dispose of/reuse faecal sludge, collection and treatment of solid waste and wastewater to establish the hygienic environment and promote public health (NPC, 2017).

Similarly, Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (SDP 2016-2030) was formulated in 2016 for sector convergence, institutional and legal reforms, capacity development and establishing coordination and harmonization in the sector. The SDP classified service system and delineated roles and responsibilities for effective and sustainable service delivery. The SDP highlighted that majority of households rely on onsite sanitation system (70%) that requires effective treatment of faecal sludge. However, there is lack of concrete policies, guidelines, and indicators on Faecal Sludge Management in the sector for effective planning, implementation, and service delivery. In alignment, 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). It is framed upon existing laws such as Environmental Protection Act (2019) and Environmental Protection Rules (2020), Self-Local Governance Act and Rules 1999, Environmental Standards on Effluent Discharge 2000, Nepal National Building Code 2003, and Land Acquisition Act amendment 2010 (MoWS, 2019). 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 Water and Sanitation User's Committee (WSUC) in the framework reflects a participatory approach that would help in sustaining the interventions.

The constitution of Nepal has provided the right for local government to form acts, rules and regulation based on the national policies and laws. Local Governance Operation Act 2017 has been formed to implement the right of local government and promote co-operation, co-existence, and co-ordination among federal, provincial, and local government. The act has mentioned the rights, roles, and responsibility of municipalities along with provision and procedure for approving laws and regulations at local level.

It is the duty and responsibility of the Birgunj Metropolitan City to improve access to accessible, safe, and sustainable drinking water and sanitation services to the people of the municipal area as mentioned in chapter 3 of the Local Government Management Act 2074 under the title of municipal work, duties, and rights; the policy, laws, standards, plan implementation and regulation related to local water supply mentioned in sub-section D of section 11. To implement this responsibility, water supply, sanitation and hygiene plan and policy has become essential. Development without planning and estimation will not lead to the expected success in access to water and sanitation (UNICEF, 2020).

3.1.2 *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, develop 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, facilitate and coordinate with federal, provincial, and local government for developing policy plan 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 23.

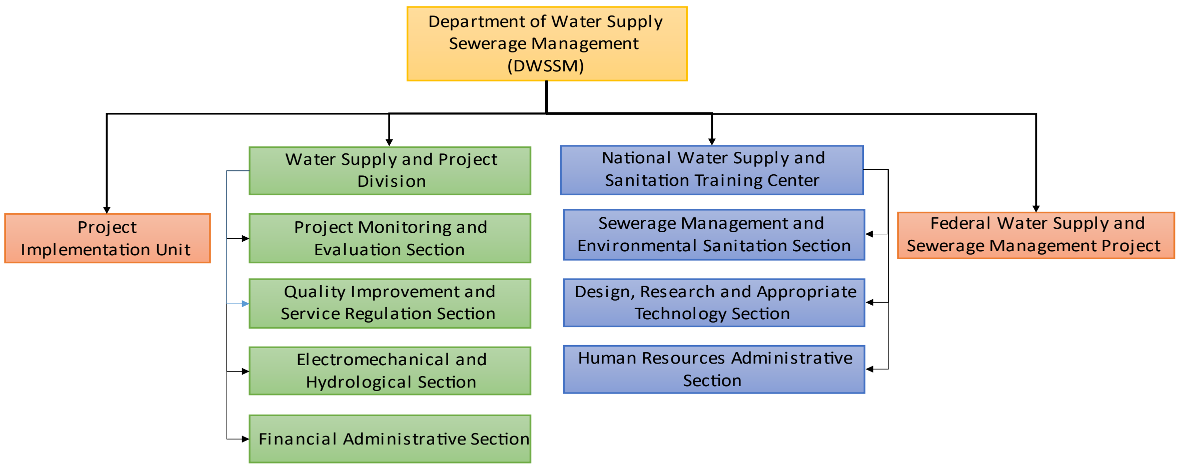

Figure 23: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).

Ministry of Urban Development: The Ministry of Urban Development (MoUD) works on integrated urban planning and development in municipalities, including faecal sludge management. Department of Urban Development and Building Construction (DUDBC) under

MoUD is implementing body and sets the standards for safe, affordable building construction and implementation for managed residential environment.

At Provincial Level

Ministry of Physical Infrastructure: Ministry of physical infrastructure of provincial government in Sudurpaschim is major executing body in the province. Planning and implementation of water supply and sanitation infrastructure is the province 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 between 5,000 to 15,000 in terai region, 3,000 to 5,000 in hilly region and 500 to 1,000 in Himalayan region.

3.1.3 *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 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 grewater	✓	✓	✓
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	✓	✓	✓

3.2 Planning

3.2.1 *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 Sustainable Development Goals (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 8.

Table 8: 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

3.3 Investments

A preliminary estimate of the annual investment requirement for the entire SDG period, 2016-2030 ranges between 42% to 54% of Gross Domestic Product (GDP). The average requirement is estimated to be about NPR 1,770 billion (USD 9.17 billion) per year, or nearly 49% of GDP over the entire duration of the SDGs (NPC, 2017).

The 15th year sanitation sector road map has estimated NRP 696 billion (USD 5.45 billion) for implementing the sector development plan of WASH. The gap on the budget allocated and required on WASH sector as mentioned in SDP (2016-2030) is shown in Figure 24. This scale of investment needs a full mobilization of all national and international sources including both public and private sector (MoWS, 2017).

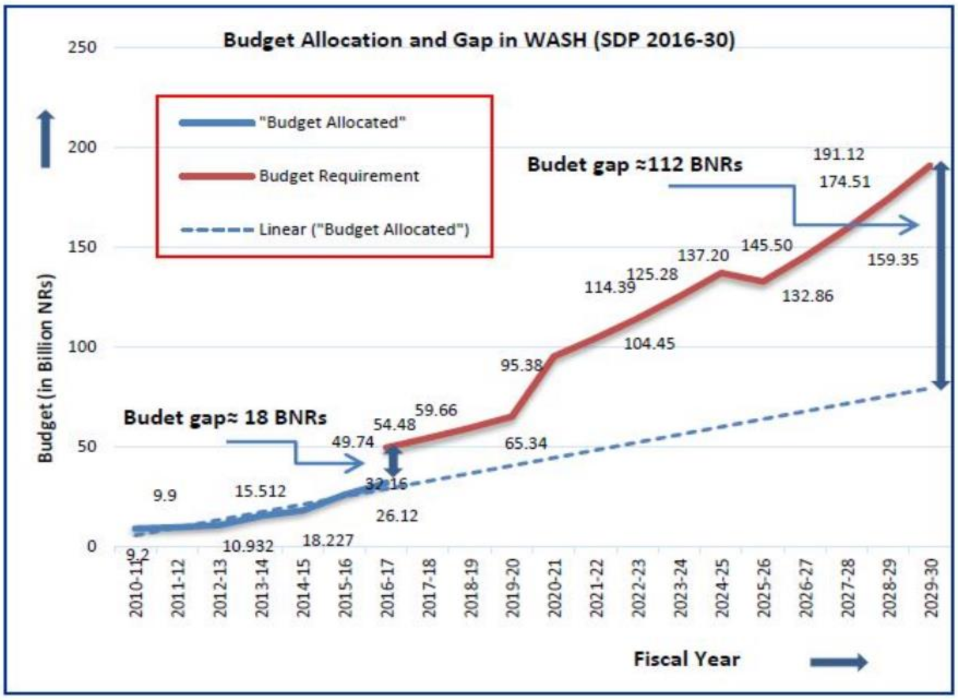

Figure 24: Budget allocation and GAP in WASH SDP 20016-2030.

3.4 Equity

3.4.1 *Current choice of urban poor*

The government has developed a Multiple Indicator Cluster Survey (MICS) for periodic monitoring of different sectors of SDG including water and sanitation service delivery (CBS, 2022). The program is supported by the Joint Monitoring Programme (JMP) from the WHO/UNICEF.

3.4.2 *Stimulating demand for services*

The mandatory provision of septic tanks during construction of building as per the National Building Code is major legal initiative for stimulating sanitation service demand in the city. Besides, the municipality must conduct awareness programs on sanitation at the community level for increasing the demand.

3.4.3 *Strengthening service provider roles*

Local government operation act 2017 and bill on drinking water and sanitation 2019 has entitled local government with authority for planning, implementation, monitoring and supervision of water and sanitation programs and services in the city. Similarly, institutional and regulatory framework on FSM has designated the local government with authority for planning, implementation, monitoring and supervision of sanitation programmes (MoWS, 2017).

4. Stakeholder Engagement

4.1 Key Informant Interviews (KIIs)

During the study, Key Informant Interviews (KIIs) were conducted to gather valuable insights from key stakeholders of the municipality and water supply committee. The objective of the interviews was to gain a comprehensive understanding of the current sanitation service practices.

Mr Imtiyaj Alam, Mayor, Mr. Sunil Karn, Cooperative Section Head and Mr. Devendra Chaudhary, Head of Water Supply and Disaster Management of Birgunj Metropolitan City were interviewed specifically regarding the municipality's sanitation services practices considering technical, institutional, and financial aspects.

Furthermore, Raj Krishna Tamrakar, driver and FS desludger in waste management division of the metropolitan city was interviewed to gain insights into the FS emptying and disposal practices. The discussion covered topics such as types of containments, containment volumes, and the frequency of emptying.

Another interview was conducted with Mr. Ram Avatar Paswan, Supervisor, Mr. Indra Raj Pandey, Senior Plumber, Mr. Ram Chandra Sahani, Accountant, Mr. Birendra Kumar Singh, Pump Operator/ Lab technician and Mr. Nabin Chaudhary, Operator of Taplejung Brihat Water Supply User's Committee which focused on the supply, quality, and distribution of drinking water in the municipality.

The KIIs also extended to the context of public toilets, where operators of the toilets were interviewed. This allowed for a deeper understanding of the operational aspects and management practices related to public toilets.

Table 9 provides a list of the KIIs conducted, including the names of the individuals interviewed and their respective designations within their affiliated organizations.

Table 9: List of Key Informant Interviews conducted to personnel.

S.N.	Name	Designation	Organization	Purpose of KII
1	Imtiyaj Alam (KII-1)	Deputy Mayor	Birgunj Metropolitan City	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development
2	Sunil Karn (KII-1)	Cooperative Section Head	Birgunj Metropolitan City	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development
3	Devendra Chaudhary (KII-1)	Head of Water Supply and Disaster Management	Birgunj Metropolitan City	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development
4	Raj Krishna Tamrakar (KII-2)	Waste Management Employee	Birgunj Metropolitan City	FS emptying and disposal practice, Types of Containments, Volume of Containment and Frequency of emptying.
5	Ram Avatar Paswan (KII-3)	Supervisor	NWSC, Birgunj Metropolitan City	Water Supply Services
6	Indra Raj Pandey (KII-3)	Senior Plumber	NWSC, Birgunj Metropolitan City	Water Supply Services

7	Ram Chandra Sahani (KII-3)	Accountant	NWSC, Birgunj Metropolitan City	Water Supply Services
8	Birendra Kumar Singh (KII-3)	Pump Operator/ Lab technician	NWSC, Birgunj Metropolitan City	Water Supply Services
9	Nabin Chaudhary (KII-3)	Operator	NWSC, Birgunj Metropolitan City	Water Supply Services

4.2 Household Questionnaire Survey

Random household questionnaire 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 on 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 visit 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= n_o/(1+ (n_o-1)/N). Where,

Z^2	1.96	At the confidence level of 95%
p	0.5	Assuming that about 50% of the population should have some sanitation characteristics that need to be studied (this was set at 50% since this percentage would yield the maximum sample size as the percentage of the population practising some form of sanitation is not known at the intervention sites).
q	1-p	
e	+/-5%	Level of precision or sampling error.
N		A total number of population (households in the municipality).

This is followed by proportionate stratification random sampling such that each ward in the municipality is considered as one stratum. The sample sized required in each ward is calculated as n_h= (N_h/N)*n, where N_h is a total population in each stratum.

Thus, a total of 1,044 households were sampled from 47,114 households distributed in 32 wards with proportionate stratification random sampling which is shown in Figure 25.

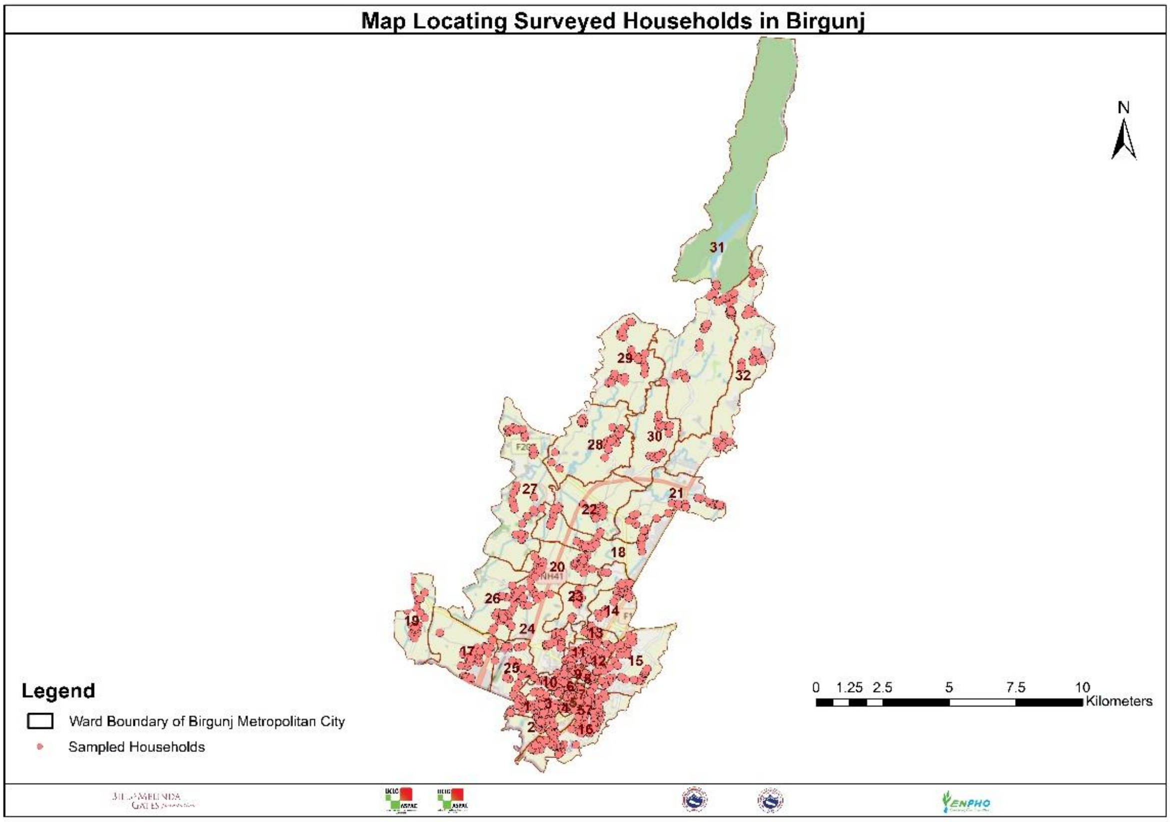

Figure 25: Distribution of sampling points in different wards of Birgunj Metropolitan City.

4.2.2 Direct Observation

Various sanitation technologies in the households in all the wards were observed and visual references were kept. Also, observation of the emptying of containments and transportation of faecal sludge were carried out. The disposal of private entrepreneur was observed during the usage.

4.2.3 Sharing and Validation of Data

The Shit Flow Diagram Sharing and Validation workshop was conducted in the metropolitan city to share the findings of the sanitation situation survey and receive the suggestion from municipal stakeholders. Participants including the Mayor, Chief Administrative Officer (CAO), ward chairpersons, section heads and other members from municipal executive council and sectoral staffs actively participated on the workshop and provided the valuable suggestions.

Laxmi Prasad Poudel, CAO of the municipality agreed that the metropolitan city needs to intervene from execution to policy level to include FSM and WW management in advocacy. He suggested the urgency to use the WWTP that is already constructed and is in working condition in Birgunj. He also requested ward chairpersons to disregard improper disposal of FS in their respective wards. Ward chairperson of ward number 4, Mr. Pradip Kumar Yadav, also agreed and added on this, suggesting that respective wards should act on people who illegally dispose FS or have connections of toilet to water resources.

Mahesh Das, journalist, stated that he was thankful for the data collection survey as it is the first and most important part for intervention in FSM as this will help in decision making level. He also suggested further study be done by the metropolitan city with the help of NGOs and INGOs. Figure 26 shows participants in sharing and validation workshop in Birgunj Metropolitan City.

Figure 26: Validation workshop at Birgunj Metropolitan City.

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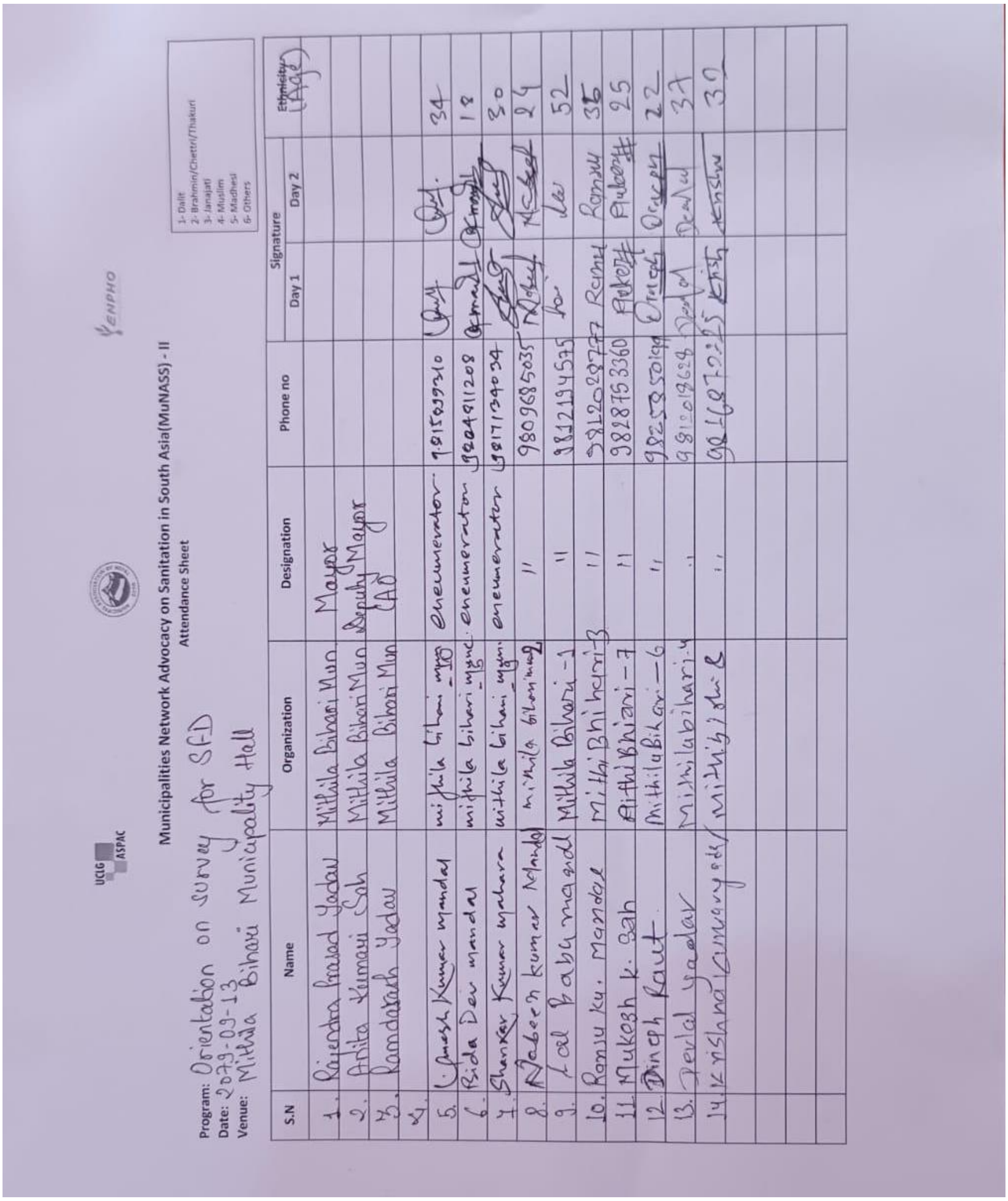
7. Appendix

7.1 Appendix 1: List of participants on orientation on survey for SFD



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

Program: Orientation on survey for SFD
Date: 2079-09-13
Venue: Mithila Bihari Municipality Hall

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

S.N	Name	Organization	Designation	Phone no	Signature Day 1	Signature Day 2	Ethnicity (Age)
1.	Rajendra Prasad Yadav	Mithila Bihari Mun.	Mayor				
2.	Anita Kumari Sah	Mithila Bihari Mun	Deputy Mayor				
3.	Ramdarash Yadav	Mithila Bihari Mun	CAO				
4.							
5.	Umesh Kumar mandal	mithila bihari mun -10	enumerator	9815099310	[signature]	[signature]	34
6.	Rida Dev mandal	mithila bihari mun -15	enumerator	9804911208	[signature]	[signature]	18
7.	Shanker Kumar mahara	mithila bihari mun -9	enumerator	9817134034	[signature]	[signature]	30
8.	Nabeen kumar Mandal	mithila bihari mun -2	"	9809685035	[signature]	[signature]	24
9.	Lal Babu mandal	Mithila Bihari -1	"	9812194575	[signature]	[signature]	52
10.	Ramju ku. Mandal	Mithila Bihari -3	"	9812028777	[signature]	[signature]	35
11.	Mukesh k. Sah	Mithila Bihari -7	"	9828753360	[signature]	[signature]	25
12.	Dinesh Raut	Mithila Bihari -6	"	9825850199	[signature]	[signature]	22
13.	Devlal yadav	Mithila bihari -4	"	9810019624	[signature]	[signature]	37
14.	Krishna Kumar yadav	mithila bihari -8	"	98168702?5	[signature]	[signature]	30

7.2 Appendix 2: Attendance sheet of sharing and validation workshop

आज मिति २०७९/११/१४ गतेका दिन नेपाल नगरपालिका संघको आयोजनामा वातावरण र जनस्वास्थ्य संस्था (एन्फो) को प्राविधिक सहयोग तथा The United Cities and Local Goverment Asia Pasific (UCLG-ASPAC) को सहकार्यमा Municipalities Network Advocacy on Sanitation in South Asia (MuNASS-II) कार्यक्रम अन्तर्गत मिथिला बिहारी नगरपालिकामा संचालन गरिएको Shit Flow Diagram (SFD) सम्बन्धि अन्तरक्रिया र प्रमाणीकरण गोष्ठीमा निम्न अनुसार मुख्य सरोकारवालाहरुको सहभागिता रहयो।

उपस्थिति

क्र.स	नाम	पद	फोन नं:	हस्ताक्षर
१	राजेन्द्र प्रसाद यादव	प्रमुख	९८४४०२३४८६	[signature]
२	शोभा देवी साह	उप-प्रमुख	९८२६८६६४२४	[signature]
३	रामदरश यादव	प्रमुख प्रशासकीय अधिकृत	९८४४०२६८६६	[signature]
४	श्रीरामशोभित ठाकुर	वडाध्यक्ष - १	९८०४८२१९२८	[signature]
५	श्री सुरेश कुमार मण्डल	वडाध्यक्ष - २	9851111640	[signature]
६	श्री कृष्ण कुमार बसन्त	" -३	९८०९६६२२०५	[signature]
७	श्री प्रदिप कुमार यादव	" -४	९८१२१४९८०६	[signature]
८	श्री सुरेन्द्र कुमार मण्डल	" -५	९८१३०५५६७९	[signature]
९	श्री विमलेश कुमार यादव	" -६		
१०	श्री संजय कुमार शर्मा	" -७	9804825260	[signature]
११	श्री जीवछ यादव	" -८		
१२	श्री विन्देश्वर यादव	" -९		
१३	श्री ललित ना० झा	" -१०	9804814673	[signature]
१४	श्री नन्दन कुमार झा	सोभाग अधिकृत (कृषि/वन)	९८६०-४८४९६६	[signature]
१५	श्री उपेन्द्र यादव	फोटो/शाखा	९८०४८४५०३२	[signature]
१६	श्री जीवछ यादव	योजना शाखा	९८२८३९९३९३	[signature]
१७	श्रीराजेशकुमार यादव	पोषणशाखा	९८१२१२२६२३	[signature]
१८	[illegible]	[illegible]	९८०४८९५२९०	[signature]

क्र.सं	नाम	पद	फोन नं.	हस्ताक्षर
१९.	सुनिता यादव	[illegible]	[illegible]	[illegible]
२०.	सीमा कुमारी झा	अधिकृत [illegible]	[illegible]	[illegible]
२१.	[illegible]	[illegible]	[illegible]	[illegible]
२२	[illegible] यादव	[illegible]	9841903242	[illegible]
२३.	चन्द्र देवी यादव	सहायक		[illegible]
२४.				[illegible]
२५	खुशबु खातुन	सहायक		[illegible]
२६.	अनिता देवी यादव	सहायक		[illegible]
२७.	[illegible] दास	सामाजिक विकास [illegible]	9804886590	[illegible]
२८.	[illegible] झा	[illegible]	[illegible]	उर्मिला
२९.	उर्मिला पण्डीत			[illegible]
३०	मुकेश कुमार महतो	प्रशासन	[illegible]	[illegible]
३१.	लक्ष्मी नि. यादव	[illegible]	[illegible]	[illegible]
३२	सुशील कुमार यादव		[illegible]	उर्मिला
३३	उर्मिला			अमिता
३४	अमिता देवी	यादव		[illegible]
३५	चन्द्र देवी यादव			[illegible]
३५	[illegible] साहा		[illegible]	[illegible]
३६	चन्द्र देवी	[illegible]		चन्द्र देवी
३७	इन्दु देवी	"		इन्दु देवी
३८	[illegible] कुमार थापा		[illegible]	[illegible]
३९	गोविन्द कु. यादव	[illegible]	9801637263	[illegible]
४०	[illegible]	[illegible]	[illegible]	[illegible]
४१	दीपक श्रेष्ठ	"	9849463840	[illegible]

7.3 Appendix 3: SFD orientation to enumerators and field visits

SFD Orientation to Enumerators.

Opening by Mr. Imtiyaj Alama, Deputy Mayor.

Wastewater Treatment Plant located in Birgunj.

Public Toilet Survey.

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SFD Promotion Initiative

SFD Birgunj Metropolitan City, Nepal, 2023

Produced by:

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