SFD Report

Mangalsen Municipality
Nepal

Final Report

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

Date of production: 15/12/2022

Last update: 26/01/2023

SFD Report Mangalsen Municipality, Nepal, 2022

Produced by:

Shreeya Khanal, ENPHO

Buddha Bajracharya, ENPHO

Jagam Shrestha, ENPHO

Sabuna Gamal, ENPHO

Rupak Shrestha, ENPHO

Anita Bhuju, ENPHO

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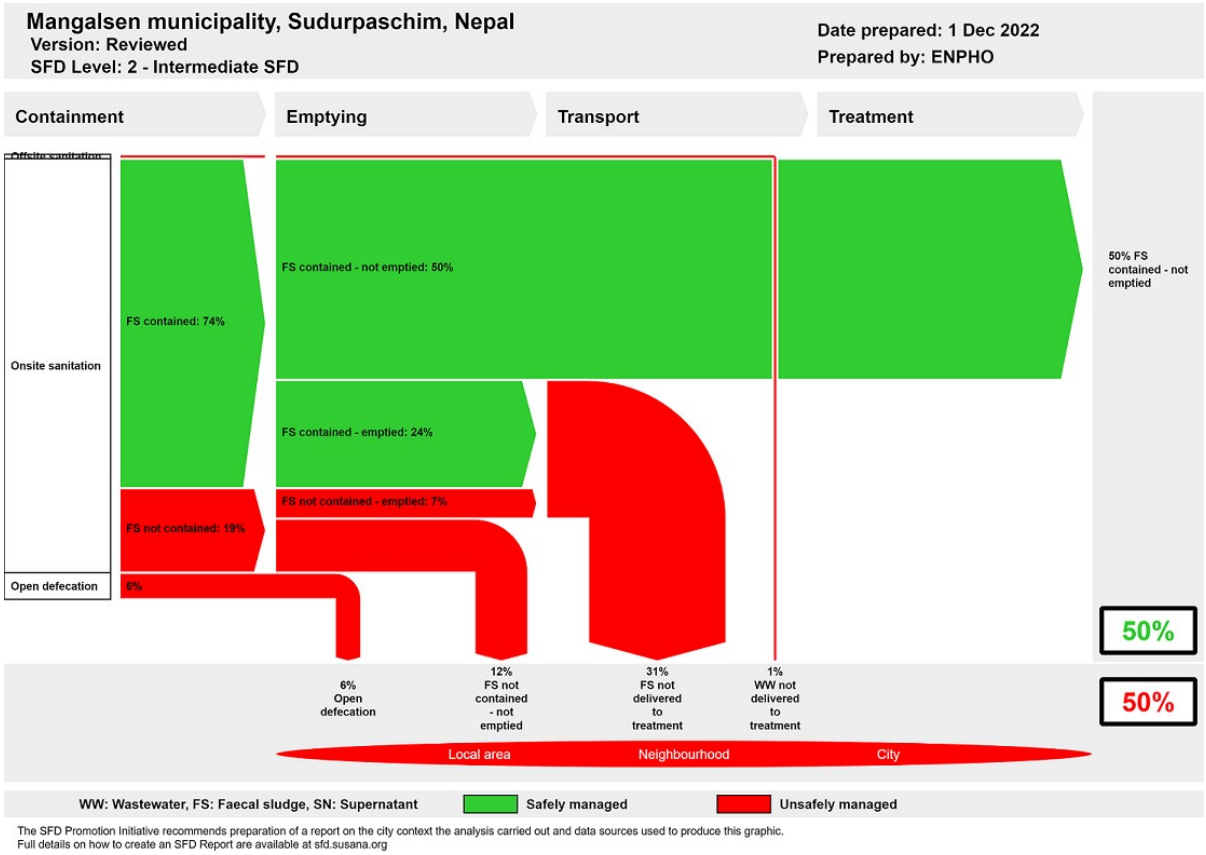
1. The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at sfd.susana.org

2. Diagram information

SFD Level:

This SFD is a level 2 - Intermediate report.

Produced by:

Environment and Public Health Organization (ENPHO).

Collaborating partners:

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

Status:

Final SFD report.

Date of production: 15/12/2022

3. General city information

Mangalsen municipality is the capital of Achham District in Far-western Province of Nepal. It was established on 18 May 2014 by merger of the former Village development committees of Janalibandali, Kuntibandali, Oligaun, Jupu, Kalagaun into its current form. There are 14 wards in Mangalsen municipality, and the municipality covers 220 square kilometres of geographical area. The municipality is 308 km from Dhangadhi, the provincial capital of Sudurpaschim Province, and 942 km from the federal capital Kathmandu (Mangalsen Municipality, 2018).

The total population of the municipality is 31,871 and the family size of the municipality is 5.3 (MoFAGA, 2017).

The average temperature of the municipality is 22.6°C. June has the highest average temperature and January has the lowest average temperature of the year. Average annual rainfall in this region is 125 mm (Mangalsen Municipality, 2018) . The climate is mild, and generally warm and temperate (Data, 2022).

4. Service outcomes

The overview of different sanitation technologies across the sanitation value chain in the municipality is briefly explained in this section. In Mangalsen municipality, people residing in 95% of households have access to toilets. The municipality achieved Open Defecation Free (ODF) status in 2018. Despite being declared as ODF municipality, people residing in 5.9% of households in wards number 3, 4, 5, 7, 8, 12, 13 and 14 do not have access to basic sanitation facilities and defecate openly.

There are no sewerage networks and Wastewater Treatment Plants (WWTPs) in Mangalsen municipality. Nevertheless, a small percentage (0.6%) of the population having toilets in their households have connected their toilet to open drains which are conveyed to open ground and water bodies.

3.8% of households (HHs) have a toilet connected to a lined tank with impermeable walls and open bottom whereas 1.3% have constructed a toilet connected to a fully lined tank. 93% have constructed unlined pits and 2% have constructed single pits.

There are altogether three public toilets installed to serve the floating population inside the municipality. These toilets are located near public tap, highway road and *tudikhel* (open ground space).

Regular emptying prevents overflow of the sludge and blockages (Linda Strande, 2014). 41.2% of containments have been emptied at least once since the installation. Instead of practising emptying of containment regularly, most of the households cover or seal the pit after it is filled and leave Faecal Sludge (FS) to decompose. Further, they dig another pit and connect the outlet of the toilet to that pit. This type of practice is mostly seen in the rural areas of the municipality where there is land availability as compared to congested urban areas.

Lack of availability of mechanical FS emptying and desludging facilities in the municipality has led to a greate number of households to use manual method of emptying containment after it is filled. Among the households that have emptied the containment at least once after its construction, the majority practice self-manual emptying.

Mangalsen municipality does not have any form of the treatment plant for faecal sludge. Majority of FS emptied is applied in farmlands and a few percentages of the emptied is dumped into forest areas and nearby water bodies. Application on farm is the most easy and convenient way for disposal of FS as it can be used as a soil improver for agricultural purposes since there is no treatment plant. However, this practise is considered as an unsafely way to manage FS since the FS is spread over the farmlands without any treatment.

Fewer households in the city have illegal connection of their toilet to an open drainage.

The SFD graphic shows that 50% of the excreta generated are safely managed while 50% of the excreta generated are unsafely managed. The safely managed percentage of FS generated by 50% 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, 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, 2017).

Several policies have been in place to accomplish the sanitation need 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 into sanitation campaign. The document adopted sanitation facilities as improved, basic, and limited in line with WHO/UNICEF guideline. The sanitation campaign throughout the country focused to achieve 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 Mangalsen municipality 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.

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	Mangalsen Municipality.
Non-governmental Organizations	Environment and Public Health Organization (ENPHO).
Private Sector	Public toilet operators, Water Supply Providers
Development Partners, Donors	MuAN, BMGF, UCLG ASPAC.

7. Credibility of data

Primary data were collected from random household sampling. Altogether, 362 households and 110 institutions were surveyed from 14 wards of the municipality. Primary data on emptying, transportation and current sanitation practices in the municipality were validated from Key Informant Interviews (KIIs) with public toilet management, sanitation, and environmental section. The overall data and findings were shared with the stakeholders of the municipality and validated through sharing program.

8. Process of SFD development

Data on sanitation situation were collected through household and institutional surveys. Enumerators from the municipality were mobilized after providing orientation on sanitation technologies, objectives of the survey and proper use of mobile application, KOBOCOLLECT for collection of data for 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 in 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:

- MoWS. (2017). Nepal Water Supply, Sanitation and Hygiene Sector Development Plan (2016-2030). Ministry of Water Supply.
- NPC. (2020). National Review of Sustainable Development Goal. Kathmandu Nepal: National Planning Commission.
- Mangalsen Municipality, M. (2018). Mangalsen Municipality Profile. Mangalsen: Mangalsen Municipality.
- Data, C. (May de 2022). Climate Data. Obtenido de Climate-Data.org: https://en.climate-data.org/asia/nepal/far-western-development-region/dipayal-silgadhi-1025266/
- MOFAGA. (2017). Mofald. Obtenido de sthaniya.gov.np/gis/website/: https://sthaniya.gov.np/gis/

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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	Kilometre
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
POU	Point of Unit
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 and Local Governments Asia Pacific
UNICEF	United Nations Children's Education Fund
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

Mangalsen municipality is the capital of Achham District in Far-western Province of Nepal. It was established on 18 May 2014 by merger of the former Village development committees of Janalibandali, Kuntibandali, Oligaun, Jupu, Kalagaun into its current form. There are 14 wards in Mangalsen municipality, and the municipality covers 220 square kilometres of geographical area. Mangalsen Municipality is 308 km from Kailali, the provincial capital of Sudurpaschim Province, Dhangadhi, and 942 km from the federal capital Kathmandu (Mangalsen Municipality, 2018).

Figure 1 shows the ward boundary map of Mangalsen municipality.

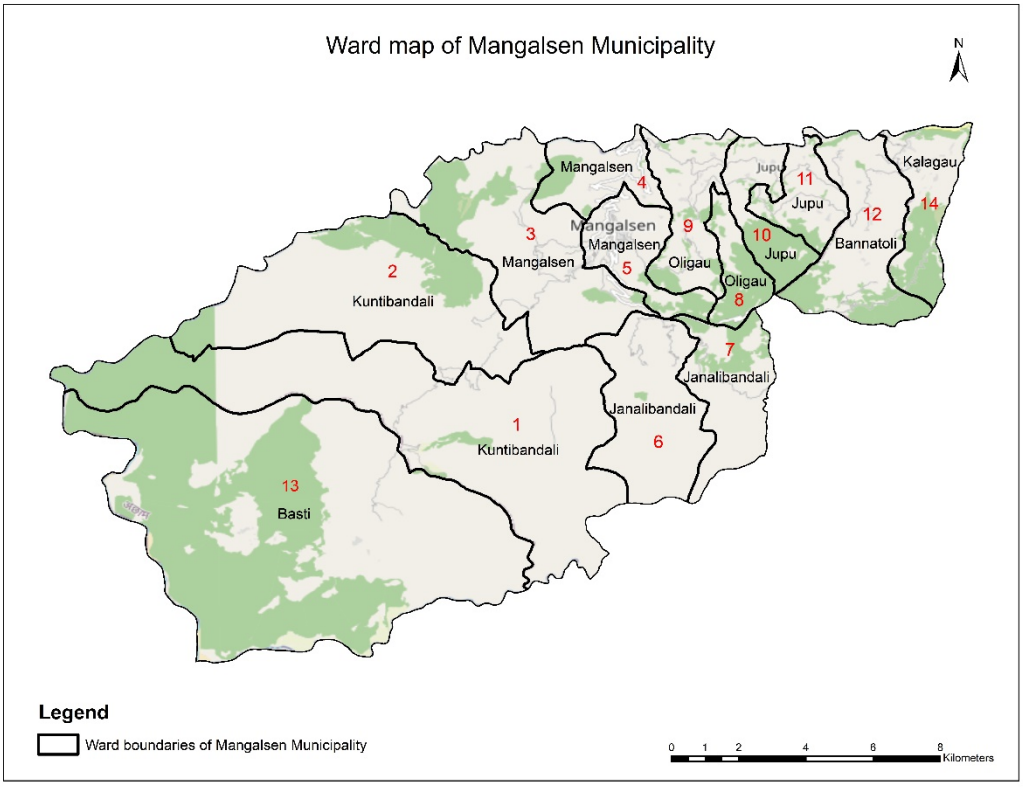

Figure 1: Map of Mangalsen Municipality with ward boundaries.

1.1 Population

The total population of the municipality is 31,871 and the family size of the municipality is 5.3 (MOFAGA, 2017). Ward-wise population distribution in the municipality is shown in Table 1.

Table 1: Ward wise population of Mangalsen Municipality (MoFAGA, 2017).

Ward	Population	Households
1	2,532	478
2	637	120
3	3,305	624
4	2,553	482
5	4,600	868
6	1,437	271
7	1,437	271
8	1,528	288
9	1,800	340
10	1,537	290
11	1,324	250
12	2,933	553
13	3,716	701
14	2,532	478
	31,871	**6,013**

Figure 2 shows the population density in different wards of Mangalsen municipality where it can be observed that ward number 4, 5, 8 and 14 have high population density and ward number 1, 2 and 13 have very low population density.

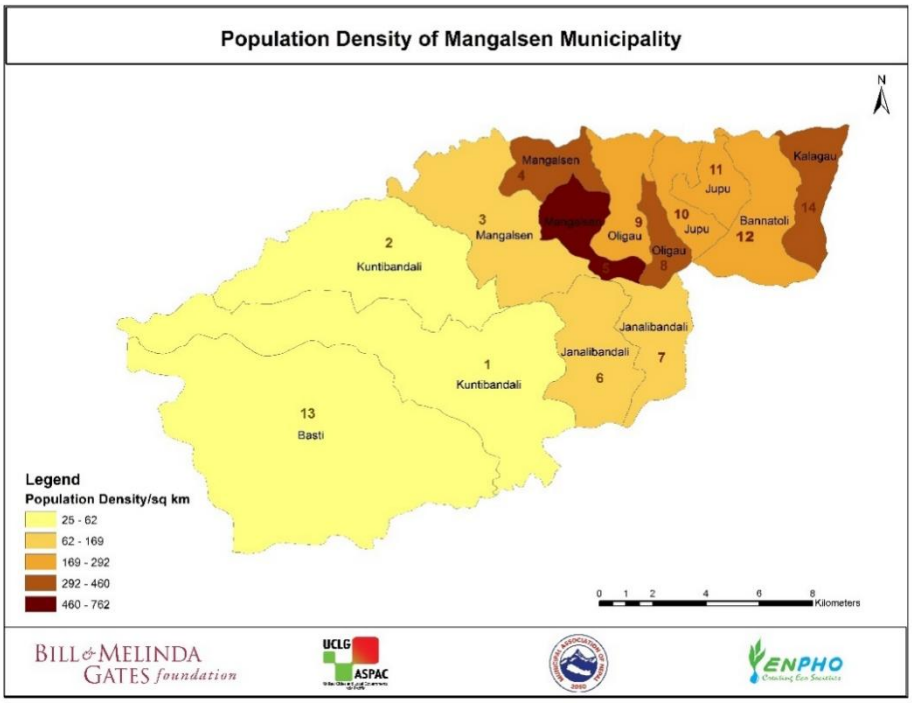

Figure 2: Population Density Map of Mangalsen Municipality.

1.2 Climate

The average temperature of the municipality is 22.6 °C. June has the highest average temperature and January has the lowest average temperature of the year. Average annual rainfall in this region is 125 mm (Municipality, 2079). With an average of 509 mm, the most precipitation falls in July and with an average of 14 mm, the lowest precipitation falls in November. The month with the highest and lowest number of rainy days are July (28.47 days) and December (3.23 days), respectively. The month with the lowest relative humidity is April (44.42 %) and with the highest relative humidity is July (86.70 %) (Data, 2022).

The average temperature of this area is between 24°C and 32°C in summer. The climate here is mild, and generally warm and temperate. In winter, there is much less rainfall in Mangalsen than in summer. The Köppen-Geiger climate classification is C. The temperature here averages 17.0°C (Data, 2022).

1.3 Topography

Mangalsen municipality lies at 29°7'48'' N and 81°12'36'' S. While the lowest and highest elevation of the municipality are 540 metres and 3,300 metres, respectively, the municipality office lies at 1,362 meters from the sea level. At east side of the municipal boundary lies Ramaroshan rural municipality and Kamalbazar municipality, at the west side lies Bogatan municipality of Doti district, at the north side lies Sanfebagar municipality, Bannigadi Jayagad rural municipality and Chaurpaati rural municipality and at the south side lies Kamalbazar municipality and Dakari rural municipality (Mangalsen Municipality, 2018).

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, 2019). In Mangalsen municipality, people residing in 95% of households have access to toilets. 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 in the municipality. The municipality achieved Open Defecation Free (ODF) status in 2018. Despite being declared as ODF municipality, people residing in 5.9% of households in wards number 3, 4, 5, 7, 8, 12, 13 and 14 do not have access to basic sanitation facilities and defecates openly.

2.1.1 Household Level Sanitation System

A sanitation system in which excreta and wastewater are collected and stored or treated on the plot where they are generated is an onsite sanitation system whereas a sanitation system in which excreta and wastewater are collected and conveyed away from the plot where they are generated is an offsite sanitation system. An offsite sanitation system relies on sewer technology for conveyance (Elizabeth Tilley, no year). Among the households having toilets, the percentage of households with connection of toilet to onsite and offsite sanitation is shown in Figure 3.

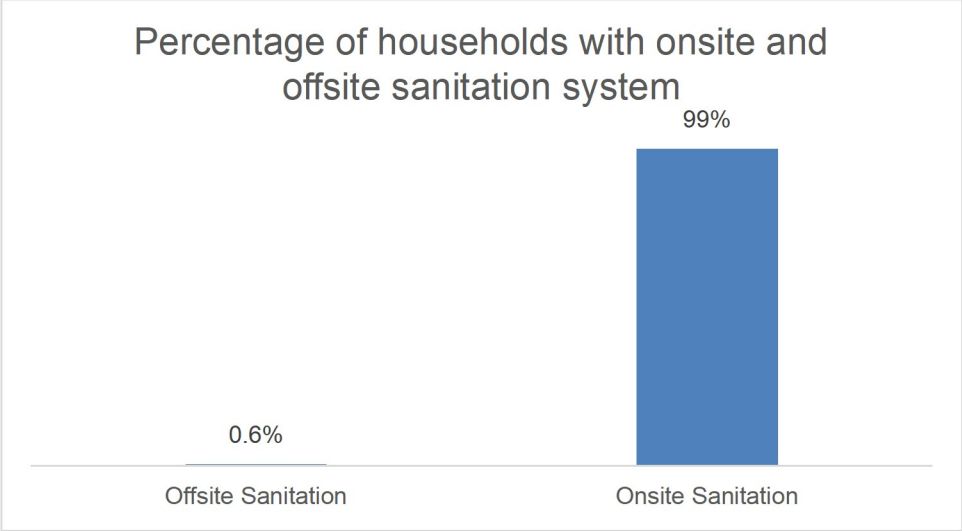

Figure 3: Percentage of households with onsite and offsite sanitation system in Mangalsen Municipality.

Types of Offsite Sanitation System

Although there are obvious advantages of sewerage networks, also known as offsite sanitation systems, in high density urban areas, the capital cost of developing sewerage network capable of connecting all households in municipalities such as Mangalsen municipality where the population is largely scattered can be prohibitive. Thus, there are no sewerage networks and Wastewater Treatment Plants (WWTP) in Mangalsen Municipality.

Nevertheless, a small percentage (0.6%) of the population having toilets in their households have connected their toilet to open drains which are conveyed to open ground and water bodies. Such unsafe practice of wastewater disposal contributes to rise of water borne diseases such as Diarrhoea and Typhoid. Diarrhoea is one of the leading causes of death among children under five worldwide (Central Bureau of Statistics (CBS), 2020) Thus, to prevent the spread of such diseases, illegal discharge of toilet waste into water bodies and open ground should be discouraged. Figure 4 shows a user interface connected directly to a water body and to open ground.

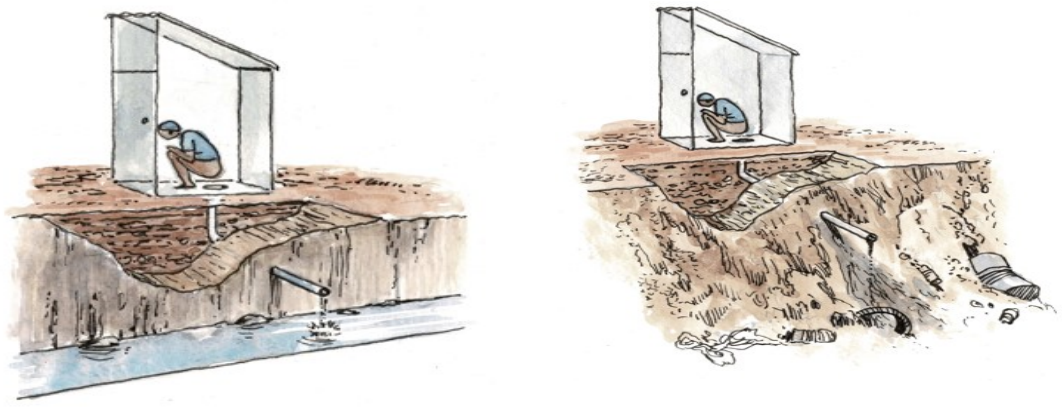

Figure 4: Toilet discharging directly to a water body (left) and to open ground (right).

Types of Onsite Sanitation Systems

Figure 5 shows that only 1.3% of households use fully lined tanks for storage of FS which is a safe onsite sanitation system whereas all other households have onsite FS storage systems that are not sealed and can contribute to groundwater and soil contamination.

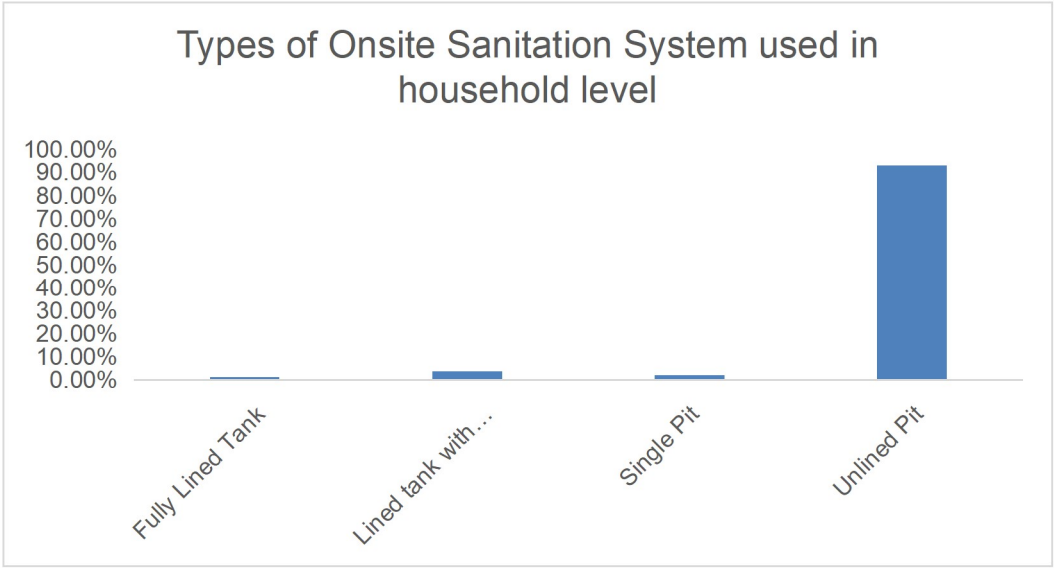

Figure 5: Types of onsite sanitation system used in household level in Mangalsen Municipality.

Different types of onsite sanitation systems used in households of Mangalsen municipality are described below:

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 are totally lined and sealed (Linda Strande, 2014). People residing in 1.3% of households with access to toilet in their houses in the municipality having onsite sanitation technology use a fully lined tank. Among them, 25% and 75% of households have outlet from fully lined tank connected to open ground and have no outlet or overflow connection, respectively.

Lined tank with impermeable walls and open bottom: Population residing in 3.8% of households with a toilet in their houses in the municipality have built a lined tank with impermeable walls and open bottom, which are rectangular onsite technologies 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.

Single Pit: Single pits are properly constructed and well-maintained pits with semipermeable, honeycombed lined walls and an open, permeable base, through which infiltration can occur (Susana, 2018). The population residing in 2.0% of households having access to basic sanitation in the municipality use a single pit as onsite sanitation technology. Such type of pits are considered as lined pits with semi-permeable walls and open bottom in the SFD graphic.

Unlined Pit: An onsite sanitation technology which is a pit dug into the ground where the walls and bottom of the tank are not sealed are unlined pits. The population residing in 93% 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 6 shows the top view of single pit and unlined pit observed in the household survey in the municipality.

Figure 6: Top view of single pit (left) and unlined pit with an exhaust pipe (right).

Figure 7 shows the distribution of various types of sanitation technologies in different wards of Mangalsen municipality. As seen in the figure, unlined pits are used in majority of the households.

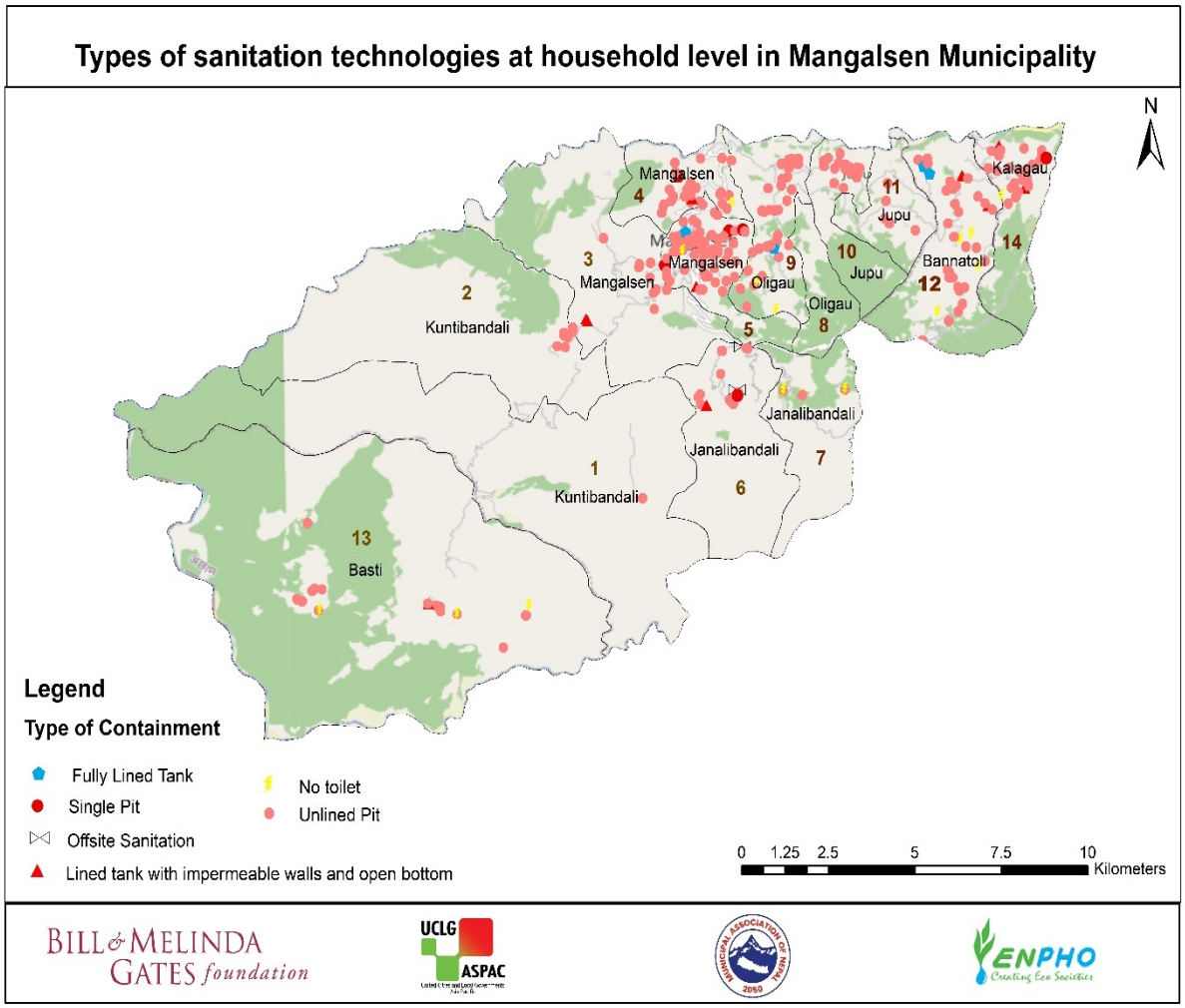

Figure 7: Sanitation technologies installed in household levels.

2.1.2. Percentage of FS emptied from onsite sanitation technologies

Emptying is one of the major components of the sanitation value chain. Regular emptying prevents overflow of the sludge and blockages (Linda Strande, 2014). 41.2% of containments have been emptied at least once since the installation. Instead of practising emptying of containment regularly, most of the households cover or seal the pit after it is filled and leave FS to decompose. Further, they dig another pit and connect the outlet of the toilet to that pit. This type of practice is mostly seen in the rural areas of the municipality where there is land availability as compared to congested urban areas. Onsite sanitation technologies that have and have not been emptied in different wards of the municipality are shown in Figure 8. Blue circle in Figure 8 represents the containments that have not been emptied and the red circle represents containments that have been emptied at least once after construction.

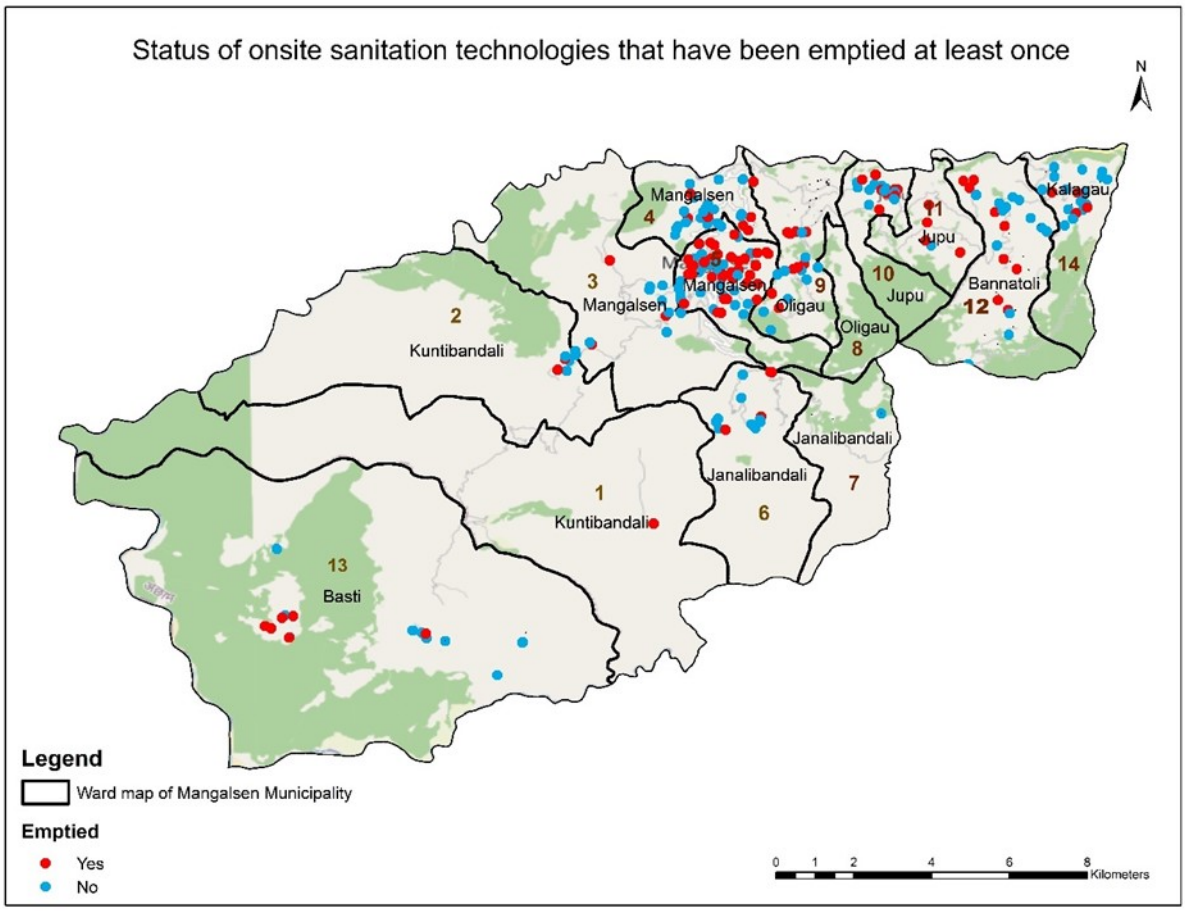

Figure 8: Onsite sanitation technologies that have and have not been emptied in different wards of the municipality.

Lack of availability of mechanical FS emptying and desludging facilities in the municipality has led to a great number of households to use manual method of emptying containment after it is filled. Among the households that have emptied the containment at least once after its construction, the majority practice self-manual emptying. This is because the trend of containment emptying by traditional labours have seemingly decreased in the last decade due to social unacceptance as suggested by KII 1. The cost of manually emptying containment differs from NRS 2,500 to 4,500 (US$ 19 to 35) depending on the size of containment.

Table 2 shows the average emptying frequency of onsite sanitation technologies in the municipality. Frequency of emptying of sealed containments is higher than pits, which can be justified by the volume of onsite containments, which shows the size of sealed containments to be greater than the size of pits.

Table 2: Average emptying frequency of different types of onsite sanitation technologies in Mangalsen Municipality.

Onsite sanitation systems	Average Emptying Frequency
Fully lined tank	Once a year
Lined tank with impermeable walls and open bottom	Twice a year
Lined pit with semi-permeable walls and open bottom	Once in every seven months

2.1.3. Treatment and Disposal/Reuse

Mangalsen municipality does not have any form of treatment plant for faecal sludge. The majority of FS emptied is applied in farmlands and a few percentages of the emptied FS is dumped into forest areas and nearby water bodies. Application on farm is the most easy and convenient way for disposal of FS as it can be used as a soil improver for agricultural purposes since there is no treatment plant. Fewer households in the city have illegal connection of their toilet to an open drainage.

2.1.4. Institutional Level Sanitation System

98% of the surveyed institutions have an onsite sanitation system in the municipality. Institutions buildings such as community schools, health post, government buildings and commercial buildings were surveyed. The percentage of types of sanitation technologies in these buildings are shown in Figure 9.

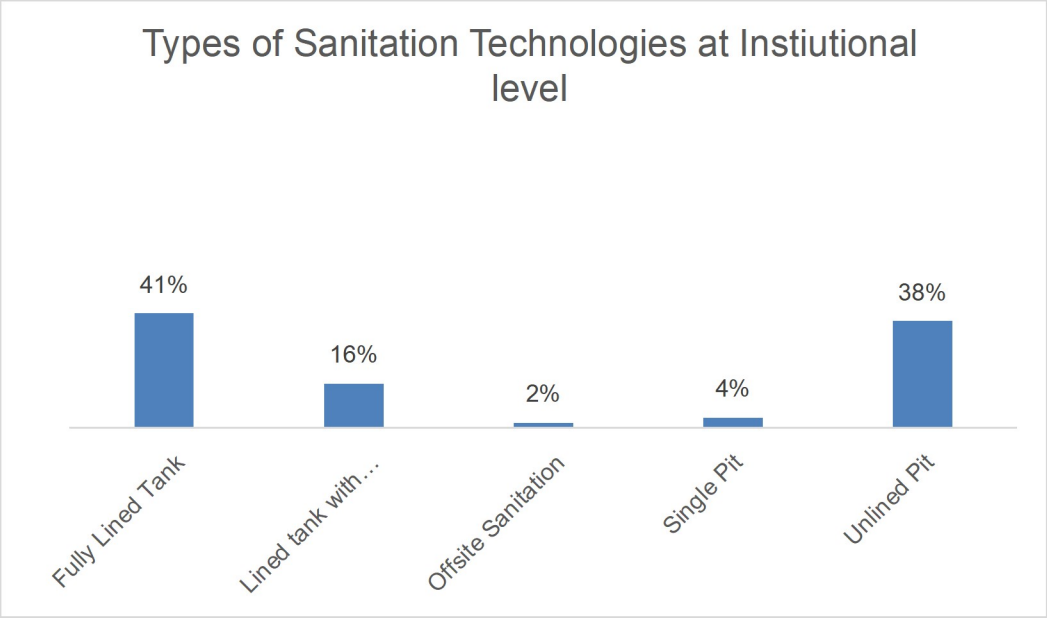

Figure 9: Types of sanitation technologies in institutions of Mangalsen municipality.

Only 7% of the institutions having an onsite sanitation system have emptied their containment at least once after construction. 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 Mangalsen municipality city is shown in Figure 10.

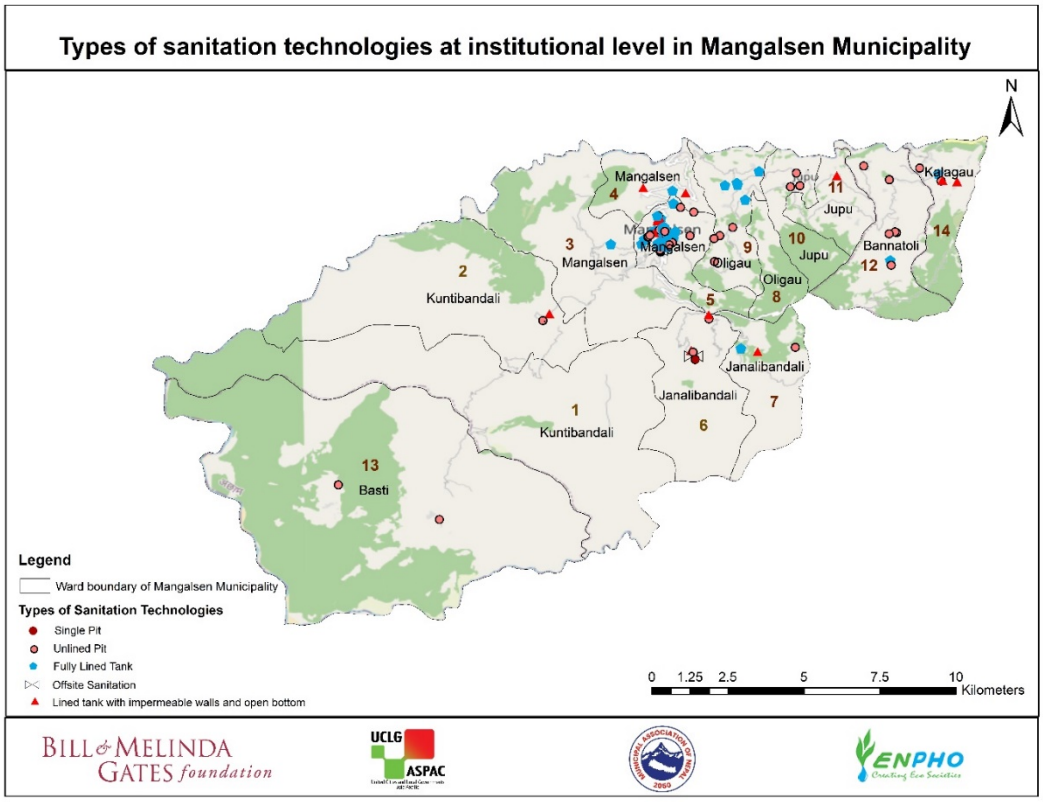

Figure 10: Types of onsite sanitation systems in institutions of Mangalsen municipality.

2.1.5. Public Toilets

Public Toilets (PT) are installed for commuters to achieve and sustain open defecation free status in the municipality. Altogether, three public toilets are installed to serve the floating population inside the municipality. These toilets are located near public tap, highway road and *tudikhel* (open ground space). The toilet located near public tap has a considerate number of users per day and the other two toilets have a few to no users as suggested by KII-4. List of pictures of public toilet located near public tap, *Bairagi Dhara* (PT: A) is shown in Figure 11.

		
Public toilet structure (PT: A)	Squatting Pan (PT: A)	Urinal (PT: A)

Figure 11: Pictures of public toilet in Mangalsen municipality.

The public toilet near public tap, *Bairagi Dhara,* has a capacity of six users; five can use urinal and one can use toilet with squatting pan at the same time. The urinal section is for male and the toilet with squatting pan is common for all genders and both toilets have pour flushing systems. The toilet was built in 2017 by the municipality.

At present, overall operation and maintenance of the public toilet is carried out by the shopkeeper near the toilet. Use of the public toilet is free of cost. A bucket of 20 litres capacity is kept near the toilet as there are no sink basins or connection of private water supply near toilet. The shopkeeper near public toilet fetches water from a public tap nearby for the convenience of the users. Since there is no line for electricity and water holding tanks, only the cost of toilet cleansing materials needs to be managed for the operation of toilet which is personally borne by the shopkeeper to minimize the foul smell coming from the toilet. The toilet has an outlet connected to a sealed rectangular containment with a manhole at top for access to empty the containment after it is filled.

2.2. SFD Matrix

2.2.1. SFD Selection Grid

Sanitation technologies selected in the SFD grid in Mangalsen municipality are shown in Figure 12. 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. 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 Mangalsen 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.

<table>
<tr><th rowspan="2">List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)</th><th colspan="10">List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)</th></tr>
<tr><th>to centralised combined sewer</th><th>to centralised foul/separate sewer</th><th>to decentralised combined sewer</th><th>to decentralised foul/separate sewer</th><th>to soakpit</th><th>to open drain or storm sewer</th><th>to water body</th><th>to open ground</th><th>to 'don't know where'</th><th>no outlet or overflow</th></tr>
<tr><td>No onsite container. Toilet discharges directly to destination given in List B</td><td></td><td></td><td></td><td></td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td>T1A1C6</td><td>T1A1C7</td><td></td><td></td><td rowspan="2">Not Applicable</td></tr>
<tr><td>Septic tank</td><td></td><td></td><td></td><td></td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fully lined tank (sealed)</td><td></td><td></td><td></td><td></td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td></td><td></td><td>T1A3C8</td><td></td><td>T1A3C10</td></tr>
<tr><td>Lined tank with impermeable walls and open bottom</td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td>Significant risk of GW pollution
Low risk of GW pollution</td><td></td><td></td><td>T1A4C8</td><td></td><td>T2A4C10
T1A4C10</td></tr>
<tr><td>Lined pit with semi-permeable walls and open bottom</td><td colspan="9" rowspan="4">Not Applicable</td><td>Significant risk of GW pollution
T1A5C10</td></tr>
<tr><td>Unlined pit</td><td>T2A6C10
T1A6C10</td></tr>
<tr><td>Pit (all types), never emptied but abandoned when full and covered with soil</td><td>Significant risk of GW pollution
Low risk of GW pollution</td></tr>
<tr><td>Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil</td><td></td></tr>
<tr><td>Toilet failed, damaged, collapsed or flooded</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>No toilet. Open defecation</td><td colspan="6">Not Applicable</td><td></td><td>T1B11 C7 TO C9</td><td></td><td>Not Applicable</td></tr>
</table>

Figure 12: SFD selection grid for Mangalsen municipality.

Here, 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 12 is explained in Table 3.

Table 3: Explanation of terms used to indicate different frame selected in the SFD selection grid in Figure 12.

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.
T1A1C7	A fully functioning toilet discharging directly to a water body. 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 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. It includes poorly designed and/or constructed and/or maintained septic tanks that, because of these faults or deficiencies, are not performing as septic tanks, instead they are acting as sealed vaults (consequently the excreta is potentially more toxic than the excreta in a septic tank). However, since the tank is not fitted with a supernatant/effluent overflow this system is considered contained.
T1A4C8	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur. Since the tank is fitted with a supernatant/effluent overflow connected to open ground, the excreta in this system is considered not contained.
T2A4C10 (High Risk)	A correctly designed, properly constructed and well-maintained lined tank with sealed, impermeable walls and an open, permeable base, through which infiltration can occur - the excreta is therefore likely to be partially treated. The tank is NOT fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained.
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.
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.
T2A6C10 (High Risk)	A correctly designed, properly constructed and well-maintained unlined pit with permeable walls and base, through which infiltration can occur. The tank is not fitted with a supernatant/effluent overflow but since there is a 'significant risk' of groundwater pollution this system is considered not contained.
T1A6C10	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.

2.2.2. Proportion of the contents of each type of onsite container which is faecal sludge

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:

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

Here, data for each selected sanitation system on the SFD Matrix is entered. Figure 13 shows the SFD matrix of Mangalsen municipality. The proportion of the contents of each type of onsite container (either fully lined tanks (sealed) or lined tanks with impermeable walls and open bottom and all types of pits), is shown in column Population (Pop) of Figure 13. F3 is the proportion of the contents of each type of onsite container which is emptied at least once after its construction. 80% of the proportion of FS in the containment is emptied as observed from the household survey.

Variable F4 accounts for FS emptied that is delivered to treatment plant. KII and household survey suggested that none of the households use FS generated in the municipality in a safe way (for example by further treating to form a safe compost). Thus, there are no values for variable F4 accounting for FS delivered to treatment plant and F5 accounting for FS delivered to treatment plant that is treated.

For systems where there is groundwater pollution risk such as lined pits and lined tanks, values for variables F3 differ despite being the same system. The population using such systems are scattered in different wards of the municipality where some households have access to road networks and mechanical FS emptying facilities whereas many other households do not have that option. Similarly, land availability plays a vital role in the management of FS generated at the household level. Population residing in households in rural areas of the municipality have farmland and open spaces providing them with an option to dig and dump the FS generated whereas population living in city areas of the municipality cannot afford to use expensive commercial lands for FS disposal contributing to unsafe FS disposal in nearby river and open ground. Thus, the varying percentage of FS emptied and managed can be observed in the SFD matrix in similar containment systems.

Mangalsen municipality, Sudurpaschim, Nepal, 1 Dec 2022. SFD Level: 2 - Intermediate SFD
Population: 31871
Proportion of tanks: septic tanks: 0%, fully lined tanks: 100%, lined, open bottom tanks: 100%

Containment						
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment
	Pop	W4c	W5c	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	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
T1A1C6 Toilet discharges directly to open drain or storm sewer	0.3	0.0	0.0			
T1A1C7 Toilet discharges directly to water body	0.3					
T1A3C10 Fully lined tank (sealed), no outlet or overflow	0.9			26.7	0.0	0.0
T1A3C8 Fully lined tank (sealed) connected to open ground	0.3			0.0	0.0	0.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	2.1			11.4	0.0	0.0
T1A4C8 Lined tank with impermeable walls and open bottom, connected to open ground	0.9			26.4	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	1.8			13.3	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	69.6			34.1	0.0	0.0
T1B11 C7 TO C9 Open defecation	6.0					
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	0.6			40.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	17.3			37.0	0.0	0.0

Figure 13: SFD Matrix of Mangalsen municipality.

2.2.3. Risk of Groundwater Pollution

From the Household (HH) survey of Mangalsen Municipality, 72% of the households have access to piped drinking water supply service through either a private tap or public taps operated by the water users committee while remaining households rely on spring source. Groundwater vulnerability is specific to containment type and pollution scenarios (Andreo, 2013). Thus, a higher percentage of HHs using piped network water indicates that the probability of groundwater pollution at household level is very low to none. As per the water quality data report of Achham District published by (Suaahara, 2018) , among the systems including reservoir, source, private taps, water for drinking and handwashing purposes 81.3% had presence of *E-coli* (bacteria found in faecal sludge). This indicates that the majority of the municipality's drinking water sources are contaminated, necessitating the use of any Point of Unit (POU) method, such as filtration, chlorination, sun disinfection, or boiling water. The household using any of these POU options before drinking in the municipality is shown in Table 4.

Table 4: Percentage of Households using POU options.

Source	Do you use POU option for treatment	
	No	Yes
Private Tap	17.9%	0.3%
Public Tap	50.9%	2.7%
Spring Source	22.9%	3.9%
Groundwater sources	1.2%	0.3%
Total	**92.8%**	**7.2%**

92.8% of the households in the municipality do not use any kind of POU options of treatment before drinking whereas remaining households use POU option of treatment before drinking.

Although many households have a connection to private Water Service Providers (WSPs), most service providers do not measure the quality of water, do not pay attention to source conservation, maintenance and cleanliness of structures. Due to this, the number of households with access to quality water is low (UNICEF, 2020).

The report published by Suaahara in 2018 showed 52 out of 64 samples were found presence of *E. coli*. But, there has not been detail study if the presence of *E.Coli* is due the use of sanitation systems such as lined tanks with open bottom and pits which are located in places where there is a high risk of groundwater pollution.

However, the risk analysis in the SFD matrix shows a lower number of systems located in high risk areas. This is because the data from the household survey using POU such as boiling and filtration options has been considered as low risk. In addition, the distance from the containment to the source of water has also been taken into consideration while determining the risk and that is shown in the final percentages assigned to the sanitation systems where this risk can occur (systems T1A4C10/T2A4C10 and T1A6C10/T2A6C10).

2.2. Summary of Assumptions

Offsite sanitation systems:

- ✓ 0.3% of the toilets discharge directly to an open drain (T1A1C6) and 0.3% discharge to a water body (T1A1C7). Since there is no treatment plant, all wastewater is disposed of untreated into the environment.

Onsite sanitation systems:

- ✓ The proportion of FS in septic tanks was set to 0% (no septic tanks were found in the municipality), the proportion of FS in fully lined tanks was set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and all types of pits was set to 100% according to the relative proportions of the systems in the municipality, as per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website.
- ✓ Variables F3, F4 and F5 for all onsite sanitation systems were derived from the HH survey and cross-checked with the KIIs conducted.
- ✓ The traditional practice of emptying and dumping the FS on agricultural land is not considered to be a safe practice for managing emptied faecal sludge. Moreover, the municipality does not have any designated faecal sludge treatment plant. Therefore, variables F4 and F5 are both set to 0% for all sanitation systems.

2.3. SFD Graphic

Figure 14 shows the SFD graphic for Mangalsen municipality. The percentage of FS and wastewater (WW) in the graphic that is coloured green indicates that they are being handled or stored safely, while the percentage that is coloured red indicates that they are being managed or stored in an unsafe manner. It also represents the sanitation value chain going from left to right.

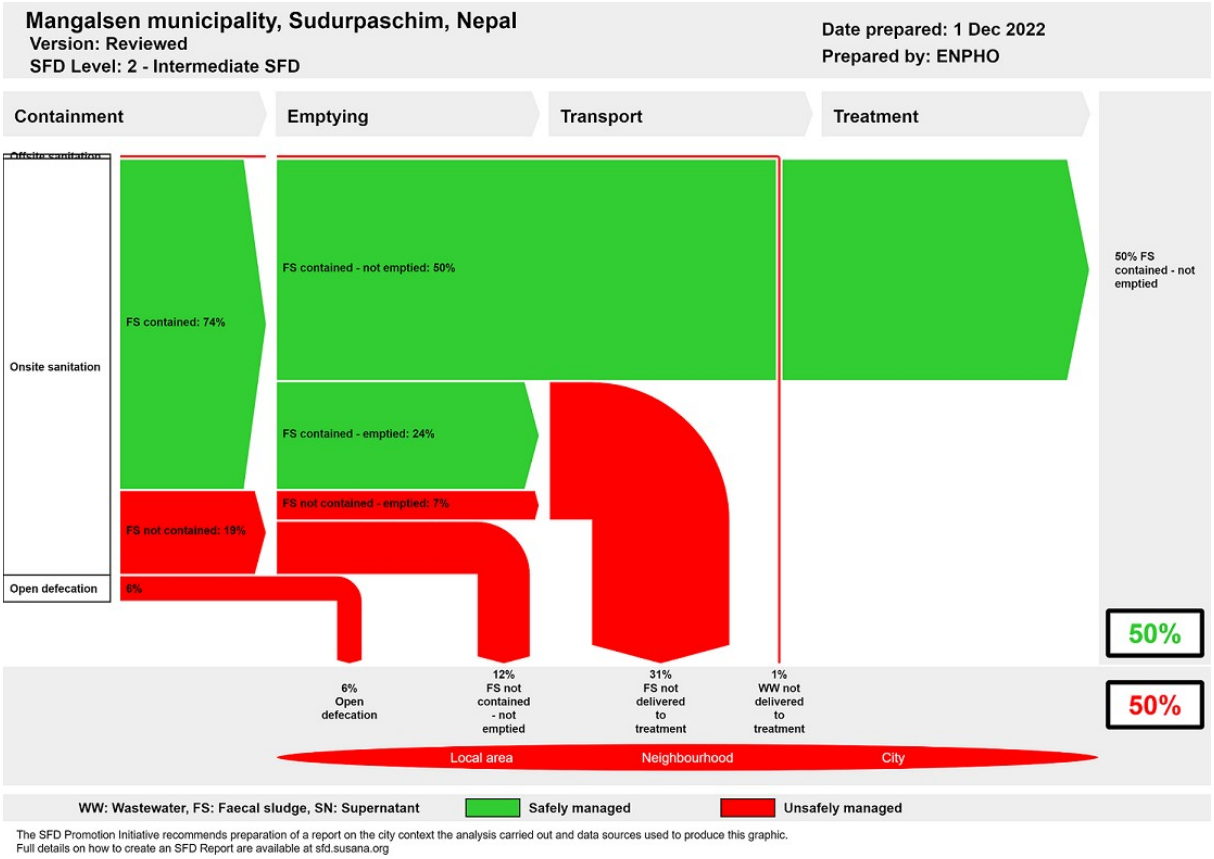

Figure 14: SFD graphic of Mangalsen Municipality.

Here, 1% of the toilets are directly connected to open drain or to a water body. They are transported at a certain distance from the household and disposed of in an unsafe environment, either directly in river, riverside or open spaces without treatment (WW not delivered to treatment, 1%).

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).

In the SFD graphic, 50% is FS contained - not emptied which is stored in fully lined tanks, lined tanks and pits which are in safe distance from sources of drinking water. However, these systems will require emptying services in the short and medium term as they fill up.

All 24% of FS contained - emptied is represented as safely managed until it is emptied as it is stored safely which eventually is considered unsafe after it is emptied and dumped without any form of treatment.

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).

In the SFD graphic, 19% is FS not contained, where 7% of this FS not contained is emptied but not disposed safely. Lack of a treatment facility in the municipality leads to disposal of FS in farmland and water bodies.

Despite ODF status, people residing in 6% of households still go for open defecation. This percentage of population going for open defecation are people from low-income families who are not financially sound enough to build toilets and containment.

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 fulfill the provisions related to right on water and sanitation, Government of Nepal (GON) 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, 2017) . 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 Mangalsen municipality 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 (NPC) 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 (MoWS) is the lead ministry responsible for planning, implementation, regulation, and monitoring and evaluation of sanitation programs in the country (GoN, 2015) . Under the MoWS, Department of Water Supply and Sewerage Management (DWSSM) plan and implement water and sanitation projects funded by foreign donors or inter provincial projects or serves at least 15,000, 5,000 and 1,000 people in terai, hilly and mountain region respectively (GoN, 2015) . The organizational structure of DWSSM is shown in Figure 15.

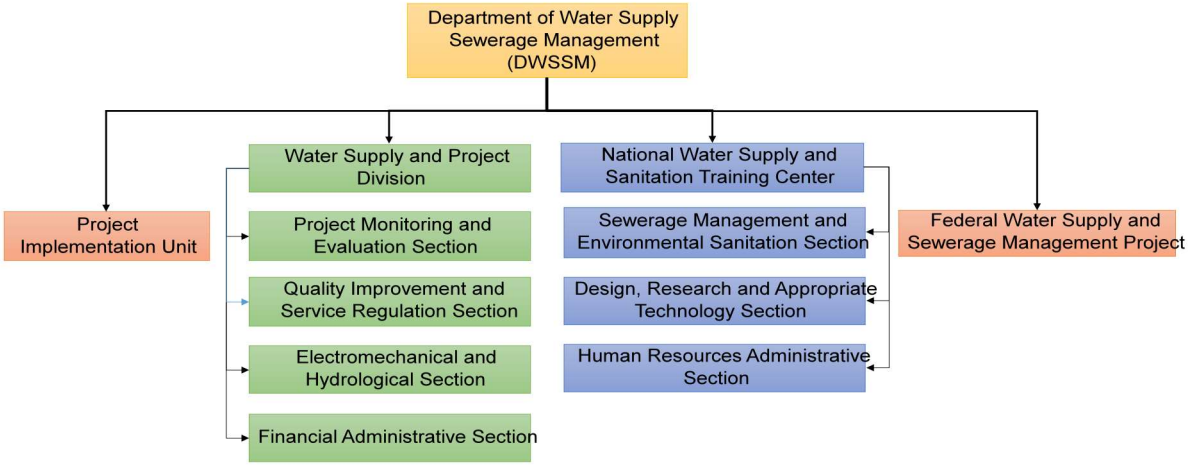

Figure 15: Organizational Structure Department of Water Supply and Sewerage Management (DWSSM).

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 also 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 5,00 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 5. However, FSM specific standards have yet to be developed and implemented.

Table 5: 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	✓	✓	✓

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 6.

Table 6: 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 16. This scale of investment needs a full mobilization of all national and international sources including both public and private sector (MoWS, 2017).

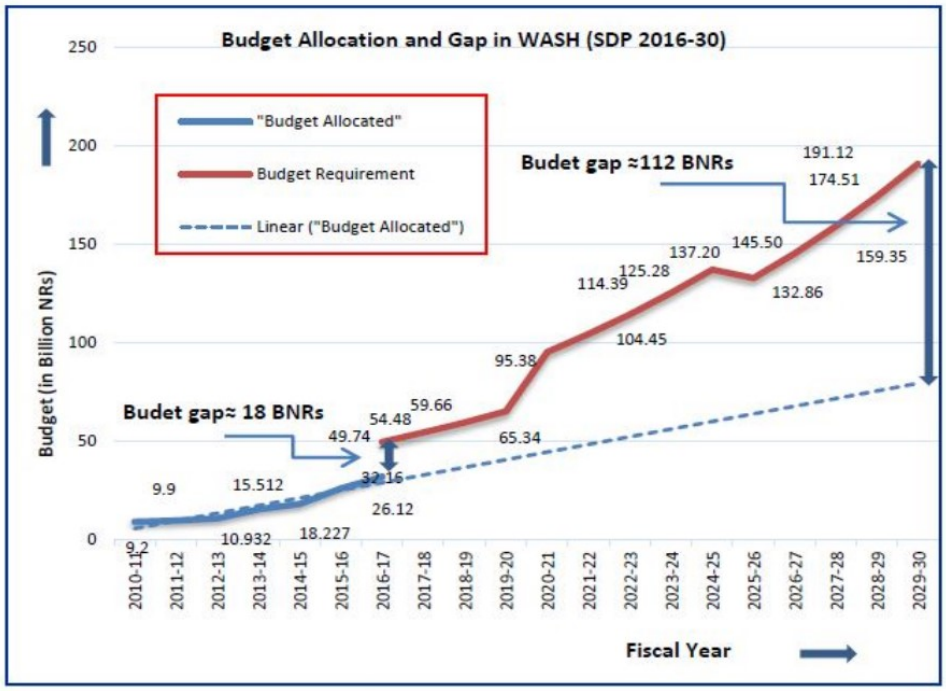

Figure 16: Budget allocation and GAP in WASH SDP 20016-2030. Source: (MoWS, 2017).

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 programs (MoWS, 2017).

4 Stakeholder Engagement

4.1 Key Informant Interviews

Key Informant Interviews (KIIs) and objective sharing of the study were conducted with the major stakeholders of sanitation sector of the municipality (Figure 17). Interviews were performed with the Mayor, Mr. Padam Bahadur Bohara and section head of Environment and Disaster Management section, Ms. Samjhana Puri along with ward chairpersons of Mangalsen municipality on current sanitation services practices with respect to technical, institutional and financial aspects of the municipality.

Figure 17: Field observation and KII at ward 4 of Mangalsen municipality.

KIIs were performed in context of public toilets with operators of the toilets. During the field visit and observation, local residents of the municipality were also asked about status of toilets and containments, sources of drinking water, use of POU options for drinking water as shown in Figure 17. Table 7 shows a list, designation and organization of KIIs performed in the municipality.

Table 7: List of Key Informant Interviews.

S.N.	Name	Designation	Organization	Purpose of KII
1.	Padam Bahadur Bohara (KII-1)	Mayor	Mangalsen municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development
2.	Samjhana Puri (KII-2)	Section Head (Environment and Disaster Management section)	Mangalsen municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development
3.	Ward Representatives (KII-3)	Ward Chairperson	Mangalsen municipality	Sanitation status, Ongoing projects on Sanitation, Policies and plan for Sanitation development
4.	Public toilet operator (KII-4)	Public Toilet Operator	Mangalsen municipality	Quantitative and management data on public toilet and public toilet operation
5.	Local Residents of ward 4 (KII-5)	Municipal Residents	Mangalsen municipality	Status of toilets and containments, sources of drinking water, use of POU options for drinking water

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 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 362 households were sampled from 6,013 households distributed in 14 wards with proportionate stratification random sampling which is shown in Figure 18.

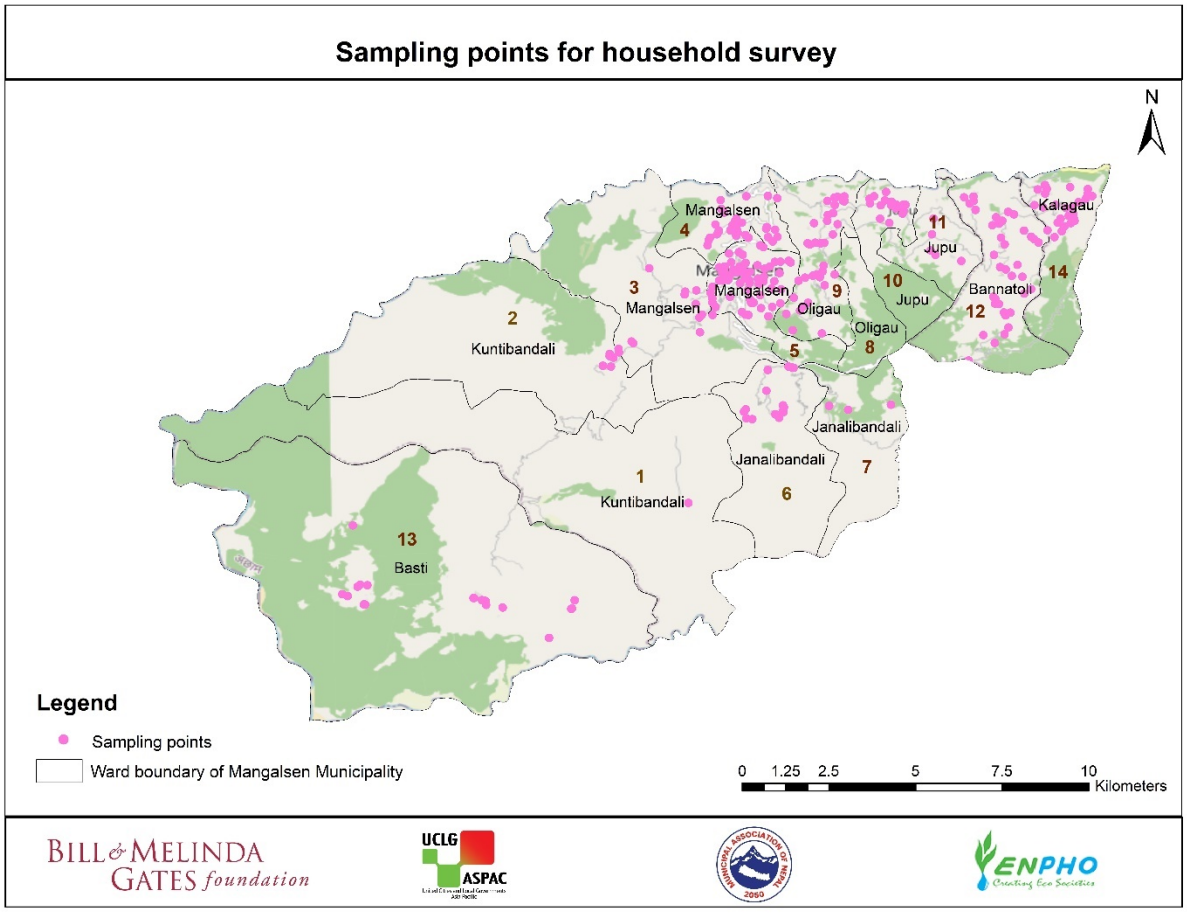

Figure 18: Distribution of sampling points in different wards of Mangalsen municipality.

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 municipality to share the findings of the sanitation situation survey and receive the suggestion from municipal stakeholders. Altogether, 38 participants including the mayor, deputy mayor, ward chairpersons, other members from municipal executive council and sectoral staff actively participated on the workshop and provided the valuable suggestions. Padam Bahadur Bohara, mayor of the municipality, said that they have faced environmental problems such as spring water sources pollution caused by the leakage from containment in core area of the municipality. He suggested that the municipality would make plans and policies to minimize

such hazards. He emphasized the requirement of technical support to prepare detailed project reports for the implementation of future projects.

Ms. Sangita Kumari Rawal, Deputy Mayor, also realizes the need for a treatment plant and proper management of FS from production, containment, emptying and safe disposal. She said that management of the faecal sludge has been key challenges especially in the densely populated area. A list of participants with their designation is attached in Appendix 2. Figure 19 shows participants in sharing and validation workshop in Mangalsen municipality.

Figure 19: Distribution of sampling points in different wards of Mangalsen municipality.

5 Acknowledgements

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

We offer our sincere gratitude to Mr. Padam Bahadur Bohara, Mayor, Ms. Sangita Kumari Rawal, Deputy Mayor and Mr. Khakendra Bahadur Sodari, Chief Administrative Officer of Mangalsen Municipality for their valuable support during the study. We are grateful towards Ms. Samjhana Puri, section head of the Environment and Disaster Management Section for her tremendous support throughout the study. We would also like to thank ward chairpersons and entire staff of municipality for their remarkable support during the study.

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

We are very much 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 entire team of ENPHO for their gracious support and MuNASS-II team without whom the study would not have been possible. Chakra Bahadur Jaigadi

We are grateful towards the enumerators, Ms. Durga Bogati, Mr. Bhojendra Bogati, Mr. Gopal Bahadur Bhul, Mr. Yakendra Bhat, Mr. Bala Ram Bhandari, Ms. Sabitra Jaishi, Mr. Pashupati Pariyar, Mr. Mohan Bahadur Rawal, Ms. Janaki Rawal, Mr. Tark Bahadur Bhandari, Ms. Ramita Dhami and Ms. Maisara Rawal for their support during the survey.

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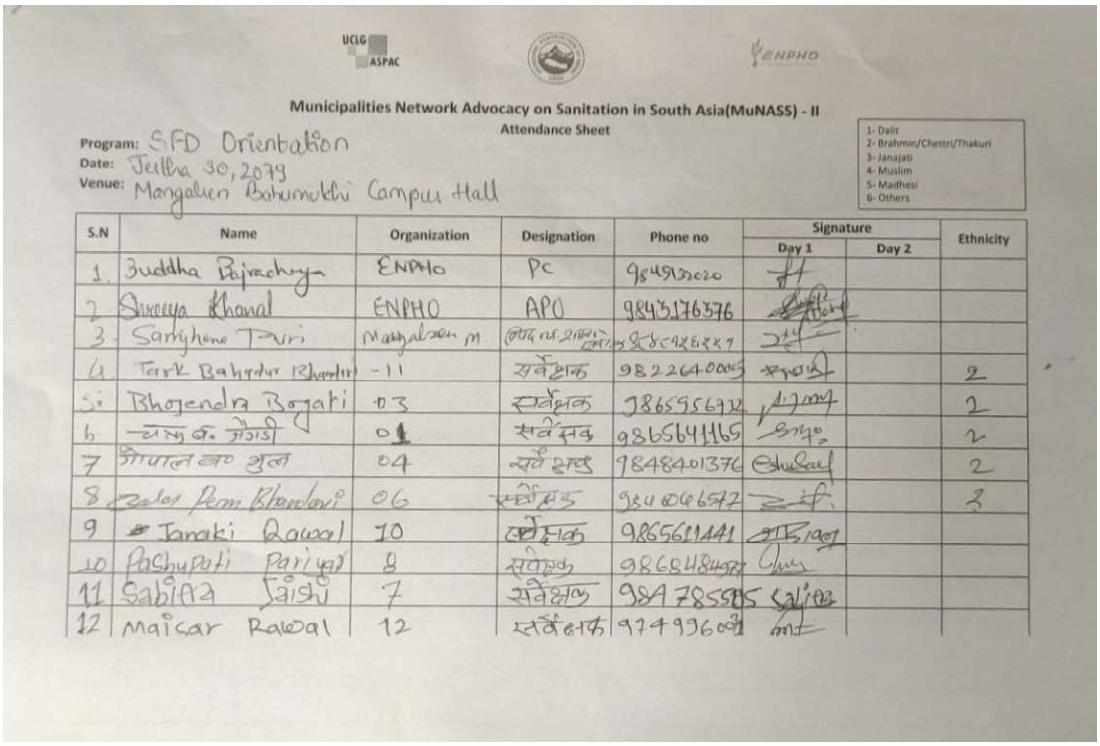
7 Appendix

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: SFD Orientation
Date: Jestha 30, 2079
Venue: Mangalsen Bahumukhi Campus Hall

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

S.N	Name	Organization	Designation	Phone no	Signature		Ethnicity
					Day 1	Day 2	
1	Buddha Bijaychya	ENPHO	PC	9849320220			
2	Shreeya Khanal	ENPHO	APO	9843176376			
3	Sanjhona Tari	Mangalsen M					
4	Tark Bahadur Khanal	-11	सर्वेक्षक	9822640005			2
5	Bhojendra Bogati	03	सर्वेक्षक	9865956922			2
6	[illegible]	01	सर्वेक्षक	9865641165			2
7	[illegible]	04	सर्वेक्षक	9848401376			2
8	[illegible]	06	सर्वेक्षक	9840646572			2
9	Janaki Rawal	10	सर्वेक्षक	9865611441			
10	Pashupati Pariyar	9	सर्वेक्षक	9868484827			
11	Sabitra Jaishi	7	सर्वेक्षक	9847855855			
12	Maicar Rawal	12	सर्वेक्षक	9749960[illegible]			

7.2 Appendix 2: Attendance sheet of sharing and validation workshop

आज मिति २०७९ भाद्र १६ गते मंगलसेन नगरपालिका अध्यक्षमा मानव मलमुत्र प्रवाह चित्र (Shit Flow Diagram) बारे छलफल र प्रमाणीकरण कार्यशाला गोष्ठी कार्यक्रम संचालन गरियो। नेपाल नगरपालिका संघ (MuAN) र वातावरण र जनस्वास्थ्य संस्था (ENPHO) को सहकार्यमा आयोजना गरेको कार्यक्रममा निम्नअनुसार सरोकारवालाहरू सहभागीता रह्यो।

क्र.स.	नाम	पद	फोन नं.	हस्ताक्षर
१	पदम बहादुर बोहरा	न. प्रमुख (मेयर)	९८६८५२२०४३	[signature]
2	संगीता रावल (सोडारी)	न. उप प्रमुख	9868545907	[signature]
3.	चक्र बहादुर खाउद	कि.दी. अध्यक्ष	9848645834	[signature]
(४)	पदम बहादुर बोहरा	वडा अध्यक्ष	9848447377	[signature]
(५)	हिक्मत बा. बोगटी	" "	9843035648	[signature]
६.	देवेन्द्र क. बोगटी	वडा अध्यक्ष	९८६५४३२५५८६	[signature]
७.	नाम सिंह धामी	वडा अध्यक्ष	९८४८६१२३८२	[signature]
८.	राज बहादुर शाही	१ वडा अध्यक्ष	९८६८४८४१८६	[signature]
९)	शंकर प्रसाद भाट	वडा अध्यक्ष	9868495624	[signature]
१०)	ज्ञानेन्द्र बोहरा	" "	९८६१२३३१८६	[signature]
११)	चन्द्र प्र. ढुंगाना	स्वास्थ्य शाखा	९८७८५०५६४०	[signature]
१२)	मनसर व्याहंत	का. ध पा.स.	9746532852	[signature]
१३)	कौशिला कडुल्ला	कार्यपालिका सदस्य	9848083569	[signature]
१४)	भाना विष्ट	कार्यपालिका सदस्य	9846695705	[signature] भाना

क्र.स	नाम	पद	फोन नं.	हस्ताक्षर
१५)	प्रेम जोशी	कार्यपालिका सदस्य	98487550045	[signature]
१६)	रेखा कुमारी खड्का	कार्यपालीका सदस्य	9864316564	[signature]
१७)	सुष्मा ढुंगाना	कृषि अधिकृत	9864833140	[signature]
१८	जगतबहादुर रावल	शिक्षा अधिकृत	९८६५६४१६३६	[signature]
१९	विष्णु प्रसाद जैसी	सूचना अधिकारी	९८५८४८५८४८	[signature]
२०	नरेश बहादुर कठायत	स्टोर शाखा	९८४८२२२०३३	[signature]
२१ -	दिपक खड्का	राजश्व शाखा	९८४८६१२६२१	[signature]
[illegible]	कृष्ण ब. लोहार	रोजगार शाखा	९८४८२००२३०	[signature]
२३	एकेन्द्र ब. बोगटी	सामाजिक सुरक्षा शाखा (MIS op)	९८४१६८०२२	[signature]
२४	होम ब. साउद	MIS op.	९८४८२२२०३०	[signature]
२५	सञ्जना पुरी	विपद तथा वातावरण शाखा प्र.	९८४८१५६६२१	[signature]
२६	मञ्जु महत	अधिकृत छैटौं	९८६८८६५७०६	[signature]
२७	देवेन्द्र प्रे. भण्डारी	अध्यक्ष मेन पा ६	९८४८५२६६२२	[signature]
२८	हर्क तिरुवा	का.वा. अध्यक्ष १४	९८६८४८३१६२	[signature]
२९	पौरख कुमार बोगटी	सू.प्र. अधिकृत	९८३३०३३०२३	[signature]
३०	राम बहादुर खत्री	का. स.	९८४८४९३३३६	[signature]
३१	गोविन्द वि.क.	का.पा.स.	९८६८२३६८८०२	[signature]
३२	खड्केन्द्र ब. सोडारी	प्र. प्रशासकीय अधिकृत	९८६८८२३९९९	[signature]
३३)	हँस कु थापा (राना)	कार्यपालीका सदस्य	9844166215	[signature]
३४)	लोक राज नाथ	वार्ड अध्यक्ष	9869158329	[signature]
३५	नरध्वज भाट	सवारी चालक का.मं.	9848617251	[signature]
३६	कुन्ती साउद	का.स. न.पा. पा.	9868559523	[signature]
३७	जंग बहादुर शाहि	कार्यालय सहयोगी		
३८)	भरत बोहरा	पूर्वाधार शाखा	9742389503	[signature]

7.3 Appendix 3: SFD orientation to enumerators for household and institutional survey

SFD Mangalsen Municipality, Nepal, 2022

Produced by:

Shreeya Khanal, ENPHO
Buddha Bajracharya, ENPHO
Jagam Shrestha, ENPHO
Sabuna Gamal, ENPHO
Rupak Shrestha, ENPHO
Anita Bhuju, ENPHO

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